

COMMENTS ON "ACCOUNTING FOR DEPLETION OF NATURAL ASSETS IN THE 1993 SNA"¹ (OECD paper STD/NA/RD (97) 7 April 1997)

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June-july, 1997

INSEE, N° 234/AV

Written by Peter Hill and Anne Harrison, the OECD paper has been presented at the OECD - UNECE - EUROSTAT Meeting of National Accounts experts (3-6 June 1997). A preliminary version had been prepared for the first "London Group" meeting on environment accounting (London, 16-13 March 1994), and a complementary note presented at the second meeting of this group (Washington, 15-17 March 1995).

Although the paper is a very interesting one, nicely elaborated, I disagree with some of its important conclusions. As a consequence I find it necessary to present some comments and my own views in this respect. These views have been quickly laid out in the Review of Income and Wealth June 1995 : Reflections on Environmental Accounting Issues, without a complete elaboration. However, taking into account various aspects of the ongoing discussion, I adjusted my proposals and completed them.

It should be stressed at the beginning that, like Anne and Peter's paper, I discuss the issue of the depletion of natural assets in the context of the general conceptual framework of the 1993 SNA. The purpose is to see, in this context, what treatment of the extraction or harvest of natural assets differing in some respects from the one actually included in the 1993 SNA would be preferable.

Non-renewable assets

Subsoil assets

I start with what is perhaps the most far reaching proposal in the paper. It concerns the accounts of the owner of the subsoil resource (in the paper accounts are first shown separately for the owner and the extractor, which allows for a clearer analysis). It is proposed to prepare a production account for the owner, called depletion account in order to differentiate it from the production account of the extractor. However it is a production account (see table 1 p. 10)). This account records, as resources, the amount of the receipts from sales (sales of the resource in the ground of course), 150 in the numerical example shown in the table. For sake of simplicity, the owner is supposed to incur no costs. Thus its gross value added is equal to its sales, that is 150. Depletion is calculated (100) and recorded in parallel with consumption of fixed capital. Thus net value added is equal to 50.

Sale of non-produced assets by the owner

Such a proposal is highly questionable. The sale of a subsoil resource is obviously the sale of an asset (a pre-existing asset). This point is stressed by the authors (see p. 7 and 23). The sale of an

¹ I benefited from comments by Pierre Muller and Marie-Helene Blonde.

asset is not recorded by national accounts as a production. It is not an output. The sale of an asset is recorded in the capital or the financial account. As far as the production account is concerned, the conceptual issue must not be confused of course with the practical way of calculating the value of output. When, as it is generally the case for goods, output is measured in practice as sales plus changes in inventories (I simplify the presentation), sales, in the absence of a newly created product, are balanced by a negative change in inventories.

In the case under review, the resource in the ground is not the result of a process of production (it is a gift of nature). The quantities that are sold (to the extractor) are withdrawn from the stocks of raw materials in the ground (they are closer to inventories in my view).

Thus, if one takes the risk of trying to elaborate a production account for the owner, one would calculate possible output as sales minus withdrawals from stocks, that is, $+ 150 - 150$. Unsurprisingly, the "output" is zero, that is, there is no output at all, as could have been expected.

As a consequence, there is neither gross nor net value added for the owner, which is normal because the owner is not engaged in a production process. (I comment later on the artificial and wrong parallel with operating leasing which is followed in the paper). In fact, selling assets is part of the owner's wealth management.

Depletion as a composite notion and recording it under two flows

What other way of building accounts for the owner can be proposed, with due respect of course to both national accounts principles and economic theory requirements? As table 1 p. 10 uses the same illustrative data for period 1 from annex table 2, I follow the same example. Readers of my comments should have in mind this annex table 2. The extraction process takes 5 periods to complete. The discount rate is 10%. Prices are constant. The situation studied is constant depletion each year. Anyway the discussion is valid in all three cases. For period 1, in annex table 2, the receipts from sale of subsoil asset are 150, the present value of remaining future receipts at the start of the period is 500, the value of depletion is 100, and the difference between receipts and depletion is 50. It is the latter amount that is shown as net value added in table 1. Depletion is defined (p. 3), according to economic theory, as "the decline during the accounting period in the present value of the subsoil asset to the owner purely as a result of the extraction [sale actually in annex tables] of the asset". Depletion is measured in terms of the decline in the present value of the future receipts, apart from any holding gains or losses. It is the generally accepted measure of the depreciation of an asset in economics (p. 20). Thus in annex table 2, the value of depletion in period 1 is the difference between the values of the asset at the start of period 1 (500) and 2 (400), that is, 100.

I question at this stage neither the definition nor the measurement of depletion in the paper. As a consequence, in the absence of any holding gains/losses as supposed in the paper, the total difference between the opening and closing balance sheets of the owner must be equal to depletion. The changes in balance sheet, recorded in the accumulation accounts, must be equal to depletion. How to reflect this in the entries of the accumulation accounts is the crucial issue. Before addressing it directly, it is worth investigating where the 50 shown in the table as receipts minus depletion come from. Or, put differently, they can also be measured in a different way. It is useful to look at the detailed calculation of the present value of remaining future receipts at the

start of period 1. With a 10% discount rate, the series of receipts from sale of subsoil asset 150, 140, 130, 120, 110 is converted into present values as 136.4, 115.7, 97.7, 81.9 and 68.3, which gives 500 in total. At the end of period 1, the first portion has been sold for 150 (+ 13.6 as compared to its balance sheet value at the beginning of the period). The remaining fourth portions are valued 127.3, 107.5, 90.1 and 73.1, that is 400 in total (+ 36.4 as compared to their balance sheet values at the beginning of the period). It is easy noticing that the difference between the initial value of the assets and their sale value during the period, when disposed of, or their value in stocks at the end of the period is also 50 (13.6 + 36.4). Actually, as stressed in the paper, 50 yields a 10 per cent return on the owner's capital which is 500 at the start of period 1. All these results are not surprising. The two estimates of present value at one year interval - including the quantities that are disposed of in period 1- show a difference equal to 10 per cent (the discount rate) of the initial estimate.

If one follows the view taken above that the owner of the deposit is not engaged in a production process but is selling his own assets, the amount of 50 must be recorded in the accumulation accounts, in one of the other changes in assets account, either other changes in volume of asset account or the revaluation account, I leave the option open for the time being. It can be interpreted as a capital gain resulting from the reduction of one period in the discounting procedure, time passing, the timing of the selling process being given.

Note that such a recording does not contradict the results that the paper derives from the economic theory. The return to the owner's capital is 50. It is recorded in the other changes in assets accounts. One must have in mind that in the 93 SNA the return to capital can be recorded as primary incomes, or other change in volume or holding gains/losses, or a combination of them. For instance the return to capital invested in gold held as a valuable consists in real holding gains, if any.

Depletion (100) as defined in the paper is recorded by me under two flows : withdrawals from stocks of natural assets in the capital account (-150) and one of the other changes in assets accounts (+ 50). The first flow is an actual transaction (as the owner and the extractor are supposed different in table 10 ; it would be an imputed transaction if they were integrated' corresponding exactly to the amount that the extractor must pay the owner. The second flow is by nature imputed. Such a recording under two flows should not be surprising. In the SNA, the change in the value of an asset during an accounting period can be recorded in various accumulation accounts.

It can be useful to note that, twenty years ago, G.D. Roy (Anatomy of Depreciation, 1977) - quoted by John Hartwick and Anja Hageman ²- called depletion (100) as defined in the paper "net depreciation" and the part of the depreciating asset used up during the period (150) "gross depreciation". Part of the latter is offset by the gain in value resulting from the reduction in the length of the period of discounting.

With the way of recording that I propose, the asset account for the deposit in question follows the pattern designed in the 93 SNA (pare 2.162). It reads as follows : opening stock {500}, plus

² Economic Depreciation of Mineral Stocks and the Contribution of El Serafy, 1993, in E. Lutz (ed) Toward Improved Accounting for the Environment, p. 219-220.

transactions recorded in the capital account, that is, withdrawals from stocks of natural assets (-150) plus other changes in assets (+ 50) (I simplify the presentation) equal closing stock (400). As can be seen again from page 2.162, all transactions on assets/liabilities are in the SNA recorded either in.....

Accounts for the extractor and combination with the owner's accounts

Looking now at the accounts for the extractor, what is proposed in the paper seems acceptable. The paper records the amount paid by the extractor to the owner in relation with the quantity extracted during each period as intermediate consumption. His output being unchanged, his gross and net value added is reduced by the same amount as compared to the 93 SNA. Then primary income payable by the extractor to the owner is also reduced by the same amount, leaving his balance of primary income unchanged. The alternative which I followed in *Reflections on Environmental Accounting*, where ownership and extraction were supposed integrated, was to treat the integrated owner-extractor in a way similar to the transport and trade industries. Thus intermediate consumption was not increased whereas the value of output was reduced. I am ready to change my mind as what is proposed in the paper would give, in this respect, a simpler and clearer picture of the activities involved.

An implication of the paper is that two different goods-like objects are defined, for instance oil in the ground and extracted oil. Thus oil in the ground has to be added to the classification of "goods and services". As goods and services-products are always in the 93 SNA a result of production and raw materials in the ground are not produced, there are terminological aspects to be investigated. An account similar to the goods and services account has to be introduced for oil in the ground. Following the paper's proposals, this account would record intermediate consumption (150) balanced by output (150). According to my analysis, the same amount of intermediate consumption (150) is balanced by withdrawals from stocks of natural assets (- 150).

When the accounts of the owner and the extractor are combined, GDP is unchanged as compared to the 93 SNA when following the OECD paper's proposals (gross value added : + 150 owner, - 150 extractor) and NDP is reduced by 150 (+ 50 owner, - 150 extractor). According to my proposals, both GDP and NDP are reduced by 150.

Destiny of the oil rent

The amount by which I propose to reduce GDP and NDP (150) corresponds to the portion of the oil rent which is finally realized during period 1 when selling the first portion of the deposit.

At the economic origin of the deposit, when it is discovered and assessed as economically exploitable, and first entered in the balance sheet of the initial owner, the present value of the whole expected oil rent (calculated after all actual or expected costs of exploration, development and exploitation are deducted) is recorded by the 93 SNA (paras 12.15 and 12.1c) in the other changes in volume of assets account (under K3 - Economic appearance of non-produced assets) because the subsoil resource is not created by a process of production. It is an addition to the stocks of economic natural assets. This treatment must be kept and is followed by Peter and Anne.

The initially estimated present value can be changed for various reasons. Such changes are recorded in the other changes in volume of assets account or the revaluation account. Acquisitions or disposals among economic units of the existing reserves, before or at the time of extraction, are recorded in the capital account.

The oil rent can be shared between possible successive owners and the extractors. An owner selling all or part of a deposit may realize his part of the rent even if the rent remains potential until it is finally realized through extraction and sale of the extracted resource. In many arrangements, the owner and the extractor being different institutional units, the extractor gets a license to extract the oil. As the extractor expects to get a part of the rent, the paper makes various suggestions as to the possible ways of reflecting such a situation. As probably the authors, I favour the solution of splitting the value of the deposit between the owner and the licensee, according to the present value of the net receipts expected by them. The other solutions are more complex. Attributing a non-financial intangible asset to the owner (which is the present SNA solution, see 10.129) would imply either that the value of the deposit, which is clearly a tangible asset, is the sum of a tangible part (the owner's) and an intangible part (the extractor's) or that the full value is recorded in the owner's assets and a (non financial) liability to the extractor is also recorded in the owner's accounts. Showing the total value of the deposit in the balance sheet of the extractor and recording a financial liability of the extractor to the owner (similarly to financial leasing) as a counterpart of the owner's share would not give a realistic picture of the process involved.

Finally there seem to be three main issues when analysing the problem dealt with in the paper. The answers given to them command the main content of a possible better treatment of this problem in the SNA.

Main issue one : subsoil resources as non-produced assets ; "to allow or not to allow for depletion ?", is it a relevant question ?

The fundamental issue is whether subsoil resources must be kept as non-produced assets, following the solution in the 93 SNA and the SEEA, or if they should be considered as produced assets, following for instance the Repetto and B.E.A.'s position. The authors follow the 1993 SNA rule. Subsoil deposits are non-produced assets. New discoveries continue to be treated as other changes in volume of assets recorded in the corresponding accumulation account (see table 3, p. 18). However there is a risk of their discussion of the relation between new discoveries and the life length of the oil reserves (p. 14 to 16) being misinterpreted, because of their recording of depletion in the capital account only (and not partly in this account and partly in the other changes in assets accounts as I propose to do) and their use of the word "income" with a general meaning which is not necessarily the one used in the current accounts of the SNA.

The paper says, "in keeping with the idea of sustainability": "if there is no reduction in the stock levels there is no need to allow for depletion" (p.15). My first reaction, when reading this, is "no need to allow for depletion? Depletion can be zero perhaps. However does this imply that there is no need to record in the capital account the withdrawals from the stocks of natural assets in the ground? I am not sure". Investigating a bit more the issue seems necessary.

The main part of the OECD paper pursues the way of a strong similarity between subsoil deposits and fixed assets. This analogy seems no longer kept on page 15. In effect, the consumption of fixed capital in the case of (by definition produced) fixed assets is defined and measured in principle for each fixed asset separately and then aggregated upon all fixed assets owned by the unit (s involved (see for instance 1993 SNA 6.198). It does not depend at all on the existence or not of newly created fixed assets during the period of recording. Why would not deposits of subsoil resources be treated one by one? I will not go farther however in the context of the analogy with fixed assets which I do not think relevant.

Actually the paper goes, on page 15, in a slightly different direction, closer to the "inventories-like" approach. The parallel is there drawn with the treatment of renewable natural assets where the level of depletion is often calculated as offtake less natural growth (I comment later on renewable natural assets). The paper says "here discoveries are the counterpart of natural growth". I am surprised to see the authors rubbing out the difference between renewable and non-renewable resources, that is generally considered a fundamental one in the context of environmental accounting with intergenerational concerns. This reminds me of a short story by Alphonse Daudet "The man with a golden brain". This poor young man had a pretty thoughtless wife. In order to satisfy her increasing demands he progressively took small pieces of gold out of his brain. The last time he tried to do it, he was able only to show to the terror-stricken young lady blood on his fingers, then he died. As long as new gold was appearing on her husband's fingers, and extraction did balance consumption, the lady was unable to perceive that this brain-resource was not indefinitely available.

Of course I know that there are uncertainties about the magnitude of the reserves, the change in demand and technological changes (resource saving techniques, substitution possibilities, etc...). However the view taken in the paper seems to rely on optimistic assumptions, if we have in mind that in the near future the world population will continue to increase substantially.

There are other difficulties with the idea that "if there is no reduction in the stock levels there is no need to allow for depletion". At what level will the balance be established? At the world level? Nobody seems to have this in mind. However from the viewpoint of sustainability on earth as a whole the question does not seem trivial. Nevertheless there are in this case implications which probably very few people would accept. At each country level? Then there are regional aspects, new discoveries being able to balance extraction in a region, not in another. So what before and after the possible collapse of a federation of states? There are also timing aspects. If adjusting more or less exploration efforts to anticipated extraction needs is feasible in big countries with important subsoil resources, it may not be the same story in smaller countries. Thus discoveries may in fact be rather unevenly distributed (the authors have this in mind when proposing to use a moving average of some years, which probably would not solve the issue in general). Or should finally the balance be established for each owner of deposits, the owner not always being government? Looking also to the issue of big corporations engaged in extraction and possibly ownership in various countries and their exploration policies may even complicate the problem.

Thus the answer to the statement "if there is no reduction in the stock levels there is no need to allow for depletion" does not seem that simple. Additionally, people advocating this conclusion seem to have in mind the physical levels in question, a position which does not seem fully

consistent with the definition of depletion as a difference between two successive net' present values.

Anyway, even if depletion were to be zero in certain cases, would this imply that there is no need to record in the capital account the withdrawals from the stocks of natural assets in the ground ? I discuss this issue in the context of the treatment that I propose above. In my view sales of existing assets have to be recorded in the capital account whatever new discoveries of subsoil assets may be. Now, we have to make a distinction between physical quantities and values. As soon as there exist sales of subsoil assets by the owner (actual or imputed) there are physical flows implicitly recorded in the capital account. What about values ? If we do not forget that the value of the subsoil assets to the owner (and the extractor when shared between them) represents a certain amount of economic rent (net receipts, etc.), it may well be that there is no economic rent at all, that is, its value may be zero (it cannot be negative in my view). In such a case, the item "withdrawals from stocks of natural assets" would be zero in monetary value (though with associated physical quantities). As long as the economic rent associated with the annual extraction is positive, its value must be recorded in the capital account (and GDP, NDP are reduced as compared to the 1993 SNA figures, notwithstanding the fact that physically new discoveries may offset or exceed extraction).

The possible decrease in the amount of economic rent realized annually through the extraction and sale of a portion of the resource can result from various causes : a decrease in the demand for the raw material in question diminishing its market price after extraction, increases in the costs associated with exploration, development and exploitation, or a decrease in the market price of the extracted resource resulting from increased supply, following for instance significant new discoveries (in new countries for example) or disagreement among countries and enterprises. However, economic rent may exist even if new discoveries balance or exceed extraction at certain institutional or geographical levels, because of inequalities, in the distribution of subsoil resources between countries or inside a given country, structural or behavioural market imperfections, etc.. It would be a misconception, in my view, to ignore these basic features of the economy of non-renewable resources and to base their treatment in national accounts on purely physical considerations, whose meaning as I tried to show above is debatable.

On the other hand, the economic rent realized in the annual extraction can be partially offset by the gain in value resulting from the reduction in the length of the period of discounting, time passing. This gain in value must in my view be recorded in the other changes in assets accounts (I come back to this issue below). There will be depletion (economic depreciation) -measured as the total of the two accumulation entries involved- as long as the economic rent realized in a given year is greater than this offsetting capital gain. There may even be an economic appreciation of course, for instance if, at the beginning of the exploitation period of a deposit, extraction is very low as compared to expected sales in the remaining life of the asset. Then the offsetting capital gain can be greater than the amount of the realized economic rent. The time of recording a new deposit in the accounts can play a role. Extraction may start after a delay and in the meantime there may be no sales, and consequently no realized rent at all. Time passing, until the extraction starts, the length of discounting future net receipts is shortened and a capital gain corresponds to an economic appreciation of the asset in question. Things can be more complex in practice. For instance, if a licensed extractor starts paying a certain amount to the owner before the extraction starts, there may be then a sale of the resource in the ground and an amount of (initially) realized

rent for the owner prior to any extraction. Of course, in such a case, there will be two entries in the capital accounts, as far as stocks of natural assets are concerned, a negative one in the owner's account and a positive one in the extractor's account. The intermediate consumption of the extractor will not be influenced during this accounting period.

Main issue two: subsoil asset-, similar to inventories or fixed assets?

I now turn to the second main issue, that is, whether subsoil resources in the ground are similar to inventories or to fixed assets. In their desire to parallel them with fixed assets, the authors analyse the progressive selling of subsoil resources as a form of operating leasing. Then they try to approximate the treatment recommended in the 93 SNA for the latter. Of course we know that in the long run the differences between some concepts used in national accounts vanish, for instance the difference between intermediate consumption of non-durable goods and the consumption of fixed capital of fixed assets. However these concepts hold in the shorter run and must be followed in the context of national accounts.

In the paper, and I said above that I am ready to follow this view, the resource in the ground that is extracted during a given period is analysed as an intermediate input of the extractor. Thus undoubtedly the resource in the ground is not considered a durable good (I use the word good in this paragraph purely for sake of convenience) that may be used during more than one year. It is not considered as a good which could be used as a fixed asset. It is an intermediate good transformed by the extraction process in another good. Of course, the authors do not disagree with this analysis. Actually, what they analyse in a similar way as a fixed asset is the deposit itself, not its content ; it is the deposit as a capital. The deposit is an asset which is able to generate (net) receipts to his owner during a series of years.

This is true of any capital in an abstract sense. Nevertheless we should not forget the double nature of capital, firstly as an amount of abstract economic value, secondly as a set of given assets which may be tangible, financial or non-financial intangible assets of various types.

A subsoil deposit is on one hand an abstract amount of economic value, on the other hand it is a pile of concrete raw materials in the ground. The slice that is extracted during a period is then physically integrated into the resource after extraction, which is not the case for the slice of value of a fixed asset that is integrated only in value in the derived product. The analogy in the paper with operating leasing does not hold³.

In national accounts, both aspects of capital matter. In many respects, subsoil resources are in my view close to inventories. A basic difference with inventories (and fixed assets as well) is that they are not produced. Therefore, in order to limit the risk of confusion, I used in this paper a different wording (withdrawals from stocks of natural assets). Anyway it is useful to go a bit deeper in the comparison between subsoil resources and produced inventories. A characteristic of subsoil resources that is sometimes stressed in order to argue against their similarity with inventories and in favour of their similarity with fixed assets, is that they are not totally available for sale immediately, both for technical and economical reasons, which is of course true. A

³ Additionally. such an analogy would imply analyzing the supposed output of the owner as an output of services. This is not done in the paper for obvious reasons: the extractor would then have no tangible raw material in its inputs and the nature of its output would become problematic.

contrario inventories are supposed to be available and capable of being sold in the short run (see for instance the paper presented by Peter Hill and Anne Harrison at Washington F. 96). Thus inventories are valued at current prices (the discounting period is deemed to be close to zero) whereas subsoil resources are valued at the present value of future net receipts, as fixed assets are.

Actually inventories do not cover only finished or nearly finished products. They include work in progress a part of which may take a rather long period of time to be completed. The extreme case is timber in cultivated forests which is rightly included by the 1993 SNA under inventories. There remain in such a case two substantial differences between inventories and subsoil resources. The first ones are produced, the latter are not. The first ones are not yet completed physically, whereas the latter are.

There may also be finished goods entering inventories at a time when it is well known that part of them will be sold only with a rather long delay. This can occur for instance in the case of certain agricultural products, like coffee. The conjunction of both big harvest(s) and a slow down in demand may significantly increase the delay for disposing of the inventories. The 1993 SNA does not analyze explicitly such a situation.

According to the general SNA rule, entries in inventories are valued at basic prices at the time they occur. In the closing balance sheet of the producer however, the inventories in question should be valued in principle at their net present value which is the value that a possible purchaser would accept to pay knowing that the stock can only be sold in the future.

It is not totally clear if the difference between the values at the time of entries and in the closing balance-sheet is to be recorded in principle as a holding loss in the revaluation account or an other change in volume of assets. Suppose that the net present value is used at the time of entry in inventory by the producer for those goods which, though being completed, will be sold only with a long delay. What would be the impact on the goods and services account of the product in question ? A reduction in the volume index of output (different quantities of the same finished good being considered as different products valued at different prices simply because they will be sold at significantly different times) ? Or a reduction in the price index of output (the goods in question being considered a single product valued at the weighted average of the actual sale price and the net present value depending on expectations about the time of sale) ? Subject to further investigation, the answer seems to be : a price effect. Then progressively there would be a revaluation (holding gain) until the time the goods are sold in spite of the fact that the apparent market prices are supposed constant (the net present value can be looked at as a, generally invisible, market value). Such a holding gain is a real holding gain in nature. It refers to a change in the relative prices of quantities which may not be sold without a significant delay, as compared to the immediate market prices of quantities actually sold. Then the latter prices may change upon time, differently perhaps from the general price level, which can result in both usual nominal and real holding gains/losses that must be conceptually distinguished from the real holding gain underlined above. Perhaps a specific name has to be found for the latter gain.

Main issue three : what is the nature of the gain in value resulting from the progressive reduction in the length of the period of discounting ?

At this stage, we can revisit an issue which I left partially open at the beginning of this paper : what is the nature -in national accounts terms- of the gain in value resulting from the reduction in the length of the period of discounting, the extraction timetable being unchanged ? That is, what is the nature of the 50 in the numerical example of the OECD paper (period 1, annex tables 1, 2 or 3, last column) ?

It should be noted that this question arises even if one accepts to follow a treatment similar to the one given to inventories. One could tell me :

"Well, I accept your view as to the similarity of subsoil resources with inventories. However, I do not follow you completely. Why not to analyse the 50 under scrutiny as an output associated with the storage of the resource ? Thus the story would be read as follows : opening stock (500), plus transactions recorded in the capital account, that is, withdrawals from stocks of natural assets (- 100, resulting from sales of subsoil assets - 150 and output of storage + 50) equal closing stock (400). And the goods and services account would read : output 50 (supposing storage is a kind of ancillary activity of the owner), withdrawals from stocks of natural assets -100 (+ 50 - 150), intermediate consumption 150. Thus both GDP and NDP would be different from what they are in the 1993 SNA by 100 only, somewhere in between your proposal (- 150 in both cases) and Peter Hill and Anne Harrison's proposal (respectively 0 and - 100). So what?"

I have the feeling -the analogy with fixed assets being in my view not viable- that this is the real issue at the core of the debate. As there is no physical change of the resource in the ground and we can assume also no storage costs (if there were some, they would be deducted in the process of calculating the economic rent), is the simple fact to keep something in stocks a process of production, in the SNA sense, time passing ?

Answering yes in the case of subsoil resources would be paradoxical. They are non-produced assets whose monetary value is estimated by the economic rent -a non-produced value- which they allow their owners to get. The net receipts are the economic rent realized or expected to be realized in each year. The fact that the rent is realized upon a series of years and consequently discounted does not change its nature. If a deposit has been actually purchased from its initial owner, the return to the capital invested by the purchaser of the deposit is a part of the rent (the initial owner himself has not invested by definition the value of the deposit) whatever the length of the period of extraction is and the proportion according to which the rent ("gross depreciation" according to Roy's terminology) is shared between depletion ("net depreciation") and the return to the invested capital. This return is an income in the sense of the economic theory. However, it should be stressed again that the income concept in the SNA central framework is narrower than the theoretic concept. If one likes to check the consistency between the requirements of economic theory and the national accounts concepts and definitions, one must take into account the fact that income according to the theory may be reflected in income in the current SNA accounts, and/or other changes in volume of assets, and/or holding gains/losses. Thus, looking only at NDP in this context is an incomplete approach. These remarks are especially relevant when dealing with non-produced assets like subsoil resources.

Finding non-acceptable, from the point of view of the SNA principles, and unnecessary, from the viewpoint of coherence with the economic theory, the treatment as an output of production of the gain in value resulting from the reduction in the length of the period of discounting, simply due to

the passing of time, this gain has to be recorded either as other changes in volume of assets or as real holding gains. After having analysed above the treatment to be given at produced inventories in a similar situation, it seems that the gain in question is to be considered as a real holding gain. The net present value of the quantities which will be sold only in year n is the price which could be paid by a possible purchaser of the deposit in year 1. It is thus the relative price of these quantities as compared to the price of the quantities that are disposed of in year 1 for immediate extraction. This relative price increases progressively until the time of sale and extraction of the quantities in question is reached in year n (market prices are supposed constant).

When the authors of the OECD paper exclude from the measurement of depletion any holding gains or losses, they have certainly in mind only the holding gains or losses resulting from possible changes in the market prices of the quantities that are actually extracted in years 2, 3... t . The taking into account of the unusual changes in relative prices that I introduce does not impair a correct definition and measurement of depletion, depletion being intended to be recorded in the accumulation accounts as a whole and not only in the capital account. Real holding gains/losses in the usual sense are excluded from the definition and measurement of depletion, though they represent an economic appreciation/depreciation of assets.

Changes in the discount rate overtime

It is useful to note that in their paper for the second meeting of the London group (see the Conference papers volume p. 96), Peter Hill and Anne Harrison state that "changes due to changes in the interest rate used in the discounting calculations represent revaluations". I propose the following rationale for such a treatment. Suppose that, when calculating the present value of a deposit at the end of a yearly period, nothing is changed (timetable of extraction, prices, costs, etc...) except that a different discount rate is used, whatever the reason for that. If a higher discount rate is used, the effect is to reduce the present value of the deposit. Using a lower discount rate increases this present value, as compared to the value obtained if the same rate as at the end of the previous period were used. Consistently with what I suggested above, this loss or gain in value is best interpreted as a change in the relative prices of the units which will be extracted in the future as compared to the price of the units that are extracted during the current period.

However changes in expectations reflected in a change in the discount rate may influence other elements intervening in the calculation of the present value. For instance the timetable of extraction may be changed. It means that the quantities which are expected to be sold (extracted) in each future year and the lifelength of the deposit may be different. Thus, the present value of the deposit becomes different when such changes occur. In my view, such changes in the value of the deposit must be recorded in the other changes in volume of assets accounts, not in the revaluation account. They influence the quantities and the receipts (at constant prices) in each future period. Such changes in the exploitation scheme (timetable of extraction) may of course result from other causes. They must be treated in the same way in all cases.

Thus, when a change in the discount rate over time is linked with changes in the timetable of the extraction of a deposit, two effects must be clearly separated out : to the extent that the expected receipts (at constant prices) are changed, the effect is an other change in volume of assets ; then,

the new expected receipts represent a higher or lower present value due to the use of a different rate for discounting, this second effect being a holding gain or loss.

Summary on subsoil assets

At this stage, I can summarize and complement how I see the treatment of subsoil resources in the context of the general conceptual framework of the 1993 SNA :

1. The deposits of (non-renewable by definition) subsoil resources are a gift of nature. They are non-produced assets
2. Deposits as economic assets in the balance sheet are valued at the present value-of the net receipts expected from them
3. New discoveries, which meet the criteria for being qualified as economic assets (I do not discuss these criteria in the paper), enters the 1993 SNA balance sheet as flows in the other changes in volume of assets account, and are valued as said in 2.
4. Changes in the level of exploitable subsoil resources due to technical changes or relative price changes are recorded in the other changes in volume of assets account (1993 SNA 12.15, 12.16, 12.31)
5. Changes in the receipts at constant prices expected in various years due to changes in the exploitation scheme of a deposit over time are also to be recorded in the other changes in volume of assets accounts, whatever the reason why the exploitation scheme over time is changed.
6. Changes in the present value of a deposit due to changes in the discount rate over time, others things being equal (notably the exploitation scheme over time), represent real holding gains/losses to be recorded in the revaluation account. When changes in the discount rate over time affects the exploitation scheme over time, this impact is to be recorded as in 5.
7. Changes in the present value of a deposit resulting from the progressive reduction in the length of the period of discounting, others things being equal (notably the exploitation scheme over time and the discount rate), represent also real holding gains/losses to be recorded in the revaluation account
8. The meaning of conclusions 6 and 7 is that the present (discounted) value of the net receipts per unit expected in a future year is interpreted as the relative price of the resource disposed of in this future year as compared to the price of the resource disposed of in the current year
9. The interpretation proposed under 8 is itself connected with the fact that subsoil resources are non-produced assets (gift of nature) and that their process of creation by nature is completed well before they are discovered. As subsoil resources in the ground, they are "ready made". The simple holding of subsoil resources by their owners is not a process of production (note that the simple holding of finished goods as inventories is not a process of production either ; the 1993 SNA - paragraphs 6.64 and 6.65, 6.104 to 6.109 - associates a process of production with storage under certain circumstances, not simply the passing of time)

10. The expected receipts from the sale of a subsoil resource, net of all costs of exploration, development and exploitation, referred to in point 2, is what is generally called the economic rent. It is the nonproduced value of a non-produced asset. The discounting procedure does not change its nature

11. As soon as a deposit, newly discovered and whose technical and economic exploitability has been assessed, enters the balance sheet of its initial owner, it is valued according to the economic rent that can be expected from it. This economic rent is only potential (unrealized)

12. The economic rent is finally realized through the sale (actual when owner and extractor are different institutional units, imputed otherwise) by the owner of the deposit of the quantities of the subsoil resource that is actually extracted during a given period.

13. A deposit or part of a deposit may be sold before its actual time of exploitation comes. The seller realizes then all or part of the expected economic rent representing the full value of the deposit. Normally the buyer expects to get part of this rent, which remains potential for him. This buyer, the new owner, incurs the risk of non realizing the potential rent he expects to get or even he may experience greater capital loss in case of negative changes in the market conditions or for other reasons

14. In case an extractor gets a license for exploiting a deposit, the simplest treatment is the sharing of the value of this deposit between the owner and the extractor

15. Acquisition and disposals between institutional units of subsoil resources in the ground are recorded in the capital account under K12 (93 SNA 12.15) at their actual transaction values when they occur, following the SNA's general rule for transactions in assets

16. The value (economic rent) of the part of a subsoil resource in the ground which is extracted in a given period is recorded in the capital account preferably under a new item to be created in the classification of transactions. I called it provisionally "withdrawals from the stocks of natural assets". These withdrawals are valued at the current value of the economic rent finally realized through extraction during this period. This value is the same as the one referred to in point 15 above, when there is an actual transaction at this time between owner and extractor being separate institutional units. When at this time owner and extractor are the same unit, this value is imputed.

17. An account similar to a goods and services account is introduced. It records the "withdrawals from the stocks of natural assets" on one side, and an equivalent intermediate consumption on the other side. This intermediate consumption is an additional input by the industry extracting the resource in the ground. The output of this industry is the raw material after extraction.

18. The economic appreciation or depreciation of the capital value of a given deposit is, as in theory for any other asset, the change in the present values of expected future net receipts (economic rent) at the beginning and end of the accounting period, apart from any neutral holding gains/losses (see definition in 93 SNA 12.89). It is a change in real net worth (93 SNA 2.149).

19. The economic appreciation or depreciation of a deposit may have to be recorded in three different accumulation accounts of the SNA, depending on the factors that make it vary.

20. The current value of the part of the deposit that is extracted during the period is recorded in the capital account with a negative sign under "withdrawals from the stocks of natural assets".

21. Changes in the present value of the deposit linked to changes in the level of the exploitable resource due to technical changes or relative price changes (point 4), changes in the receipts expected in various years because of changes in the exploitation scheme over time (point 5) are recorded in the other changes in volume of assets account.

22. Changes in the present value of the deposit due to changes in the discount rate over time, other things being equal, or resulting from the progressive reduction in the length of the discounting period are recorded in the revaluation account as real holding gains/losses.

23. Changes in the present value of the deposit due to expected changes in the relative price of the resource after extraction -if taken into account- are also recorded in the revaluation account as real holding gains/losses.

24. Depletion is defined, more narrowly than the economic depreciation of a deposit, as the reduction in the deposit's value purely as a result of the physical removal and using up of the asset (93 SNA 12.29). It covers entries to be made in both the capital and the revaluation accounts. For this reason, the use of the word depletion is better avoided in the classification of flows (contrary to 93 SNA, item K61, see paras 12.29 and 12.30). It is not sure that depletion is a useful concept in the context of economic national accounting if the analysis I propose is followed.

25. The concept of income, as usually defined in economic theory in the context of the theory of capital, is wider than the concept of income as defined in the SNA central framework. The latter is closely connected with value added resulting from production. Even if new discoveries are left aside as windfall gains, a number of capital gains covered under points 21, 22 and 23 above are possible candidates for measuring alternative concepts of income closer to the theoretic definition. The SNA refers explicitly in chapter XXI. Satellite analysis and accounts to such complementary or alternative concepts of income (see especially-.- paras 21.26 and 21.27).

26. Especially the real holding gains resulting from the reduction in the length of the period of discounting, time passing (point 22), which are offer qualified as the income component in the sale value of the resource in the ground that is currently extracted, can be included in an enlarged concept of income in satellite accounting, if so wished.

27. Attempting to reflect some theoretic elements of income of the type referred to in points 21, 22 and 23 directly in domestic product or national income would imply substantial changes in the conceptual basis of the 1993 SNA (the present overestimate of GDP/NDP/GNI/NNI due to the absence of recording of the "withdrawals from the stocks of natural assets" in the capital account contradicts this conceptual basis), mainly concerning the fundamental distinction between produced and non-produced economic value.

28. The estimate of the economic appreciation or depreciation of the capital value of all subsoil deposits must be made in principle for each deposit separately and then aggregated over all

deposits, thus following- the SNA general rule for any type of asset. The same holds if calculating only depletion, that is, a part of the economic depreciation of deposits.

29. For the latter and other reasons, trying to determine as a prior question if depletion occurs by comparing in physical terms discoveries and extraction in certain circumstances of time and space is meaningless in economic national accounting. Depletion is to be recorded in two different accumulation accounts (point 24 for a reminder). The value of the resource in the ground extracted during a given period if it exists (that is, if there is any economic rent associated with this extracted resource) has always to be recorded under "withdrawals from the stocks of natural assets", with a negative sign. This value can be offset, partly or totally, by the capital gain due to the reduction in the length of the discounting period. Beyond this depletion there may be other factors resulting in an appreciation or depreciation of the capital value of subsoil resources.

30. In pure economic accounting, sustainability can be discussed only in the context of appreciation or depreciation as a whole of the value of subsoil resources as capital, under the constraints imposed by the market short-sightedness.

31. In broader environmental accounting, sustainability can be approached in physical terms. This is a different story implying long term considerations about the undiscovered reserves, population growth, consumption levels and patterns, technological substitutabilities, internal and intergenerational equity, etc...

32. The realized economic rent recorded in the capital account may be paid in practice to the owner in various forms using various terms : royalties, taxes, dividends, etc... Whatever form it may take, this rent is to be recorded as disposal of assets, actual or imputed, by the owner.

33. Conceptually, the economic rent derived from subsoil resources may not be negative. If an indirect estimate of the rent is made and give a negative result, this means that the normal rate of return to the produced capital invested in the extracting activity is not reached. In any case, the rent actually payable and observed (point 32) represents the minimum level of the rent to be estimated. Possible subsidies to mining are subsidies to the extractor, not to the owner.

Other non-renewable assets

Degradation of land

The OECD paper takes the view that "strictly speaking... it can be argued that for agricultural output, value added is already measured net of degradation of land" (p. 12). This conclusion is based on the following reasoning "in fact, if agricultural land does suffer degradation, the economic rent of the land itself declines and is reflected in the production account already".

I discussed this issue in *Reflections on Environmental Accounting Issues* (R.I.W. June 1995 p. 121) and came to a different conclusion. When deterioration of land is caused by improper agricultural practice, there is a case for recording in the capital account a consumption of land (consumption of natural assets) similar to the consumption of fixed capital for produced assets, thus reducing net value added in agriculture.

It seems to me that the OECD paper does not take completely into consideration the time dimension. Firstly, deterioration may start before fertility of the land decreases and value added is actually reduced. Secondly, when the value of land decreases because of a negative change in expected future returns, this change in value is not reflected by definition in the current net value added, as traditionally measured, at the time the deterioration takes place. Only the current decrease in output and/or increase in intermediate consumption and consumption of fixed capital influences net value added.

The 1993 SNA records a change in the value of land resulting from improper agricultural practices in the other changes in volume of assets account (pare 12.33). A better treatment is to record it in the capital account as I proposed in my June 1995 paper.

When the degradation of land results from cause other than agricultural practice, the recording in the other changes in volume of assets account can be kept, unless broader changes are made to the SNA of the type which I proposed in 1995 (see R.I.W. June 1995 p. 119 and 121)

Major improvements to land

What is written in the OECD paper is not totally clear for me. In the 1993 SNA major improvements to land are treated as gross fixed capital formation. However, they do not give rise to separate assets. Their value is included in the value of land. This inclusion does not need a reclassification from fixed capital to non-produced assets contrary to what is written in Peter and Anne's Washington March 1995 paper⁴. It results simply from the working in the case of land of the SNA assets and liabilities account as shown in pare 2.162. This means that, though land is a non-produced asset, a part of it can be actually produced (in fact, it is in that sense a mixed asset). Consumption of fixed capital is recorded for that part.

As noted by the authors, things are complicated by the fact that the unit carrying out such improvements is not always the owner of the land benefiting from them, and that the enhancement to the value of land needs have no direct relation with the cost of the land improvement. Also (93 SNA, pare 10.52) new structures linked with land improvements may not be used directly themselves to produce other goods and services in the way that most structures do. Clarifications are obviously needed. I leave this issue out for the time being.

Renewable natural assets

Cultivated natural assets

The conceptual treatment of cultivated natural assets, as economic assets, is specified in the 1993 SNA. There is however one point which may need some additional clarification, when looking at cultivated resources with a long period of production, like timber. The output is equal to the value of the entries in inventories (the cultivated natural growth). Sales of standing timber are withdrawals from inventories. In a regularly cultivated forest, without extension or reduction or changes in the cultivated species and supposing no exceptional losses, the value of the output is

⁴ In the present paper, they reject the need for a reclassification. However the reason given at the top of page 13 (end of first paragraph) sounds strange

every year the same as the value of the sales of standing timber. It is constant in volume upon time. There is no change in inventories, whose level -at constant prices- is constant.

Measuring the output when there is an extension or reduction of forest is a bit less simple. In order to investigate this issue, let us look at the case of a new area being devoted to forestry. Standing timber is classified in the 93 SNA under "work in progress on cultivated assets" (AN. 1221). If we look at the entire period of production T, there are costs associated with the activity of forestry, probably major costs at the beginning (plantation costs), then every year some small costs for watching, slimming, etc.... There may be sales of secondary products, and of immature trees in connection with slimming. At the end of the period, in year T, mature trees are sold for felling. How to measure output in each year? In order to simplify the presentation, we may assume no secondary products, no receipts from slimming and all costs are concentrated at the start of the first year when the plantation is made. Whatever their nature is, these costs represent an investment in inventories made at that time (I1). If we suppose the price of standing timber constant and the sale takes place at the end of year T, we have

$$I1 (1 + S)^t = ST, F1 (1)$$

S is the value of sale of mature trees in year T, s is the rate of net operating surplus/mixed income which the investment made will yield. At the end of year 1, the value of standing timber is $I1 (1 + s)$. It is also the measure of the output during year 1. At the end of year 2, the inventories of standing timber become $I1 (1 + s)^2$. Output and increase in inventories in year 2 are measured as $Is (1 + s)$. At the end of year n, inventories are $I1 (1 + s)^n$. Output and change in inventories during year n are measured as $Is (1 + s)^{n-1}$. At the end of year T, just before felling, inventories are $I1 (1 + s)^t$. Output is $Is (1 + s)^{t-1}$. From year to year, the volume index of both total inventories and output is $1 + s$, except in year 2 when it is $1 + s$ for total inventories and s for output.

How does the above formulation compare with the recommendation in the 1953 SNA for valuing work in progress in case of a long period of production? The SNA says (para 6.77) "the value of the final output is distributed over the various periods during which production takes place in proportion to the costs incurred". Costs means "total production costs". However in the case of products with a long period of production, this expression needs a certain specification. Production costs usually in the SNA include no other cost of capital than consumption of fixed capital and no cost for own-account labour (the opportunity cost is covered by operating surplus or mixed income, the cost of own-account labour by mixed income). If we followed this narrow interpretation in the case of timber under review, the value of the sales in year T would be allocated upon time in proportion to the usual production costs (basically intermediate consumption, compensation of employees, consumption of fixed capital) constituting the I's that are invested in timber inventories. In the oversimplified case taken here as an example the whole output would have to be attributed to the first year. This is counter-intuitive and in contradiction with the idea of natural growth as a continuous process.

Thus, when dealing with work in progress in long term processes of production, the production costs used to apply the rule stated in the SNA (6.77) include in each year the return on the already accumulated costs. With this interpretation in mind, my above formulation is an application of

the 93 SNA rule. Of course it needs to be complicated when there are I's in other years, secondary outputs and sales of immature trees, as well as exceptional losses.

With changing prices, the basic formula becomes, in the context of the simplified case being reviewed, and with s and p constant over time

$$I_1 (1 + S) (1 + P)^t = ST, PT \quad (2)$$

Stocks of inventories are revalued. The price index for output/entries in inventories is $1 + p$; p is the rate of change in the price of sales of standing timber. In practice, p is not constant.

It must also be noted that the rent of the land covered by forest is a part of the operating surplus/mixed income. It is included in s , not in I , in conformity with the 1993 SNA (rent of land is a property income). In practice estimating separately, if so desired, the rent of land, which is generally notional, not actual, is very problematic.

In practice, in a given year, the previous I's are known. Future I's, future receipts from possible secondary outputs and sales of immature trees, and the final prices of mature trees are anticipated. Thus s is also an expected rate. In principle, every time something is changed, time passing, in this set of expectations, s and consequently output and inventories of standing timber must be revised, upon the whole period of production since the beginning (93 SNA 6.78). Most probably in practice past estimates will not be changed and adjustments will be made in the other changes in volume of assets account and/or the revaluation account in accordance with the new estimate of inventories. For the remaining part of the period of production, the new anticipated figures are used, including a new estimate of s (when in principle the realized s must be the same upon the whole period of production).

Until now, when dealing with cultivated standing timber, I did not use the word discounting. However the similarity of the above capitalization formulas with the discounting procedure is obvious. It can be useful to investigate a bit more this issue, as in practice in national accounting for forestry -because of lack of data- a discounting procedure seems generally followed. Even in the simplified situation corresponding to formula (1), ST , P_1 being the starting point, the discounting procedure will generate the correct initial investment I_1 only if the discount rate r is equal to s , the endogenous rate of net operation surplus (with changing prices in formula (2) the discount rate must be equal to $s + p + sp$). The 1993 SNA has probably something of this kind in mind when expressing in paras 13.34 that "The rate of discount and the capitalization factors should be derived from information based on transactions in the particular type of assets under consideration -forest lands, mines and quarries- rather than using a general rate of interest, such as one derived from the yield on government bonds". Actually what is needed conceptually for discounting the expected value of the sales of standing timber is an accurate estimate of the rate of net operating surplus/mixed income for each type of forest. In less simple situations, the I's, that is, the investments in standing timber inventories are not wholly concentrated at the start of the period of production, which makes the usual working of the discounting procedure still less accurate for estimating net natural growth (natural growth less felling), if any, and total inventories of standing timber in any case.

Thus, in the case of forestry activity, an important issue is the estimate -for each age group of trees- of the new capital (the I's) invested every year during the production period in the creation of standing timber inventories (this capital investment is made of various types of expenditures - intermediate consumption, compensation of employees consumption of fixed capital- apart from the return on the already accumulated capital/costs).

At this stage it is worth stressing the following difference between produced and non-produced natural assets/resources. In the case of non-produced natural assets/resources, no capital (whatever form it may take, including labour) is invested in the creation of the assets/resources themselves. Using the above notation, there are no I's in their case, as compared to produced assets/resources. The absence of any capital investment in the creation of the non-produced natural assets/resources must not be -confused with the actual investment of capital in the discovery of these resources, their exploitation or possibly their acquisition through purchases from the initial or subsequent owners.

This leads me to suggest a more precise definition of true nonproduced assets than what can be found in the 1993 SNA itself⁵. True nonproduced assets are tangible assets in the creation of which no capital of any type has been invested. They are gifts of nature".

Non-cultivated renewable assets

Concerning non-cultivated renewable assets (virgin forests, fish stocks in the oceans), it is admitted that their natural growth is not an economic process of production. The issue is "how to treat the offtake ?" which is presently in the SNA recorded in the other changes in volume of assets, which means that the monetary value of the extracted resources, if any, is included in the output and value added of the extractors. The discussion is usually in terms of the relation between offtake and natural growth. It is frequently recommended to record depletion in the capital account only when offtake is greater than natural growth. I adopted this view in *Reflections on Environmental Accounting Issues*.

However I feel uncomfortable with some aspects of this issue. It is generally accepted that the monetary value of a non-produced natural resource is measured by the economic rent that can be derived from its extraction and sale. Also -this point is probably less clear- the monetary value of a non-produced natural resource is a non-produced value. So, if we simply continue to apply the SNA treatment when offtake is not greater than natural growth, we can face the following difficulty in case an extracted resource provides an economic rent to the extractor. The corresponding economic rent will be recorded both positively and negatively in the other changes in volume of assets account, whereas the same amount of economic rent (a non-produced value) will be recorded in fact under output and value added. Thus a non-produced value given by nature is transformed into a produced value, which seems at least a questionable result.

It is worth exploring a different solution which could accommodate apparently conflicting requirements. In order to keep the presentation simple, I take the case of a non-cultivated

⁵ Most intangible economic non-produced assets, perhaps all of them, are not truly non-produced assets They are classified among them by the 1993 SNA either for sake of convenience, like purchased goodwill, or because of a wrong treatment of the activity creating them, like the results of research and development In no case of course, intangible assets are a gift of nature

renewable resource that is not considered as an economic asset (in the SNA sense) until the time of its extraction. I suppose also that a certain amount of economic rent is derived from the sale of the extracted quantities.

I would do the following :

1. record this amount of economic rent positively in the other changes in volume of assets account (as a gift of nature) at the time of extraction, as in the 93 SNA.
2. record in any case, negatively, the value of the economic rent of the extracted quantities under the new proposed item in the capital account "withdrawals from the stocks of natural assets"
3. similarly to what has been proposed by Peter Hill and Anne Harrison for subsoil resources (and I agree with them in this respect), introduce an account similar to a goods and services account for the resource before extraction (thus completing the classification of goods like items). The above withdrawals would be balanced by an additional intermediate consumption of the extractors. The output of the resource after extraction would be unchanged as compared to the SNA. Both the gross and net value added of the extractors, and GDP/NDP, would be reduced by the amount of the economic rent.
4. similarly to what I suggested in the case of subsoil resources, define a concept of income wider than the SNA one which is closely connected with value added resulting from production. Certain capital gains/losses can be covered by such an extended concept, as follows
5. include in an extended concept of income the economic rent derived from the extraction of the resource that is recorded as an other change in volume of assets (see point 1). When offtake is not greater than natural growth, the measure of extended income is equal to (current) income in the present SNA
6. when offtake is greater than natural growth, estimate the value of the reduction in the stock of the natural resource in question (for instance as the present value of the net value added which must be foregone during the period of reconstitution of the resource) and record it also, with a negative sign, in the other changes in volume of assets account. Take this item into account in the extended concept of income referred to above. As compared to income in the SNA, the measure of extended income is reduced by the full amount of the estimated value of the reduction in the stock of the natural resource (part or the reduction being thus recorded possibly in the capital account, possibly in the other changes in volume of assets account, depending on the existence and size of an economic rent)

The treatment outlined above would permit to cover in an integrated way all cases, whether it exists or not an economic rent derived from the extraction of the natural resource and whether offtake is or is not in excess of natural growth. At the same time, a consistent treatment would be given to non-produced natural assets/resources. Relations with theoretic concepts of income must be looked at by taking into consideration what happens both in the current accounts and the full set of accumulation accounts. Theoretic requirements seem to be respected in all cases, as are national accounts requirements especially in relation with the basic distinction between produced and non-produced assets/values.

These proposals need to be carefully examined. There may be aspects that I forgot to take into account. In any case, there remain difficulties to be solved, apart from the well known difficulty of estimating the possible economic rent. They are not specific to my suggestions.

Cases where offtake is greater than natural growth or not may be difficult to define and delineate. Difficulties can be greater perhaps in the case of fishstocks than for non-cultivated forests. Again we can face the issue of the areas of observation. Fishstocks are a mobile resource. Fishing boats can operate in waters under the control of countries other than their country of residence (fishing rights if any are a component of economic rent) or in international waters. It can be uneasy to determine if and to what extent fishing boats belonging to a given country are responsible for an offtake exceeding natural growth, even if in total offtake is greater than growth.

Though forests are not mobile, there exist also difficulties. The situation is rather easy when dealing with virgin forests not included under economic assets. It can probably be considered in such a situation that the net natural growth of virgin forests before exploitation is zero, natural growth being offset by natural death. Offtake in such non-cultivated forests are generally connected with a decrease in the forest area and can be deemed to exceed natural growth.

The issue becomes a bit more complex when looking at non-cultivated forests that the 93 SNA includes under economic assets (AN 213. Non-cultivated biological resources, see annex to chapter XIII p. 310) because ownership rights are enforced over them, though their natural growth and/or regeneration is not under the direct control, responsibility and management of institutional units (this is the reason why they are not cultivated forests). The fact that offtake can be controlled by legislation does not mean necessarily that offtake does not exceed natural growth. It may mean simply that the government tries to slowdown, for various reasons, the exploitation of the forests. In order for offtake not to exceed natural growth, it is necessary that both the forest area does not decrease and the age structure remains constant or a negative change in the age structure is compensated by an increase in the forest area. Meeting the last condition is very improbable under purely natural circumstances. Thus after the exploitation of a virgin forest starts, even if offtake is controlled by government and the forest area remains stable, offtake will exceed natural growth until the age structure reaches its equilibrium state. Then a properly enforced legislation may perhaps allow for a balance between offtake and natural growth (I say perhaps because I know little about the life of virgin forests).

Once cases where offtake exceeds natural growth are determined, estimating the value of the reduction in the stock of the natural resource in question is a delicate issue which deserves further thinking (the usual proposal to estimate the present value of the net value added foregone has not yet been, to my knowledge, fully elaborated). I have nothing more to offer for the time being.

In the context of the treatment proposed above, as well as in the proposals by others, there are drastic consequences resulting from the distinction between cultivated and non-cultivated renewable assets. Due to the importance of such a distinction, the definition of cultivated natural assets needs to be more specified, on the basis of actual studies of forests, not simply conceptual reflections.

Moreover, the category of non-cultivated economic renewable natural assets must be carefully examined also. The 1993 SNA does not seem totally clear in this respect. In chapter X and XII

describing respectively the capital account and the other changes in assets accounts the approach is in favour of a wide coverage of natural economic assets inside the economic asset boundary. Para 10.12 is very restrictive as to the scope of natural assets left aside. It states "Finally, when wild animals, birds, fish, etc... live in locations such that no institutional units are able to exercise effective ownership rights over them -for example, in the oceans or quite inaccessible regions- they fall outside the asset boundary. Similarly, the forests or other vegetation growing in such regions are not counted as economic assets". Para 12.26 refers to "fish in the estuaries" and 12.30 to "fish stocks in the open seas" as included in the asset boundary. On the other hand, the already quoted annex to chapter XIII The balance sheet presenting the classification and definition of assets, while giving virgin forests and fisheries within the territory of the country as examples of Non-cultivated biological resources AN213, introduces just after a significant restriction "Only those resources that are currently, or are likely soon to be exploitable for economic purposes should be included" (93 SNA p. 310).

This restriction may perhaps be explained in two ways. Firstly, the 93 SNA reflects a compromise between those who tried to have the widest coverage of uncultivated natural assets within the economic asset boundary (probably because they thought it would facilitate afterward environmental accounting, which is not at all sure) and those who were in favour of a more clear-cut distinction between economic assets, rather narrowly defined, and nature as a set of natural assets outside the border of the economy. Thus certain contradictions may surface. Secondly, this can be the main source of explanation, people drafting chapter XIII and the classification and definitions of assets had more present in mind, in this context, the conceptual and practical difficulties involved in the actual valuation of such assets. Para 13.61 says, concerning non-cultivated biological resources and water resources, that "as observed prices are not likely to be available, they are usually valued by the present value of the future returns expected from them".

Thus chapter XIII in its annex is more demanding than chapter X (capital account) which simply says (para 10.11) "Secondly, in order to comply with the general definition of an economic asset, natural assets must not only be owned but capable of bringing economic benefits to their owners, ..." The annex to chapter XIII seems to add the following qualification : capable of bringing economic benefits to their owners in the near future. In fact, if they do not fulfil this condition, how would it be possible to calculate for them the net present value of expected future returns, when such returns may neither be precisely assigned to specific years nor precisely estimated as to their amount ?

There is so a significant ambiguity in the 93 SNA as to the borderline between uncultivated natural assets that are inside the asset boundary and those which are outside. One could perhaps try to solve the issue by saying that a part of the uncultivated natural assets included in the asset boundary are present only in physical terms, not in value until expected future returns can be estimated. Such an interpretation is not acceptable. Actually it has been proposed, more extensively, during the process of elaborating the 93 SNA. The proposal has been made at a time to have all natural assets included in the definition of economic assets in physical terms, an important part of them being not valued. The 93 SNA took a different position. The boundary of economic assets is the same both in physical and value terms.

Anyway, it seems to me that the only feasible interpretation of the 93 SNA position is the one expressed in the annex to chapter XIII. Any wider interpretation of the coverage of economic

natural assets leads to big difficulties, perhaps impossibilities in valuation attempts for both conceptual and practical reasons.

In this context, it is necessary to see how the treatment proposed above for a non-cultivated non-economic renewable natural assets can be adapted to non-cultivated economic renewable natural assets. In the latter case by definition non-cultivated economic assets are included in the balance-sheet starting from the time they qualify as economic assets and an entry is recorded in the other changes in volume of assets account at this time. That is, the economic rent which is expected from the future sales of the assets is included in net worth at the same time. When a part of it is realized through sales (of standing timber for instance) in a given year, no entry has to be made again in the other changes in volume of assets account. On the other hand, time passing, there is a gain in value resulting from the progressive reduction in the length of the period of discounting, as we have seen when dealing with subsoil deposits. This gain, to be recorded in my view as a particular real holding gain, must be included in the -extended concept of income introduced above. Then, if offtake exceeds natural growth, the same procedure is followed as in the case of non-economic natural assets.

Of course, if it is not found feasible to both delineate the perimeter of non-cultivated economic natural assets and measure their value satisfactorily, it will be necessary to treat them in practice as non-cultivated non-economic natural assets, not including them in fact in the balance sheet and starting the recording process when extraction takes place and only for the portion actually extracted. At the limit, only two types of renewable natural assets would thus be distinguished in practice, those that are cultivated and those that are not. The later would be considered as non-economic assets.

Some concluding remarks

1. The discussion in this paper is limited to a possible better treatment of a using up of natural assets by offtake in the context of the 93 SNA conceptual framework. Natural assets are looked at in this context from an economic point of view. Ecological values attached to other functions of natural assets are not considered.

2. A basic requirement for such a reflection is a complete understanding of the 1993 SNA, especially in those parts where it differs from previous versions. The meaning and potentialities of the new accumulation accounts that have been introduced, namely the other changes in volume of assets and the revaluation account, must be fully investigated. It is necessary to take full advantage of them. These accounts are not reconciliation accounts. They are an integral part of the SNA. Without understanding them completely, it is not possible to understand correctly the meaning of the SNA current accounts and the other accumulation accounts (the capital and the financial accounts). In particular, it is impossible to understand the meaning of GDP and NDP and consequently the SNA concept of income. Without filling in them, it is not possible either to account correctly for non-cultivated natural assets in an SNA context. Such accounting needs some changes to the respective contents of the capital account and the other changes in assets accounts, with consequences on the current accounts.

3. The distinction between produced and non-produced assets is essential in the 93 SNA, as well as the distinction between produced and non-produced value. They need to be further elaborated.

The conceptual analysis of true non-produced assets must be improved. Also the other kinds of non-produced assets in the 1993 SNA must be classified by type in order to clarify the whole issue.

4. It would be useful to elaborate more completely the fact that the value of non-produced assets is not produced by economic activities whereas at the same time its magnitude is determined through the set of economic exchanges.

5. Also the conceptual relations between the economic rent derived from non-produced assets and the economic rent which may exist in production activities should be clarified.

6. The definition of cultivated natural assets needs to be improved in both conceptual and practical terms.

7. The issue of those non-cultivated renewable natural assets that are included by the 93 SNA inside the economic asset boundary is to be clarified.

8. As stressed in the 93 Blue Book itself, complementary or alternative concepts of income can be defined by combining those resulting from the current accounts with flows belonging to the accumulation accounts, especially the other changes in volume of assets account and the revaluation account. Some of such income concepts can be closer to theoretic concepts derived from the economic theory. It is essential to make clear that the relation between SNA concepts and theoretic concepts cannot be investigated only in the context of the current accounts. Such analysis must embrace both the current accounts and the accumulation accounts. It seems necessary to actually elaborate, in satellite accounting, some of the complementary or alternative concepts of income I am referring to, to define and name them, and to present as clearly as possible for potential users the way they are derived from the SNA. Terminology is very important in this perspective.

9. Analysing the treatment of natural assets inevitably raises complex questions. Practical estimates may represent a formidable task. In any case, they must be based on a good understanding of conceptual issues. Conversely attempts to make practical estimates can help to clarify some conceptual aspects. However it is important not to confuse conceptual requirements and practical, sometimes unavoidable, simplifications.

10. In this paper, one purpose of which was to react to Peter Hill and Anne Harrison's challenging paper, I took views that are sometimes different from the ones I expressed briefly two years ago in *Reflections on Environmental Accounting Issues*. All this business is work in progress. Any comments from possible readers are welcome.

11. From the point of view of statistical policy, it would not be wise, I think, to hurry up too much in trying to adjust actually the 1993 SNA with respect to the so-called depletion of natural assets. In my view, it is necessary to study more thoroughly the issue and try to implement possible solutions on an experimental basis before including a recommendation in the Blue Book.

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