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The Netherlands
Directorate of Economic Statistics

AN ENVIRONMENTAL MODULE AND THE COMPLETE SYSTEM OF NATIONAL ACCOUNTS

Abram J. de Boo, Peter R. Bosch, Cor N. Gorter and Steven J. Keuning*)

*) The authors are on the staff of the CBS Department of Statistics of Manufacturing and Construction, the Department of Environmental Statistics and the National Accounts Department (twice), respectively.

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Summary

A linkage between economic environmental data and the National Accounts is often limited to the production accounts. This paper argues that the consequences of economic actions on ecosystems and vice versa do not only relate to production processes, but also to other parts of the System of National Accounts (SNA).

The module in this paper distinguishes both environmental matter accounts (including 'free' gifts of nature as well as various types of 'free' disposals) and environmental assets accounts (i.e. ecosystems). One should begin with relating volume flows of environmental matter to the standard economic accounts, This is done in a so-called National Accounting Matrix including Environmental Accounts (NAMEA), a format which incorporates all (simplified) accounts of the next SNA in a flexible way. This is illustrated with an example.

1. Introduction

The standard System of National Accounts (SNA) is an integrating framework for the description of monetary activities and the balance sheets in an economy. This does not imply that it gives an account of all economic events in society. On the other hand, broadening the scope of the SNA by introducing large scale imputations in order to account for non-monetairy phenomena like unpaid household services, the use of natural resources and so on would affect the relevancy for many practical purposes of largely financial parameters like GDP. A solution to this dilemma has been found in the development of so-called satellite accounts. Satellite accounts can be defined as data sets on particular subjects which supplement the central economic data as described by the SNA. Their purpose is to enable more detailed analyses than is possible with the information contained in the SNA or analysis using different definitions, while maintaining an explicit link with the traditional overall system. A major advantage of this approach is that the results of detailed studies can be put in the perspective of the full (financial) economy.

Satellite accounts were first developed at the INSEE (see Vanoli, 1986). Originally, they served to describe, in monetary and non-monetary terms a particular group of goods and services from three different angles: production, beneficiaries and financing. Following this approach, satellite accounts were constructed on research, education, health, transport etc. Later on supplementary accounts were constructed which did not fully comply to this approach. Indeed, a whole range of different types of supplementary data sets round a core set of economic data can be distinguished (Gorter and Van der Laan, 1989). That is why we prefer to use the more general word of 'modules' to the SNA instead of satellites, the satellites being a particular kind of module.

In recent years a lot of work on supplementing the SNA with environmental indicators has been done, in particular in France, Norway, Japan and Germany (refer to Peskin and Lutz, 1990). Also, staff members of the UNSO proposed the introduction of new aggregates as Environmentally adjusted GDP and Sustainable Domestic Product in the revised SNA (UN, 1990). Often however, the efforts were limited to particular aspects of the environment (e.g. Schäfer and

Stahmer, 1989). In this paper, we shall advocate a comprehensive approach by linking systematically all kinds of environmental information to the complete (revised) SNA. We hope that in this way a clearer view of the entire impact of environmental phenomena on the economic system and vice versa can be obtained. At the same time, great stress is laid on applicability. By systematically distinguishing between physical data and their valuation we hope to have adopted a practical and flexible approach to one of the most intricate problems connected with the construction of an environmental module.

The general features of the environmental module will be discussed more extensively in Section 2. Section 3 introduces environmental accounts in the framework of a National Accounting Matrix. These accounts are subsequently illustrated with physical data in Section 4. In Section 5 an elaboration of the National Accounting Matrix with respect to environmental expenditures is presented. Finally, Section 6 discusses the use of the matrix in relation to the debate on supplementing the national accounts with an additional, adjusted national income figure. However, methods for the valuation of non-monetized environmental transactions fall outside the scope of this paper.

2. General features

2.1. Aims of an Environmental Module to the SNA

In general terms, the aim of the environmental module is to provide a complete account of all links between the environment and the transactions, 'other changes in assets' and balance sheets recorded in the main National accounts. The module should show these links where they occur in reality. Within this general framework our first aim is to provide a systematic and complete account of the effects of economic activities on the environment. In the environmental module a clear connection between data on production, consumption etc. and data on all kinds of changes in the environment will be made. Changes in the environment can take many different forms, such as the depletion of a resource, changes in the use of space or the pollution of the environmental media water, soil and air.

In this respect, the environment can be defined as the physical surroundings of man on which he completely depends for all his activities (production, consumption, leisure activities, breathing, dwelling, etc.). Thus defined, it does not encompass social environment. It also excludes the environment within houses and workshops.

The module should provide information, step by step, on the human-induced flows of matter, species and energy (commodity flows), as well as on the resulting effects on the environment (changes in ecosystems), and on the nuisance experienced by the population, thus linking economy, environment and society.

In several countries, data on changes in the environment are collected within the framework of environment statistics. The special advantage of the environmental module approach is that it gives a complete and systematic account of all changes caused by production and consumption processes in a way which is explicitly linked to the overall SNA framework. In the first instance the basic tables of an environmental module contain all changes in the environment in physical units. These are supplemented with a systematic survey of all current expenditures to prevent, reduce or repair damage to the

environment in relation with the entries of these data in the SNA. Also all damage to the assets as they are defined in the standard accounts is included.

Summarizing, the following essential aspects should be considered for inclusion in a full-fledged environmental module:

A. The change of the environment stemming from economic activities in the registration period. This encompasses the elements:
   A.1 Net pollution;
   A.2 Net depletion.
B. Current costs and incomes with respect to the environment.
   This category can be subdivided into:
   B.1 Actual outlays and benefits: prevention, cleaning and compensation;
   B.2 Non-restored damage.
C. The stock of environmental assets and liabilities.

This paper focusses on A and B.

Because of its completeness and because of the linkage between production/consumption activities and environmental data, the environmental module may provide information in a format which is suitable to further analysis and modelling exercises. In particular, it is our objective to provide analysts and policy makers with a data framework which can be used to sketch the trade-offs between the objective of environmental sustainability and other macro-economic policy objectives. This has led us to pay much attention to the linkage of indicators of environmental change not only to GDP-growth, but also to other important policy objectives like income distribution, balance of payments equilibrium etc. The environmental module proposed by us contains cross-classifications which are relevant for specific purposes, like analysis of the impact of taxation alternatives or a quantification of the income generated in the 'environmental industry'.

Building upon the full integration of different kinds of data, the environmental module should also provide basic material for designing indicators on the relation production - environment. Examples may be sectoral indicators or performance indicators, like energy or environment efficiency of production processes (OECD,1991).

Finally, an environmental module should be presented in a clear and easily accessible format. This implies that there is a need for one or two schemes which provide an overview of the whole module. These can then be complemented with a set of tables which follow the same pattern for each environmental problem. This is elaborated in the next section.

2.2. A matrix approach to the SNA including environmental accounts

The environmental module centres around a set of tables which give an overview of all relevant relations between the SNA and an environmental data system. As the burden on the environment originates from the emission of a multitude of agents into a whole range of ecosystems on the one hand, and from the extraction of many different resources on the other, a detailed picture cannot be given in one table. Therefore, a coherent, generally applicable system should be designed where specific tables for each relevant substance can be easily related to the overall picture.

For this purpose, it is most suitable to put the national accounts in a matrix format (see Table 1). This means that the whole system at the macro-level can be shown on one sheet of paper. This in turn facilitates substantially the understanding of the interrelations between various types of (monetary and physical) flows and their impact on each of the balancing items (NDP, NNI, Savings, Changes in Net Worth etc.) distinguished within the system.

Subsequent, more detailed tables then serve to elaborate a single vector or cell in the macro-matrix. These tables are labelled according to their position (row and column account number) in the reference matrix. In this way, the link between detailed figures and the overall system remains transparent throughout the whole set of tables. The subtables use the type of classifications given in parentheses in the row and column headings of the main matrix.[1)]

Another advantage of the matrix format is that it always reveals which entities and which accounts are involved at both ends of all monetary and

Table 1. NAMEA: A National Accounting Matrix Including Environmental Accounts

ACCOUNT (Classification)			Goods and Services (Commodities)	Goods and Services (Consumption Purposes)	Production (Production Activities)	Production (Household (Waste) Prod. Activities)	Income Distribution and Use a. National (Sectors) Primary Inc. Distribution	Income Distribution and Use a. National (Sectors) Secondary Inc. Distribution	Income Distribution and Use a. National (Sectors) Use of Income	Income Distribution and Use b. Rest of the World (ROW)	Indirect Taxes (Tax/Subsidy Type)	Worth Generation a. National (Sectors)	Worth Generation b. Rest of the World (ROW)	Other Accumulation a. National (Sectors)	Other Accumulation b. Rest of the World (ROW)	Financial (Financial Assets)	Other Asset Changes (Asset Types)	Environmental Agents (Agents/ Resources)*)	Environmental Assets Change (Ecotopes/Res)	Changes in Balance Sheet (Sectors)	TOTAL
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	
Goods and Services	Commodities	1	Trade&TransportMargins		Intermediate Consumption	Housek.Cons. Expenditures			Government Consumption	Exports				GrossCapital Formation							Commodity Use (ep,exVAT)§
	Consumption Purposes	2							Final Housek Consumption												Final Withi Housek. Use
Production	Production Activities	3	Output (basic prices)															'Free' Emission by Production			Total Outp (basicpric
	Household (Waste) Prod	4		Within Hh.Output														'Free' Emission by Consumption			Total Prod Withinhous
Income Distrib. & Use	National (Sectors) Primary Distrib. of Income	5			NDP (factor costs)		Property Income Flows			Wages and Property Income from Abroad	Net Indirect Taxes										Primary Income Origin
	National (Sectors) Secondary Distrib. of Income	6			Consumption of Fixed Capital		NNI (market prices)	Current Transfer Flows #		Current Transfers from Abroad #									Current Effects, Past Emissions		Secondary Income Origin
	National (Sectors) Use of Income	7						Gross Disposable Income and Future Effects											Natural Cleansing		Total Income
	Rest of the World	8	Imports				Wages&Property Inc.toROW	Current Transfers to ROW #										'Free' Emission from Abroad			Current Pa ments to R
Indirect Taxes (Tax/Subsidy Type)		9	Net General Product Tax		Net Other Tax on Production	Consumption Taxes, Net				Specific Taxes on Exports, Net				Investment Taxes, Net							Net Indire Taxes
Worth Generation	National (Sectors)	10							Net Saving			Capital Transfer Flows #	Capital Transfers from ROW								Finance Generate Worth Cha
	Rest of the World (ROW)	11								Bal. of Payments Current Account Deficit		Capital Transfers to ROW									Financeof Generate Worth Cha
Other Accumulation	National (Sectors)	12							Consumption of Fixed Capital					Transactions in Non-prod. Assets	Sales of Non prod. Assets to Abroad	Borrowing	HoldingGain & Economic Appearance			NetWorthChanges, Saving & Cap.Transfer	Finance Gross Wor Accumulat
	Rest of the World (ROW)	13												Purch.of Non prod. Assets from Abroad		Net Lending to Abroad	Holding Gains			NetWorthChanges, Curr.Acc &Captransfer	Capital Payments to Abroa
Financial (FinancialAssets)		14												Lending							Increase in Asset
Other Changes in Assets (Asset Types)		15												Holding Losses and Destruction	Holding Losses and Destruction					NetWorthChanges, Other AssetChanges	Oth.Asse Changes Gross Wor
Environmental Agents (Agents /Resources)		16			'Free' Extraction (Net)				Current Consumption of Pollutants	'Free' Emission to Abroad				Net Losses due to Natural Causes			ReferrableDamage,due to EnvironmEff		Immission		Extractio Destinat of Emiss
Changes in Environmental Assets (Ecotopes/Res.)		17							Current Effects, Past Emissions					Non-referable Degradation				Net Depletion		Changes in Worth of Ecosystems	Depletio and Degradat
Changes in Balance Sheet (Sectors)		18										NetWorthChange,Sav&Capitr incl.Env.Eff	NetWorthChanges,Curr.Acc &Captransfer	NetWorthChange,OthChange incl.Env.Eff	NetWorthChanges, Other AssetChanges						Total Changes Net Wor
TOTAL			Commodity Supply (ep, excl.VAT)§)	Within Household Supply	Input (at basic prices)	Input into Production Within Housh	Primary Income Destination	Secondary Income Destination	Total Expenditures	Current Receipts from Abroad	Net Indirect Taxes	Generated Worth Change	Generated Worth Change by ROW	Gross Worth Accumulation	Capital Receipts from Abroad	Increase in Liabilities	Oth.Assets' Changes in Gross Worth	Origin of Extraction & Emissions	Depletion and Degradation	Total Changes in Net Worth	

*) 'Free' Emissions refer to positive volume flows at a zero price (in reality) or at a negative price (in simulation experiments).
§) ep,excl.VAT = Valued at market prices, but excluding indirect taxes which apply only to some specific (final) demand categories (like VAT).
#) Including the transfer of 'free' emissions.

physical flows (origin and destination), and this has clear advantages if the data in the environmental module are to be used in subsequent (general equilibrium) modelling exercises (cf. Pyatt, 1988). Finally, a matrix delivers data in the required format for 'tracing back' the origins of certain transactions and for some 'quick and dirty' simulation experiments with the help of (fixed) multiplier analysis (cf. Keuning and Thorbecke, 1989). In this way, it is possible to simulate the effects of alternative valuation procedures on the conventional macro-economic aggregates.

Therefore, the module has been based on the Social Accounting Matrix (SAM) approach. Originally, SAMs were designed to incorporate concerns of inequality and poverty within the production-oriented national accounts and input-output tables.[2] Later, it was shown that in fact a complete system of national accounts can be transformed into a SAM-format. This allows for considerably more flexibility than in the traditional format, especially regarding the classifications applied (Keuning, 1991). This flexibility is particularly important in an environmental accounting system with its emphasis on the links between environmental effects and various types of transactions. Moreover, an important consequence of introducing disaggregated links between production, incomes and expenditures within our accounting system is that the effect of environmental degradation and of the costs involved in preventing this on the income distribution can be traced. In addition, the analysis of employment issues in conjunction with the environmental accounts comes within reach.

This is worked out in Table 1 which shows a so-called National Accounting Matrix including Environmental Accounts (NAMEA). This matrix is based on a design for the standard accounts as proposed by Keuning (1991) in his paper on a Social Accounting Matrix which fits into the next SNA. In Table 1, this SAM has been expanded and slightly re-arranged.[3] As a consequence, Table 1 integrates a) the (next) SNA sequence of accounts as well as a set of supply and use tables, and b) separate accounts for the relations between the economic flows and changes in the environment. A crucial aspect of these interactions is that the eventual effect on ecosystems is transmitted through all kinds of environmental 'agents': emission of pollutants on the one hand and depletion of resources on the other. This is recognized in our framework by inserting a special account for all kinds of environmental 'agents' in

between the conventional accounts and the account for environmental assets (i.e. ecosystems). Agents is to be read here as substances as well as noise, radiation and species.[4)]

The distinction between an environmental agents account (#16 in Table 1) and an environmental assets account (#17) is expedient to both the supply and the use of the data. Often, emission and waste statistics can be detailed by discharging industry or final demand category, but it is almost always impossible to attribute the degradation of ecosystems directly to certain economic activities (United Nations, 1990: 22). In addition, environmental policy instruments will generally also focus on certain environmental agents instead of directly on ecosystems.

Therefore, account #16 in our framework serves to register the emissions and extraction of all kinds of environmental agents, while account #17 serves to sketch the effects on ecosystems and to provide a general description of changes in the state of the environment. Eventually, this may yield a rough indication of the total effects of economic activities on environmental assets which are not absorbed during the current period: changes in net worth of ecosystems. This balancing item is combined with the changes in conventional balance sheets to arrive at a final evaluation of our economically relevant position at the end of the current period.

Separating these accounts is also advantageous because part of the environmental effects has a current character, while another part precipitates on (the value of) assets already distinguished in the standard national accounts. In our system, this is catered for by recording first e.g. the (total negative value of) all kinds of emissions by a certain activity, air transport say, and then their impact on a) current accounts - in this example, the 'consumption' of noise by household groups neighbouring the airport, b) conventional assets - such as a decrease in the value of houses as a consequence of the enlargement of a nearby airport, and c) environmental assets - like air quality.

Generally, Table 1 reflects our thinking that the interrelations between national accounts and the environment are not limited to the production

accounts, and that these effects should be shown where they actually occur. This means that, if shadow prices for these effects were available, all major national accounts balances would be affected. These effects cascade down the balancing items until finally, in the total changes in net worth, all (lasting) effects have been incorporated. In Table 1, all important balancing items have been framed.

Incorporating income distribution issues into an environmental accounting framework is all the more important when it comes to a valuation of environmental effects. The strength of the conventional aggregates is that they agree with the sum of incomes which are allocatable to individual units and that these incomes also underly their expenditure decisions. For example, most producing units make some allowance for the consumption of fixed capital, so that this is actually taken into account when decisions are taken about the incomes payable against value added. Analogously, if the objective is to construct environmentally adjusted national accounts aggregates, like NDP, one cannot do without a hypothesis on the incidence of these effects. For instance, if it is concluded that part of the generated net product caused future costs which are big enough to be anticipated upon right now, pinpointing the direct incidence of these costs must be the point of departure for any policy or analysis aimed at reducing them. It goes without saying that the actual, final incidence and amount of these costs depends on all kinds of economic and social mechanisms which can at best be simulated with the help of a formal model. However, the introduction of separate income distribution and use accounts as well as various capital accounts opens up the opportunity of at least presenting various environmentally adjusted National accounts aggregates in which these first-order effects are taken into account.

As shown in Table 2, a possible adjustment of the net product measure incorporates, as far as possible, all environmental effects of current production. An adjusted income measure may focus on those effects which are currently absorbed; that is, including present effects of past disposals and excluding future effects of present disposals. Analogous to these intertemporal flows, cross-national flows are also settled in the income accounts. The distinction between these concepts corresponds with an interest in the environmental effects of current domestic production and consumption on

Table 2. Adjusted national accounts aggregates, related to 'free' emissions

I. *Generation*		
1.		'free' emissions by production activities (-)[1]
2.		'free' emissions by consumption activities (-)
3.		Transformation of 'free' emissions by collection and treatment of waste activity (+,-)
4.	(1..3)	Total 'free' emissions generated (-)
5.		DOMESTIC PRODUCT (+)
6.	(4+5)	Adjusted DOMESTIC PRODUCT
II. *Distribution*		
7.		Exports of 'free' emissions (+)
8.		Imports of 'free' emissions (-)
9.	(4+7+8)	'free' emissions on the ec.territory (-)
10.		Current effects of 'free' emissions in previous periods (-)
11.		Future effects of current 'free' emissions (+)
12.	(9..11)	Effects of 'free' emissions which are absorbed in current period (-)
13.		DISPOSABLE NATIONAL INCOME (+)
14.	(12+13)	Adjusted DISPOSABLE NATIONAL INCOME
III. *Absorption*		
15.		Natural cleansing (+)
16.		Absorption by defensive outlays (+)[2]
17.		Absorption by consumption (+)
18.		CONSUMPTION
19.	(15..18)	Adjusted CONSUMPTION
20.		SAVING
21.	(=11)	Future effects of current 'free' emissions (-) a. to economic assets; b. to eco-systems
22.	(20+21)	Adjusted SAVING
IV. *Other events*		
23.		Correction due to registration in transaction accounts of referable damage on economic assets (+)
24.		Changes in eco-systems not referable to transactions (-)
V. *Balance sheets (changes)*		
25.	(21a+23)	Damage to economic assets (-)
26.	(21b+24)	Changes in worth of eco-systems (-)

1) Between brackets: sign of valuation (in welfare or monetary terms).

2) The value of the absorption of free emissions by way of defensive outlays is to be valued for environmental accounting purposes as the net benefit of these outlays over and above monetary costs. This is because the latter are already included in conventional National Accounts.

the one hand and in the current quality of the national environment on the other hand. Obviously, adjusted savings should incorporate all those effects not absorbed in the present period. Finally, adjusted changes in net worth should take into account all changes in the condition of the environment. In this way, each balancing item has a different purpose to serve[5]. The balancing items and the other concepts are elucidated step by step in the next sections which explain the NAMEA matrix presented in Table 1.

3. A Set of National Accounting Matrices including Environmental Accounts

3.1. Goods and services account

The first row and column of Table 1 above contain the 'traditional' goods and services account. The row presents the upper part of a consolidated use matrix, split into intermediate consumption, household consumption expenditures, government (and private non-profit institutions) consumption expenditures, exports and gross capital formation. All these elements are valued at purchasers' prices excluding net indirect taxes which apply to some (final) demand categories only, like VAT. Therefore, trade and transport margins add up to zero, row-wise.

In the first column, the third cell contains the consolidated domestic supply matrix (in basic prices). A more detailed, subsequent table should show the value of all commodities generated by each production activity. Imports (at c.i.f. prices) originate from the current account for the rest of the world. General net taxes on products (excise taxes etc.) are put on a separate account for (various types of) indirect taxes. This method of recording obviates the necessity to allocate e.g. import duties to domestic industries or sectors (which is actually not possible in any meaningful way).

However, there is yet another reason why various types of indirect taxes are recorded in different columns. In this module, showing the incidence of specific instruments of government regulation is of particular importance. It is likely that for instance a tax or a subsidy has a different impact (at least temporarily) depending on the base to which it applies. The distinction between net taxes on products (e.g. an excise tax on fuels) on the one hand and taxes on production processes on the other (e.g. a levy on the discharge of oxygen-demanding materials) is well known.

In order to arrive at total domestic supply at market prices, trade and transport margins must still be settled. This is done in the submatrix in the top left-hand corner of this table. In a macro-matrix, total margins are evidently equal to zero. (cf. Keuning, 1991: Table 3, for more details).

The total of the first column now corresponds with domestic commodity supply at market prices excluding VAT (and other net taxes for specific purposes), and this is equal to the concomitant row sum representing the value of total use. This equality naturally applies to all row and column totals.

It is generally felt that if an environmentally adjusted value added (say GDP) is computed, this should take into account the pollution caused by final consumption too. Since value added can only originate in production, this must imply that production processes also occur within households.[6] In the environmental module, this amounts to a transformation of their consumption expenditures into household output plus various types of 'free' emissions.[7] The value added resulting from these activities is equal to the (non-positive) value attached to the disposals.

The 'free' emissions are delivered to the environment and the other household 'output' accrues to the producing households as final consumption. Apart from the disposals, the physical appearance of the input and output of these production processes is the same. However, there is no need to apply the same classification twice. It is even expedient to show household consumption not only by commodity type but also by purpose. In that case, comparisons (between household groups, countries or periods) can be made concerning the consumption patterns by purpose (e.g. budget share spent on transport) and concerning the allocation to goods and services for each purpose (e.g. riding a bicycle or driving a car).

This is worked out in the second and fourth account of Table 1. The second row registers the use of this household output and the second column how it is produced. Whereas the first row registers consumption expenditures excluding VAT etc., the second row contains the market values. The fourth account is discussed together with the ordinary production accounts.

3.2. Production account

The production account (#3) registers output as receipts of production activities, and intermediate consumption, fixed capital consumption, net

indirect taxes on production processes and net value added as their outlays. In addition to the output for sale, most production processes also generate less wanted 'by-products' in the form of substances which are dumped into the environment (including discarded capital goods). Usually, there is no direct relationship between the amount of a certain pollutant emitted by a certain firm and any monetary settlement. The statistical approach, i.e. a registration of the way things actually happen, as followed in this environmental module, requires that these flows are recorded accordingly. This means the registration of a monetary value in cell (3,16) equal to zero. In this way, the equality of row and column totals is also maintained.

However, at the same time the emission in physical terms is registered too. The essence of our accounting method lies in subsequent disaggregations, not only by production activity and type of agent emitted, but also into volumes and prices. Cell (3,16) is thus blown up into two separate submatrices, of which one is filled with volumes using units which are relevant to the type of emittant under consideration, and another is filled with prices. The latter matrix is actually not at all interesting in our *statistical* system, since it contains only zeros. However, the system as portrayed here serves, among other things, to provide a suitable framework for simulation experiments. A principal feature of those experiments should be to analyze the effects of replacing the zeros in the second submatrix above by various sets of negative (shadow) prices. Naturally, an essential consequence of replacing the zeros in row and column 16 by negative numbers is that all balancing items in Table 1 are adjusted as well, in order to maintain the equality of row and column totals. However, we view the estimation of these price sets as a distinct, second step.

The third column registers the inputs in production. Apart from intermediate inputs obtained from other firms, the environment delivers unpaid resources which are used up in production processes. These amounts appear in cell (16,3) in this matrix. It is probably most convenient to book this extraction of depletable resources net of the natural growth which may be expected under average circumstances. In this way the net depletion of fish etc. is recorded here.[8)] As in the case of emissions, their monetary value remains equal to zero and the balancing items are not affected, in the first instance.

The fourth account shows the transformation of household consumption expenditures into household output (i.e. the same products as were bought) and 'free' emissions. As soon as the disposals are valued, value added generated by these household waste production activities becomes negative. In the column of this account, net consumption taxes (like VAT) are added. The treatment of consumption taxes in this matrix serves to provide the data required for simulation experiments with (changes in) specific consumer subsidies or taxes. Those policy instruments may in fact aim at shifting expenditure patterns into a more environment-friendly direction. Moreover, our registration opens up the opportunity to re-route some compulsory fees paid by households. In the SNA, these are all seen as direct taxes (United Nations, 1968: 6.89-6.90 and 7.65). In this module, environmental levies can be rerouted to the consumption of a (subsidized) service, e.g. in the case of refuse collection, or to consumption taxes, if no actual service is provided.

3.3. Income distribution and use accounts

The balancing item of each production account equals net value added. Since net indirect taxes have already been subtracted, this item is recorded here at factor costs. Value added adds up to Net Domestic Product (NDP), and this is booked on the primary distribution of income account.[9)] In that account, institutional sectors receive several types of primary income: NDP at factor costs, property income received from other (domestic) institutional units, wages and property income received from abroad, and net indirect taxes, which accrue to the government.

In the columns of the income account, outlays on account of having incurred liabilities (i.e. payments of property 'income') are also settled for each sector. Moreover, wages and property income may have flown abroad. The residual equals Net National Income (NNI), at market prices. NNI reappears on the credit side of the secondary distribution of income account. Further, flows of transfers from and to other institutional units and the rest of the world are shown here. Transfer outlays are recorded on the debit side and the balance is known as Disposable Income (of each sector).

Above, it is explained that in the income accounts one should focus on the current effects. This implies that current effects of past disposals should be added, as a kind of (negatively valued) transfer from the past to the present (cell 6,17), and that future effects of present disposals and extraction should be singled out (in cell 7,6), because they entail a transfer from the present to the future. In this way, one arrives at an adjusted Disposable Income concept. To remain consistent, this procedure should also be followed for the 'ordinary', positive intertemporal transfers. This implies that consumption of fixed capital (production in the past, consumption now) is added (cell 6,3) and that the future effects of present investments (production now, but consumption in the future) are also shown separately (in cell 7,6). Notice that this adjusted, Gross Disposable Income concept is not necessarily equal to total consumption (i.e. total expenditures minus net saving) in the present period. One may still have decided to consume either more or less, or in other words, net saving is not necessarily equal to net investment. On the other hand, the gap between adjusted Disposable Income and adjusted consumption expenditures will typically be lower than the one between the original variables.

The way of recording described above presumes the possibility of monetary valuation directly from currently experienced nuisance. This is probably less complicated than a valuation of the total expected nuisance of current economic activities. In this respect, it is important to record the experienced nuisance in relation to a realistic reference period. The grief over the deteriorating water quality should refer to this year's change in water quality only. The implication is that once consumed nuisance will not re-appear again in a later year.

However, in an environmental module in physical terms it will still be difficult to separate changes in the environment induced by pollution in the previous years from those in the current year. Usually one only knows the total environmental burden which is currently 'consumed' (i.e. cell (16,7) + cell (17,7). In a few situations, such as the release of pollutants in the soil, it is possible to judge changes in the quality of groundwater as the effect of past disposals, while the current pollution is still under way in the soil above the aquifer. In many cases it is academic how large the future effects of present emissions will be. These future effects are merely incorporated in cell

(7,6) in order to show a consistent approach to an adjustment of the income measure.

Next, the use of income account records how Gross Disposable Income is 'spent'. The government and household groups have outlays on consumption, and the balance, (net) savings, is put on the capital account. In the case of corporations, all disposable income is saved. In addition, the environment absorbs some of the pollution by means of natural cleansing. Here this is shown in the row, with a positive sign of course. Finally, this column also contains items called 'current consumption of pollutants', originating from the environmental agents account, and naturally the absorption of the current effects of past disposals.

These cells may need some further explanation. Most environmental effects of economic actions have a capital character, in the sense that the impact is not, or not only, felt during the current period. A notable exception is noise, where at least part of the effect disappears when the noise stops. Noise can be seen as a particular kind of environmental 'agent', emitted by production and consumption processes (and included in column 16). If sufficient information on the identity of the victims were available, this noise could be recorded as a 'free' delivery in kind to them in (a detailed version of) the secondary distribution of income account -it is then included in 'current transfer flows'-, followed by its consumption in the use of income account (cell 16,7). Noise and other disposals with a non-capital character (e.g. stench) can thus be seen as an unappreciated gift from the producers to the consumers. If a shadow price were attached to this noise, GDP, NNI and Disposable Income and total consumption expenditures would be negatively affected. Clearly, net Saving and the balancing items further down the system would remain unaltered.

Another example of current consumption of pollutants refers to the current effects of past disposals. An adjusted concept of final expenditures would thus add the current consumption of past disposals to the ordinary final consumption as shown in the first two cells of this column. By now, it may be clear that our registration method ensures that current effects of past disposals would be taken into account in adjusted current income and final expenditures, but not in adjusted net product and saving measures. Reversely, the likely future

effects of present disposals and extraction would only appear in adjusted net product and saving measures, but not in the adjusted income and final expenditure aggregates.

In accordance with international practice, the income distribution and use accounts for the rest of the world (in Table 1 sometimes abbreviated as ROW) have been combined. The traditional registration method of national accounting systems is followed here: current receipts of the rest of the world appear in the row and current outlays in the column. The balance is transferred to the capital account of the rest of the world. The framework in Table 1 can easily accommodate physical flows of pollutants across the border. In row 8 various disposals, emitted abroad, float into the national territory (cell 8,16). Obviously, the shadow price of these imports is negative. This should then also be reflected as a (negative) monetary transfer from the rest of the world (cell 6,8). Reversely, pollutants are exported too, as shown in cell (16,8), and this is counterbalanced by a transfer to abroad (cell 8,6). Also the 'transit' of waste can be recorded in this way. The balance of these flows affects Disposable Income as well as all other balancing items further 'down' the system.

Subsequently, indirect taxes are specified in a separate account. The classification of this account will have to pay special attention to various types of environmental levies and subsidies. Above, it has already been explained that this account has been introduced in view of the necessity to distinguish between various tax bases (a product in general, a production process, or a specific expenditure category). This is reflected in the row of this account. In the column, all net indirect taxes are collected by the government.

3.4. Capital accounts

Because the registration of all effects on the balance sheets is an important objective of this matrix, the capital account is quite extensive. The first capital account describes the generation of net worth due to net savings and actual capital transfers received (from other institutional units and from abroad) minus capital transfers paid. Capital transfers include a (negative)

imputation for the flow of 'free' emissions with a capital character, from the dumping sector (in the column) to the stricken sector (in the row). If the latter cannot be identified, it may be assumed that the national or even global common heritage is affected, and this may or may not be combined with the government sector. Like ordinary saving, the net environmental effects of present activities which are not completely absorbed during the present period, are transferred to the changes in balance sheet accounts.

The second capital account (#12) records the use of funds for the accumulation of assets as defined in the standard accounts. The row adds depreciation, sales of land and other non-produced (non-financial, non-environmental) assets (like antiques), borrowing (i.e. incurring various types of liabilities), and not elsewhere classified increases in the volume and price of assets to the balancing item (exluding the environmental effects) of the first capital subaccount. Environmental effects are taken up again in the other changes in assets and changes in environmental assets accounts. All elements of this row taken together yield total funds available for gross worth accumulation, which is presented in the column. It consists of: gross capital formation, purchases of non-produced assets (from other institutions and from abroad), lending (net purchases of financial assets), not elsewhere classified decreases in the volume and price of (non-environmental) assets, net losses of environmental assets to natural causes, non-referable degradation of environmental assets, and the sum of the other changes in assets (here including 'other' changes in environmental assets)[10].

Net losses in environmental assets due to natural causes refers to capital gains and losses not resulting from human activities, or which are an unexpected result of human activities. It also includes net growth of uncultivated species (cf. note 8). The item non-referable degradation of environmental assets has been added because demonstrable deterioration of an ecosystem may not be attributable to *specific* economic activities or even to a specific period. Therefore, it has not been included in the environmental effects of any activity. Examples are the unexpected detection of polluted soil, or a reduction in the number of seals in the North Sea. However, this detoriation should be incorporated when assessing total changes in net worth. The solution is to put this damage in cell (17,12) for the moment, with a

counterbalancing value in the changes in net worth of ecosystems (cell 17,18)[11].

Similar accounts are drawn for the rest of the world. Foreign saving, which may bear a negative sign, agrees with the deficit on current account of the balance of payments of the national economy. The rest of the transactions are analogous to those for the domestic sectors.

3.5. Financial and other changes in assets accounts

Subsequently, the financial accounts (#14) are presented. These indicate which sector (including the rest of the world) has acquired which types of assets (and liabilities) during the reference period.

The next row and column of Table 1 contain the other changes in assets accounts. The character of this account differs from the others since it does not really relate to flows (consequences of actions), but to changes in states (other economic events). Not elsewhere classified changes in the volume and price of assets claimable by institutional sectors and the rest of the world are recorded here, as well as the balance of those adjustments, called changes in net worth due to other changes in assets. On the credit side, it concerns economic appearance of non-produced assets (e.g. discovery of subsoil resources), nominal holding gains of all kinds of assets etc. On the debit side, the destruction of assets by non-insurable risks, disappearance of non-produced assets, nominal holding losses etc. are recorded.

In the standard national accounts, changes in national worth due to environmental effects are already partially shown here, at least in theory. For instance, this concerns holding losses and destruction of capital goods which are demonstrably due to pollution. This implies that the losses exceed depreciation due to normal wear and tear. Other examples are: destruction of assets as a consequence of a nuclear disaster, or a fall in house prices when the enlargement of a nearby airport has been approved. In the environmental module, those losses are singled out and shown as a separate (negative) item, called referable damage due to environmental effects, in the column of this

account. In this way, the balance of this account does not change.

An interesting consequence of this registration method is that if a) the size of the damage to these non-environmental assets can be estimated from actual data, and b) this damage can be clearly attributed to a certain economic activity, this value can be re-routed within the statistical framework of the environmental module. It implies putting a negative value in e.g. cell (3,16), and concomitantly reducing NDP (cell 5,3), NNI (cell 6,5), Future Effects (cell 7,6), Net Saving (cell 10,7), Capital Transfer Flows (cell 10,10), Net Worth Changes due to Saving and Capital Transfers including Net Environmental Effects (cell 18,10), and Holding Losses and Destruction (cell 15,12). The same negative value then appears in cell (16,15), while Net Worth Changes due to Other Changes in Assets including Net Environmental Effects (cell 18,12) is increased with a positive amount. It can be easily checked that in this sequence all account numbers appear just as frequently in the rows as in the columns, except for accounts #12 and #18 where a negative adjustment is compensated by an equally large positive adjustment. This ensures that the equality of all row and column totals is maintained in this re-routing. Therefore, the consistency of the system is not affected by the adjustment of balancing items.

A similar procedure can be followed for the appraised value of the depletion of natural resources which are subject to ownership (e.g. standing wood, some mineral resources). Only in this case the capital loss is usually not thrust upon another party (cell 10,10 remains empty). Here, cell (16,3) contains a positive value followed by a subsequent reduction of all the balancing items through Net Worth Changes due to Saving and Capital Transfers including Net Environmental Effects (cell 18,10) and of Holding Losses in cell (15,12). Again, a negative value appears in cell (16,15) while Net Worth Changes due to Other Changes in Assets including Net Environmental Effects (cell 18,12) is increased, so that consistency is restored. Note that in this way a written off depletion of natural resources subject to ownership is recorded as other changes in (non-produced) assets and not as changes in environmental assets (ecosystems). This is in accordance with the treatment in the standard national accounts.

Environmental damage to the standard assets which is not referable to specific economic activities in the present period remains included in cell (15,12) (holding losses and destruction).

3.6. Environmental changes and changes in balance sheet accounts

Above, all interrelationships between the economy and the environment have been discussed where they actually occur. This means that now it suffices to sum up the balances which are implicit in the accounts 16 and 17. The sign of the variables in simulation experiments with non-zero prices is given in parentheses in front of each term. The balancing items, which are computed residually, have been printed in bold letters. We start with account #16:

1) for natural resources (e.g. fish, trees of various kinds, mineral deposits):
   (+)net 'free' extraction (cell 16,3) + (+)net losses due to natural causes (cell 16,12) + (-)referable damage of owned assets due to environmental effects (cell 16,15) =
   (+)net depletion of (not owned) environmental assets (cell 17,16)

2) for environmental agents without a capital character (e.g. noise):
   (-)'free' emissions by production (cell 3,16) + (-)'free' emissions by consumption (cell 4,16) =
   (-)current consumption of pollutants (cell 16,7)

3) for environmental agents with a capital character (e.g. acid rain, carbon dioxide, waste):
   (-)'free' emissions by production (cell 3,16) + (-)'free' emissions by consumption (cell 4,16) + (-)'free' emissions from abroad (cell 8,16) =
   (-)'free' emissions to abroad (cell 16,8) + (-)referable damage of owned assets due to environmental effects (cell 16,15) +
   (-)immission into ecosystems (cell 16,17)

It is clear that in simulation experiments all (shadow) values in the first equation are positive, with the exception of the referable damage, while those

in the last two are negative. Finally, the equalities underlying account 17 are given here:

4) for national ecosystems (e.g. air, seas etc.):
(-)current effects of past disposals (cell 6,17) + (+)natural cleansing (cell 7,17) + (-)immission (cell 16,17) =
(-)current effects of past disposals (cell 17,7) + (+)non-referable degradation (cell 17,12) + (+)net depletion (cell 17,16) + (-)changes in worth of ecosystems (cell 17,18)

Current effects of past disposals appear both on the left-hand side and on the right-hand side of this equation. For the rest, it can be seen that total worth of national ecosystems decreases in proportion to an absolute increase of all other elements in this equation, except natural cleansing. It goes without saying that filling in this equation is a lot easier said than done, if only because the total effect on an ecosystem may deviate from the sum of the individual effects.

At the bottom and at the right-hand side, changes in the balance sheets close the full sequence of accounts and balancing items. The totals of this account reflect in principle all changes in net worth, including changes in worth of ecosystems. Total changes in net worth should be added to the opening balance sheets to arrive at the closing balance sheets[12].

It is obvious that at present insufficient data are available to fill this matrix completely, even in physical terms. For that purpose, an abbreviated table focussing on a few environmental agents with a known origin and destination may be more practical at present. In such a matrix, some of the accounts could be deleted. This is illustrated in section 4.

3.7. Matrices behind the cells (16,17) and (17,16)

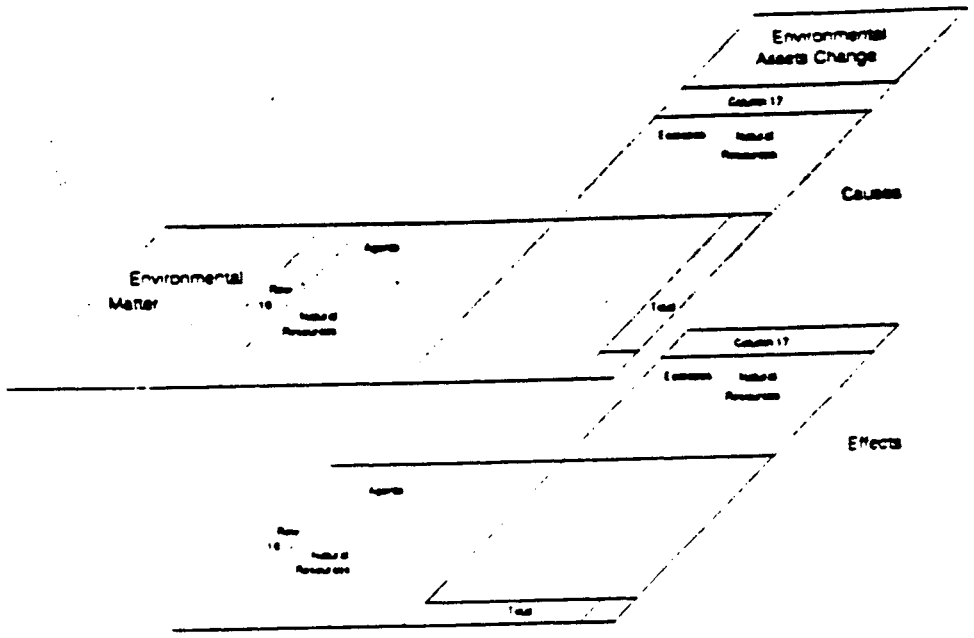
In the module, agents and the natural resources are described in column and row 16 as physical quantities. The agents and natural resources are included because the immission (cell 16,17) and net depletion (cell 17,16) cause changes

in the ecosytem. These effects are described in column and row 17 as changes in the quality of the ecosystem.

At the intersection of colums and rows 16 and 17 we find two very important cells in our module, because there the relation can be found between the immission c.q. net depletion on the one hand and the consequenses of this for the quality of the ecosystem on the other hand. The problem with these cells is however that depending on the side from which one looks at them, they have a different dimension: along column and row 16 physical changes and along column and row 17 ecological changes. In our module this has been solved by imputing two figures in the same cell: one gives the immission or net depletion (cause) and the other the effect on the ecosystem that is caused by this immission or net depletion (effects). So immediately the relation between these two is shown[13].

The two figures in the cells 16,17 and 17,16 are the summations of respectively all immissions c.q net depletions and all effects on the ecosystem. The detailed information behind these totals is given in matrices. The two matrices behind cell 16,17 (immission) have as column head environmental assets change with a subdivision into ecotopes[14] and natural resources (see figure 1). As row head these matrices have environmental matter which is subdivided into agents and natural resources. The two matrices behind cell 17,16 (net depletion) have as column head environmental matter and as row head environmental environmental assets change. Both column and row head of the matrices behind cel 17,16 are subdivided as those behind cell 16,17. Confrontation of both pairs of matrices gives a detailed picture of the relation between causes and effects of the use of the environment.
The construction of the detailed cause and effect matrices for immissions (16,17), which concerns mainly the top left side of the matrices (agent/ecotopes), will be a difficult task: all the agents must be spread over the ecotopes on which they cause effects and all the ecotopes that are influenced by agents, must be analysed to see which agents are causing these effects. These difficulties could be reduced by accepting some aggregation (e.g. to ecozones) or the introduction of dummy columns. Such additional columns can 'absorb' various agents which have a collective effect on one or more ecotopes.

Figure 1 : Matrices behind cell 16,17



The construction of the cause and effect matrices for net depletion (17,16) will be relatively easy because the relation between net depletion and changes in the stock of resources (bottom right side of the matrices) is a direct one. Only when the depletion effects also ecotopes (top right side of the matrices), e.g. damage to the vegetation by the production of groundwater, the same problems arise as with the construction of the cause and effect matrices for immisions.

4. An illustration of the Environmental Module in physical terms

By way of example, in Table 3 a condensed complete matrix is presented. With data on waste many entries in the matrix can be highlighted, so waste has been chosen as an illustrative example. The data are derived from official statistics for the Netherlands. Of course, tables can be presented covering various other agents (substances, species or physical changes) in water, soil and air in a similar way. Waste amounts are shown in brackets, and for the corresponding money amounts 0:0 has been added. In this way, it is still possible to add the data in the matrix to row and column totals.

Waste emission from production is shown in cell (3,16) of Table 3. Through a magnifying glass the physical content of this cell looks like Table 4. The

Table 4. 'Free' emission by production: Waste[1], 1988, part estimates (#3,16)

ISIC category	Total (mln kg)	by method of disposal: dumped	incinerated	other
Agriculture and fisheries[2]	17,500	17,500	-	-
Mining and quarrying	x[3]	x(98%)	x	x
INDUSTRY (incl. mining and publ.ut.)	7,240	6,240	530	470
among which				
Food, beverage and tobacco industry	2,200	2,070	70	70
Wood and furniture industry	130	70	60	0
Paper and paper products industry	370	280	x	x
Chemical industry, manufacture of artificial filaments and staple fibres	3,000	2,610	x	x
Manufacture of building material, earthenware, glass and glass products	510	480	10	20
Basic metal industry	410	270	10	120
Manufacture of metal products, machinery and transport equipment	160	110	20	20
Public utilities	x	x(94%)	x	x
Trade, hotels, restaurants, repair of consumer goods[4]	490	130	280	80
Transport, storage and communication[4]	2,140	50	90	2,000
Other services and n.e.c.[4,5]	75,660	74,070	920	670
Total	104,370	99,230	1,840	3,290

1) Excluding radioactive waste, but including earthy wastes such as polluted soil and sludges.
2) 1986 data.
3) 'x' means: confidential figure.
4) Hospital, office and shop waste: 1986 data; waste from shipping: 1985 data.
5) Also consists of the bulky wastes: dredging sludge (65,000), sewage sludge (2,860) and polluted soil (220).

figure of 104,370 mln kg in cell (3,16) is the total of Table 4. The second figure (1,200 mln kg) will be explained below. As mentioned before, also at a detailed level the environmental module uses standard matrices to allow for comparison with other cells. The "'free' emission from production" cell therefore is subdivided according to substances on the one hand and production activities on the other hand. For the time being, we have considered all waste to be of the same kind. Solid waste also encompasses more or less fluid wastes like sludges from sewage treatment plants which are dumped in the same way as solid waste (ECE, 1989).

Waste is probably the only substance on which statistics are available concerning the 'free' emission of capital goods. In theory it would be possible to account for all demolition waste in a separate cell in row 12, but as the data quality is rather poor we have included this amount (5,000 mln kg) in waste emission from production. The amount is attributed to the construction industry, as this is the activity which actually disposes of the waste.

In the same way also the 'free' emission from consumption (Table 5) is presented: this encompasses all waste delivered by households including small portions of chemical waste collected separately. The total of Table 5 reappears in cell (4,16) of Table 3.

Table 5. 'Free' emission by consumption: Waste, 1989 (#4,16)

	Total	by method of disposal: dumped	incinerated	other
	mln kg			
Households	5,310	2,180	2,290	890

The transport of waste across national boundaries is not yet incorporated in the Dutch statistics on waste. Some data are available on the import and export of hazardous waste, which have been entered in #8,16 and #16,8 (cf. Table 6). Transboundary flows in general constitute an area in which additional work has to be done in environment statistics. Because of this

Table 3. NAMEA: A National Accounting Matrix including an Environmental Account for Waste, fictitious data for the Netherlands based on 1988 estimates; National accounting data in mld gld, waste data in mln kg

ACCOUNT (Classification)			Goods and Services (Commodities)	Goods and Services (Consumption Purposes)	Production (Production Activities)	Production (Household (Waste) Prod.Activ.)	Income Distribution and Use a. National (Sectors) Primary Inc. Distribution	Income Distribution and Use a. National (Sectors) Secondary Inc Distribution	Income Distribution and Use a. National (Sectors) Use of Income	Income Distribution and Use b.Rest of the World (ROW)	Indirect Taxes (Tax/Subsidy Type)	Capital a.National (Sectors)	Capital b. ROW	Financial (Financial Assets)	Environmental Agents (Agents/ Resources)*)	Environmental Assets Change(Ecotapes/Res)	TOTAL
			1	2	3	4	5	6	7	8	9	10+12	11+13	14	16	17	
Goods and Services	Commodities	1	I&I-margins 0.0		Interm.Cons. 389.9	Hh.Cons.Exp. 233.0			GovernCons 71.2	Exports 246.4		GrossCapForm 90.1					CommUse(mp)B 1030.5
	Consumption Purposes	2							FinalHhCons 268.9								FinalInHhUse 268.9
Production	Production Activities	3	Output (basic prices) 801.2												'Free'EmisProd (106370, 1200) 0.0		TotOutput(bp 801.2
	Household (Waste)Prod	4		InHhOutpu 268.9											'Free'EmisCons (5510) 0.0		TotProdInHh 268.9
Income Distrib. & Use	Basic- ional (Sectors) PrimDist of Income	5			GDP (fc) 359.3	0.0	PropIncFlows 127.2			PrimInc frROW 32.0	NetIndTax 42.1						PrimIncOrig 560.6
		6			ConsFinedExp 48.0		NNI(mp) 399.3	CurrTrFlows 241.2		CurrTrfROW 10.4							SecIncOrig. 698.9
		7						GrDispInc&Fut 443.8									Total Inc. 443.8
	Rest of the World	8	Imports 227.1				PrimIncToROW 34.1	CurrTrToROW 15.9							'FreeEmisfrROW (90) 0.0		CurrPayteROW 275.1
Indirect Taxes (Tax/Subsidy Type)		9	NetGProdTax 2.1		NetOthTaxProd 4.0	NetConsTax 35.9				SpecTaxesExp ..		NetInv.Taxes ..					Net Ind.Tax 42.1
Capital	National (Sectors)	10 + 12							Gross Savings 103.7			CapTrFlows 92.5	CapTr.frROW 2.4	Borrowing 145.8			FinGr.Worth Accumulation 344.4
	Rest of the World (ROW)	11 + 13								BalofPayments CurrentAccdef -13.7		Cap.Tr. to ROW 1.1		NetLend to Abroad 15.8			Capital Paym.to ROW 2.4
Financial (FinancialAssets)		14										Lending 160.8					IncrInAssets 160.8
Environmental Agents (Agents /Resources)		16			'Free'Extract (4220) 0.0					'Free'Emis. to ROW (190) 0.0						Immission (105360), (1200) 0.0	Extraction & Dest. Emis. (109770,1200 0.0 + p.m.
Changes in Environmental Assets (Ecotapes/Res.)		17										ChWorthEcon (106560) 0.0			Net Depletion (..) 0.0		Depletion & Degradat. (106560) 0.0 +p.m.
TOTAL			Commodity Supply(mp)B 1030.5	InHouseh Supply 268.9	Input (basic prices) 801.2	Input into ProdWithinHh 268.9	Primary Income Dest 560.6	Secondary Income Dest 698.9	Total Expenditure 443.8	Current Rec from ROW 275.1	Net Ind Taxes 42.1	Gross Worth Acc 344.4	Capital Rec fromROW 2.4	Increase in Liabil 160.8	Origin of Extr.& Emis. (109770,1200) 0.0	Depletion &Degradat. (106560) 0.	

B) mp,excl.VAT = Valued at market prices, but excluding indirect taxes which apply only to some specific (final) demand categories (like VAT).

lack of data the closing balances of the matrix will present a preliminary figure for the moment.

Table 6. 'Free' emission from and to ROW: Waste[1], 1986 (#8,16 and #16,8)

	Total	by method of disposal: dumped	incinerated	other
	mln kg			
Emission from ROW	90	-	90	-
Emission to ROW	190	.	.	.

1) only hazardous waste, other waste unknown.

We have used the 'free' extraction entry in the matrix also to account for the part of the waste stream that re-enters the economic process. In column 16 of the matrix, total production of waste (excluding the amount recycled) is recorded. Part of this amount is used as input in processes aiming mainly to reduce the volume of waste (cf. Table 7). This waste can be considered to re-enter the economic system as (free) inputs for waste incineration plants and the like. And consequently it does not enter into the environment (account #17) in the form it was delivered to the waste collecting service.

Table 7 'Free' use of waste materials, 1988 (#16,3)

Environmental matter \ ISIC category	Waste incineration
	mln kg
Combustible waste	4,220

After being processed (burned) the remains of the waste (1,200 mln kg) show up in our matrix in cell 3,16 as the 'free' emission of waste processing services (cf. Table 8). Of course, the same rerouting should be carried out for waste which is not dumped or incinerated, but treated otherwise. To keep Table 3 easy to understand this has not been done. Moreover, much of the waste removed for composting in the Netherlands is usually dumped near the

composting site. One could also think of re-routing the huge volumes of polluted soil and dredging sludge which are not cleaned up or incinerated, but deposited at another site where they do not constitute an immediate danger to public health or ecosystems. At their new destinations (mostly special depots) they form the basis of new ecosystems, although of less quality. Because the only thing that happens is their transfer from one ecosystem to another and because this kind of waste is very voluminous, a separation from other kinds of waste seems desirable. One of the advantages of the matrix approach is that all these special situations can be recorded in the system by the addition of a few extra lines.

Table 8. Results of waste incineration, 1988; tentative data based on figures of public incineration plants (#3,16)

		mln kg	
Resulting slags and fly ash (-waste)		1,200	#3,16
Air emissions:	sulphur dioxide	2.7	
	nitrogen oxides	6.1	
	carbon monoxide	3.2	appears in matrix
	aerosols	3.9	for AIR
	volatile organic compounds	1.3	
	hydrogen fluoride	0.08	

The most important balancing item in the waste example is the immission, the total load on the environment within the country's borders (#16,17); for a calculation see Table 9. This item finally influences the state of the environment, which is registered in cell (17,12).

Table 9. Immission into the Netherlands, 1988 (#16,17)

	mln kg
'Free' emission by production	+105,570
(of which waste incineration residues	+ 1,200)
'Free' emission by consumption	+ 5,310
'Free' emission from abroad	+ 90
'Free' emission to abroad	- 190
'Free' extraction - incinerated	- 4,220
Immission	106,560

Waste disposal, or the emission of pollutants in general, is only one aspect of the burden on the environment by human activities. Another important aspect is the extraction of resources. These processes are of course related: for instance, production of packaging materials made of paper and cardboard requires wood, energy and water, and it results in packaging waste. Ideally, data on the input from the environment as well as on the output into the environment of production processes should be shown simultaneously. In practice one may choose to combine all 'free' extraction tables in a separate section. Table 10 can be considered as a concise example of the contents of cell (16,3).

Table 10. 'Free' extraction of water and natural gas, 1986 (#16,3; transposed)

	Groundwater	Surface water	Gas
ISIC-category	mln m^3		
Agriculture and fisheries	.[1]	.	
Mining and quarrying	x	x	74,028
INDUSTRY (incl. mining)	318	3,800	
of which			
Food, beverage and tobacco industry	119	133	
Textile industry	4	4	
Leather and rubber industry	13	3	
Paper and paper products industry	37	38	
Chemical industry, manufacture of artificial filaments and staple fibres	58	3,322	
Manufacture of building material, earthenware, glass and glass products	11	6	
Basic metal industry	50	6	
Manufacture of metal products machinery and transport equipment	10	237	
Other manufacturing industries	x	x	
Electric power plants	1	9,200	
Public waterworks	667	367	
Total[2]	986	13,367	74,028

1) 'x' means confidential figure; "." stands for 'data not available'.
2) For comparison: the yearly net natural inflow of water by precipitation in the Netherlands amounts to 5 786 mln m^3.

As stated above: it is very often impossible to relate changes in the environment to individual influencing factors. The state of the environment is the outcome of a) immission (of waste materials), b) depletion of

resources and c) non-referable degradation which may be a result from a) or b). As is the case with the extraction of resources, the changes in the worth of ecosystems also constitute a separate chapter in the environmental module. In order to be able to account for all non-referable degradation of the environment we have included cell (17,12) in Table 1. In the abbreviated matrix of Table 3 this cell is included in the change in worth of ecosystems. Table 11 provides an example of its contents. More examples can be found in the chapter on the natural environment in CBS (1990) and other national environmental compendia. An enlargement of cell (17,12) should give an overview of all non-referable changes in the environment: from changes in air quality to the disappearence of species.

Table 11. Non-referable degradation: Bird oil victims, washed onto the coast (#17,12 in Table 1)[1]

	All species	among which			
		divers *Gavia spp.*	Fulmar *Fulmarus glacialis*	scoters *Melitta spp.*	Larus-gulls *Larus spp.*
Birds found dead on coast					
Total 1969-1985	95,986	722	2,090	11,555	18,616
of which examined for oil pollution	71,942	615	1,627	10,963	12,297
	%				
of which oiled	68.4	92.0	68.0	95.4	43.4
Oil victims [2]	number /100 km beach				
1965/1969	552.5	8.6	2.1	269.8	39.1
1970/1974	220.1	7.1	1	39.9	53.3
1975/1979	579.2	6.3	4	34.6	109.1
1980/1984	659.4	3.1	10.9	23.6	110.1
1985/1988	911.8	4.9	9.3	35.5	106.8

1) Of course data should refer to 1988 only for proper inclusion in Table 1.
2) Found dead or alive.

The physical data, as presented in this section, can be linked with SNA-tables on production, consumption etc. The picture is not complete, however, without data on the expenses for environmental control. This is the subject of the next section.

5. Monetary flows specific to the Environment Module.

5.1. Introduction

Several transactions registered in the core of the SNA are related to the environmental problem. These monetary flows can be separated into outlays for environmental *control*, for the *compensation* of the loss of environmental functions and for the *repair* of environmental damage. The way these outlays are treated in the SNA depends on the kind of activity and sector. To show these outlays[15)] the usual concept of production has been expanded and the system of make and use tables, which is part of Table 1, is extended into a framework with which these outlays can be easily analysed. In this section the make and use system for environmental outlays is demonstrated. Here only figures are given for the outlays to diminish environmental pollution, because this part of the environmental problem is best documented.

5.2. Environmental control

Measures to prevent or diminish environmental pollution or the depletion of scarce natural resources or measures related to land-use problems are called environmental control. In this module environmental control is taken into account only when it causes extra costs to the economy. Measures that pay for themselves by way of savings on inputs or by selling by-products are not shown separately.

5.2.1 Internal and external environmental control

Environmental protection measures can be divided into internal and external measures. Environmental control is called internal when it aims to reduce the environmental pollution caused by the production establishment or the household itself. In this module internal environmental control is seen as a consumption by the establishment of its own production. So the production boundary as used in the SNA had to be extended to include a specific within-unit transaction. When environmental control is done to diminish the pollution caused by another unit, it is called external.

Although many firms recommend their products as "environmental", external environmental control in this module is performed only by enterprises classified in division 90 of ISIC or NACE[16] (Sewage and refuse disposal, sanitation and similar activities) or by the government (division 75). The "environmental" products of establishments outside this division are considered as inputs into internal environmental control.
The reason for this way of booking is that the classification of establishments in ISIC and NACE is based on the character of the products and not on the use of them. For example, there is no technical reason to divide the services of private R&D enterprises into environmental and non-environmental, so all these enterprises are classified in division 74.2.
According to CPC-rules part of the goods and services that are used for internal environmental control cannot be classified as environmental goods and services. These goods and services are environmental by purpose of use and not by character. The use of these products is shown seperately in the module.

5.2.2 Recycling

A special form of environmental control is the recycling of used products. Often this is a technical or costs-saving part of production and does not belong to environmental control. Only when recycling takes place with the intention to decrease environmental pollution or the use of natural resources it is included in this module.

Like other environmental control, environmental recycling can be divided into internal and external recycling. When it takes place within the enterprise the extra costs are shown in Table 12 under the internal costs of environmental control. When environmental recycling takes place as an external activity it could be done by specialist enterprises which are classified in division 37 of ISIC and NACE (Recycling)[17]. These enterprises mostly recover materials for economic reasons. The environmental recycling they perform cannot be financed completely by selling the regained materials. The additional costs are financed by the unit which wants to dispose of the recycled products or by subsidies from the government. These former payments are in exchange for the delivery of a service by the recycling establishments

to the disposing units, and thus entered in Table 12 (#1.3).

5.2.3 Make and use table

Using the principles mentioned above, Table 12 was constructed. This table is directly related to Tables 1 and 3, but contains more detail, for instance regarding the production of internal and external environmental control (subcolumns in column 1). In column 3 an extra sub-column has been added to show the input structure of the production of external environmental control. In row 1 extra subrows have been introduced to show the use of internal and external environmental control and the use of other products for environmental purposes. A further extension can be made when also other categories of products are used for environmental purposes. As mentioned before the totals in #3.1 and #1.3 differ from those in the standard SNA because production and intermediate consumption have been enlarged with internal environmental control, which is seen here as being produced and consumed by the same establishment.

From Table 12 it appears that in 1988 environmental control has been produced with a value of 10.9 mld gld. Also the origin of this production is shown (column 1). At the moment information on the part of environmental control which has been imported directly is not yet available. Row 1 shows that internal environmental control was used for intermediate consumption by establishments (by definition) and how external environmental control was used both by establishments (0.2 mld gld), households (1.4 mld gld) and the government (4 mld gld). From row 1 it also becomes clear that 1.1 mld gld of manufacturing products and 2.1 mld gld of construction products have been used for environmental purposes. No information is available on the export of environmental control.

From column 3 it becomes clear that for external environmental control 1.5 mld gld has been paid in salaries and 1.8 mld gld in depreciation.

The costs which have been made by producers of internal environmental control (5.3 mld gld) may have been passed on to the users of their products. These effects may be calculated with the help of input-output analysis.

Table 12. Environmental Control Activities in a System of Make and Use Tables, 1988 (mld gld; estimates)

			Goods & Services			Production			Income distribution & use		Gross fixed Capital Formation	TOTAL
				o.w. environmental control		Production activities	o.w. environmental services	Households	Government	Rest of the World		
				internal	external							
			(1)			(3)		(4)	(7)	(8)	(10+12)	
Goods & Services	(1)	Agriculture, hunting, forestry, fishing				18.0				14.8	-0.3	31.7
		Mining and quarrying				3.0				8.0	0.3	11.3
		Manufacturing products for environmental purposes						0.2			0.9	1.1
		Manufacturing n.e.c.				187.4	1.3	123.0		169.1	7.1	486.6
		Public utilities				12.3	0.1			0.0	1.5	13.8
		Construction products for environmental purposes									2.1	2.1
		Construction n.e.c.				37.1	0.3			1.1	56.9	96.7
		Trade, hotels, restaurants, cafés, repair of consumer goods				37.2		29.5		24.4	10.6	101.5
		Transport, storage and communications				16.2		26.0		20.6	0.7	63.5
		Internal environmental controls				5.3						5.3
		External environmental controls				0.2		1.4	4.0			5.6
		Other services and n.e.c.				73.2		52.9	67.2	9.1	10.9	213.3
		Total				389.9	1.7	233.0	71.2	246.4	90.1	1030.5
Production activities	(3)	Agriculture, hunting, forestry, fishing	36.7	0.6								36.7
		Mining and quarrying	19.6	0.2								19.6
		Recycling	-		-							-
		Manufacturing n.e.c.	270.3	1.4								270.3
		Public utilities	21.5	0.5								21.5
		Construction	61.0	0.6								61.0
		Trade, hotels, restaurants, cafés, repair of consumer goods	108.2	1.8								108.2
		Transport, storage and communications	46.0	0.2								46.0
		Environmental Services by goverment	5.3		5.3							5.3
		Environmental Services by division 90	0.3		0.3							0.3
		Other services and n.e.c.	232.2	0.1								232.2
		Total	801.2	5.3	5.6							801.2
Primary inputs	(5)	Salaries and social charges				239.1	1.5					
		Operating surplus				120.2	0.6					
		Total				359.3	2.1					
Income distribution	(6)	Consumption of fixed capital				48.0	1.8					
Rest of the world	(8)	Imports	227.1	.	.							
Indirect taxes	(9)	Net Gross production Tax	2.1	.	.	4.0	.					
TOTAL			1030.5	5.3	5.6	801.2	5.6					

Since internal environmental control amounts only to about .5 % of total production, the effects will be minimal.

5.3. Compensating and repairing environmental damage

When environmental damage is not prevented it will lead to a loss of environmental or other assets. Sometimes the loss of an environmental asset is such that it is compensated for by extra activities (e.g. the extra treatment of polluted groundwater that is used for the production of drinking water). In other cases the loss can be partly repaired (e.g. monuments). Common to these losses is that they cause additional costs. These expenses are already included in the core of the SNA and will be shown explicitely in separate tables in this module. This is not elaborated for the moment.

As both the losses of assets and the outlays for compensation and repair are part of this module, attention should be given to prevent double counting. Therefore it is important to discern when the losses become manifest and if and how they have been valued: inclusive or exclusive of the costs of repair or compensation.

Not explicitely shown in the module are the losses of present production due to environmental pollution. This financial damage manifests itselve in lower production figures in the outcomes of the national accounts. A separate presentation is difficult, however, because often these losses can only be reasoned and it is difficult to measure them.

6. Supplementing the National Accounts

6.1. Indices

An essential feature of this module is the recording of environmental figures in relation to the outcomes of the national accounts. In this way a detailed picture arises of the consequences of production and consumption for the environment and reversely of the effects of environmental degradation on production and consumption. These consequences, like the consequences on other fields of interest, manifest themselves in so many ways that it may be difficult to draw a general conclusion. Therefore aggregation could be desirable.

Aggregation of physical data about the environment is often difficult because many different aspects of the environment must be put together. A first step to facilitate the interpretation of the data is to aggregate where ever the character of the data permits it or to select a small number of representive indices. So the aggregates of the national accounts can be supplemented with relatively few indices on the quality of the environment. Such a limited set of indices together with indices from the SNA and about other field of interest can give an impression of the direction society is heading.

6.2. An Adjusted National Income

Although the environmental indices that supplement the figures of the national account can give a good image of the consequenses of production and consumption, one may even want to bring all this information together in one figure. A reason for this could be the wish to construct an indicator that for a wide public is simple to interpret. A way to achieve this could be the construction of an adjusted national income that serves as an indicator of sustainable economic development (Daly, 1989).

Starting from the conventional national accounts, in our module an environmentally adjusted national income could be found by substracting the

consumption of environmental capital leading to substantial future costs. These costs are not sufficiently taken into account in the conventional national accounts, which reflect the actual exchange values which prevailed in a particular institutional setting.

The costs of consuming environmental assets consists of the costs caused by the depletion of natural resources and the degradation of the environment. Natural resources are mostly valued at exploration costs whereby the depletion of stocks has not been taken into account. For the degradation of the environment no price is charged because it is seen as a public property the use of which is free. The result of this neglection is a higher national income. The neglection of these costs could be corrected by putting a value on the depleted natural resources that reflects the (future) scarcity. For the costs of the environmental pollution that is generated by production and consumption the correction should be made by putting a value on environmental degradation.

The construction of an adjusted national income will be a proces of extensive computation involving many assumptions and, depending on the method, more or less intricate modelling for which this module supports the statistical information and a framework for presentation. The adjustment however only takes into account environmental aspects of production and consumption so that the constructed indicator does not become an index of human welfare. Nevertheless its changes over time might be juxtaposed with the conventional set of macro-economic aggregates, which remain intact, so that a proper evaluation can be made.

6.3. Defensive expenditures

Defensive expenditures are those expenditures which are booked in the SNA as final outlays while they are in fact necessairy to compensate negative influences of production and consumption (Kutznets, 1971)[18] . Therefore these outlays could also be seen as costs of production. The conventional way of booking leads to a higher volume change of the national income. In order to remove this anomaly it is sometimes suggested to subtract the defensive

expenditures from the national income. This however creates a false image about the activity level in the economy.

In our module the problem of defensive expenditure does not arise since the generation of agents and the damage to the environment is booked as a negative attribute to the production and consumption sectors. The treatment of these agents by the governmental sector, and the compensation or repair of the losses results in an enlargement of environmental functions so the outlays for this can still be booked as final consumption.

Notes

1) Consult Keuning and de Ruijter (1988) for general issues of classification.

2) For an introduction to SAMs see: Pyatt and Round (1986); Alarcon, van Heemst, Keuning, de Ruijter and Vos (1991). Treating the environment in a SAM framework has also been proposed by Barker (1990).

3) When compared with the proposals for the next SNA (Intersecretariat Working Group on National Accounts, 1990) some of the (sub)accounts have been (de)consolidated here, emphasizing those accounts which are of particular importance to the environmental module. For instance, the matrix contains neither a Redistribution of income in kind account nor subdivisions of the Income distribution and use account, and of the Other changes in assets account. Moreover, the Capital account has been subdivided to facilitate the link with the Changes in balance sheet accounts. Finally, Opening and Closing balance sheets have been deleted. Yet, all changes in the balance sheets are incorporated in this table.

4) Similar to the conventional commodities, the 'value' of environmental matter may depend on its location. For this reason, an ideal accounting system might distinguish both matter and ecosystem at the same time. However, the number of subgroups would then easily get out of hand. Besides, a lot of information is only available for the country as a whole.

5) Apart from the adjustments mentioned in Table 2 other adjustments can be made. In studies in which global effects are analysed, the environmental burden embodied in imports and exports may also be taken into account.

6) Since final consumption expenditures of government and private non-profit institutions consist only of goods and services they produce themselves, all their 'free' emissions can be ascribed to a (conventional) production process.

7) Note that this registration method, proposed here for the environmental module, can also be applied if one wanted to expand the production boundary by including unpaid household services. In that case, inputs and outputs of these household production processes would be different, and an imputation for the unpaid labour input would lead to a (substantial) increase in GDP. Similarly, the services provided by household durables could be incorporated, and then consumption of fixed capital would also apply to the within-household production activities in column 4.

8) If total extraction is surpassed by expected natural growth, a negative number should not be recorded here. Instead, this net expected positive change should be subtracted from net losses due to natural causes, as recorded in the capital accounts (discussed below).

9) In order to restrict the proliferation of accounts, a subdivision of the primary distribution of income account into an income generation account and an income appropriation account is not shown here. However, if one wants to take into account the macro-economic policy objective of 'full employment' or if this framework is to serve as a basis for a full-fledged (general equilibrium) modelling exercise, then this subdivision is indispensable. It will allow for the modelling of factor markets as a link between production and institutional incomes (cf. Keuning [1991]).

10 Strictly speaking, we should have included as well a seperate 'other changes in environmental assets' account, as a supplement to this type of account for the conventional assets. In that case, the present cells #16,12 and #17,12 would have appeared in the column of that account and the row of the account would have put the sum of those items in the other accumulation account (#12). Such a more refined registration method would however not deviate much from the present one.

11 It is possible that the non-referable degradation refers to a specific type of matter (in our example: seals). In that case this may be booked first in #16,12 (+), than in #16,17 (-), and finally in the cells #17,18 (-) and #18,12 (-).

12 If one wished to incorporate not only the changes in balance sheets, but also the balance sheets proper within this matrix, this can easily be achieved by adding another row and column (#19). The elements in the present column #18 then shift one place to the right, and total changes in net worth are then shown in cell (19,18). The last diagonal cell (19,19) then contains the opening stocks and the totals of row and column #19 present the closing stocks.

13 In the final stage with a complete monetarisation there will be only one figure, because the value of the immision and net depletion and of the effect of it on the ecosystem are the same: one is the result of the other.

14 Ecotopes are the smallest possible areal unities within a landscape with a characteristic homogenity. They can be combined to form larger units (ecozones) depending on the question under consideration.

15 Sometimes these outlays are difficult to distinguish, especially in case of prevention when changes in production processes for environmental reasons must be separated from cost-saving or other changes.

16 Division 90 of ISIC and NACE encompasses the collection and treatment of waste and waste water. We suggest that the cleaning up of polluted soil also be included when this is done by specialized enterprises. This activity can be seen as collection and treatment of waste or waste water to prevent a further spread into the environment.
Although a subdivision of division 90 is given neither in ISIC nor in NACE, we suggest a subdivision into the following five categories:
90001 Collection of waste water
90002 Treatment of waste water
90003 Collection of solid and hazardous waste
90004 Treatment of solid and hazardous waste
90005 Cleaning of polluted soil
Categories for the other aspects of environmental control, like diminishing air pollution or noise, are not necessary because these activities can be executed near the source of the pollution only

(internal environmental control) and not be contracted out.

17 From the description of division 37 it becomes clear that only part of the external recycling is to be classified in this division, because often recycling of characteristic products is to be classified in the division of origin. So in the case of recycling also establishments classified outside division 37 could produce external environmental control.

18 In addition to the outlays on behalve of the environment, defensive expenditures could also be distinguished on fields like health care and guarding (Leipert, 1987).

References

Alarcon, J.V., J. van Heemst, S.J. Keuning, W. de Ruijter and R. Vos, 1990, The Social Accounting Framework for Development: Concepts, Construction and Applications (Gower, Aldershot).

Barker, T., 1990, The Treatment of the Environment in a SAM for Europe. Paper presented at the Conference A SAM for Europe, Valencia, Spain.

Blades, D.W., 1989, Measuring Pollution within the Framework of the National Accounts. In: Ahmad Y.J., S. El Serafy, and E. Lutz (eds.), Environmental Accounting for Sustainable Development (UNEP/Worldbank, Washington D.C.).

CBS, 1990, Environmental Statistics of the Netherlands 1990 (Netherlands Central Bureau of Statistics, 's Gravenhage).

CBS, 1991, Kosten en financiering van het milieubeheer 1987-1988 (Netherlands Central Bureau of Statistics, 's Gravenhage).

Daly, H.E. 1989, Toward a Measure of Sustainable Social Net National Product. In: Ahmad Y.J., S. El Serafy, and E. Lutz (eds.), Environmental Accounting for Sustainable Development (UNEP/Worldbank, Washington D.C.).

ECE, 1989, Draft ECE Standard Statistical Classification of Wastes. (United Nations Statistical Commission and Economic Commission for Europe, Geneva).

Gorter, C. and P. van der Laan, 1989, An economic core system and the socio-economic accounts module for the Netherlands. Paper for the twenty-first General Conference of the International Association for Research in Income and Wealth, Lahnstein, West Germany.

Harrison, A., 1990, Major Changes Proposed for the Revised SNA: An Overview. The Review of Income and Wealth, Series 36, pp. 335-53.

Hueting, R., 1989, Correcting National Income for Environmental Losses:

Toward a Practical Solution. In: Ahmad Y.J., S. El Serafy, and E. Lutz (eds.), Environmental Accounting for Sustainable Development (UNEP/Worldbank, Washington D.C.).

Inter-Secretariat Working Group on National Accounts, 1990, System of National Accounts (SNA) Review Issues. Discussion Paper for 1990 Regional Commissions Meetings on SNA (United Nations Statistical Office, New York).

Keuning, S.J., 1991, A Proposal for a SAM which fits into the next System of National Accounts. Economic Systems Research, Volume 3, Number 3, pp. 233-248.

Keuning, S.J. and W.A. de Ruijter, 1988, Guidelines to the Construction of a Social Accounting Matrix. The Review of Income and Wealth, Series 34, pp. 71-101.

Keuning, S.J. and E. Thorbecke, 1989, The Impact of Budget Retrenchment on Income Distribution in Indonesia: a Social Accounting Matrix Application. OECD Development Centre Technical Paper, No. 3 (Organization for Economic Cooperation and Development, Paris).

Kuznets, S., 1971, Economic Growth of Nations: Total Output and Production Structure. (Harvard University Press, Cambridge, Massachusets).

Leipert, C., 1987, Folgekosten des Wirtschaftsprozesses und Volkswirtschäftliche Gesamtrechnung (International Institut für Umwelt und Gesellschaft, Berlin).

OECD, 1991, Environmental Indicators, Progress report. Environment Committee Meeting at Ministerial level, 30th-31st January, Background Paper no. 4 (OECD, Paris).

Peskin H.M. and E. Lutz, 1990, A survey of Resource and Environmental Accounting in Industrialized Countries. The World Bank Environment Working Paper No.37 (Worldbank, Washington D.C.).

Pyatt, G., 1988, A SAM Approach to Modelling. Journal of Policy Modelling, Volume 10, Number 3, pp. 327-52.

Pyatt, G. and J. Round, 1985, Social Accounting Matrices: A Basis for Planning (Worldbank, Washington D.C.).

Schäfer, D. and C. Stahmer, 1989, Input-Output Model for the Analysis of Environmental Protection Activities. Economic Systems Research, Vol. 1, No. 2, pp. 203-28.

United Nations, 1968, A System of National Accounts. Studies in Methods, Series F, No. 2, Rev. 3 (United Nations, New York).

United Nations, 1990, SNA Handbook on Integrated Environmental and Economic Accounting. Preliminary draft of part I: General Concepts (United Nations, New York).

Vanoli, A., 1986, Sur la structure générale du SCN à partir de l'expérience du système élargi du Comptabilité nationale française. The Review of Income and Wealth, Series 32, nr 2.

VROM, 1990, Kosten van milieubeheer, 1985-2010. (Ministery of Physical Planning and Environment, 's Gravenhage).

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National Accounts Occasional Papers

NA/01 **Flexibility in the system of National Accounts**, Van Eck, R., C.N. Gorter and H.K. van Tuinen (1983).
This paper sets out some of the main ideas of what gradually developed into the Dutch view on the fourth revision of the SNA. In particular it focuses on the validity and even desirability of the inclusion of a number of carefully chosen alternative definitions in the "Blue Book", and the organization of a flexible system starting from a core that is easier to understand than the 1968 SNA.

NA/02 **The unobserved economy and the National Accounts in the Netherlands, a sensitivity analysis**, Broesterhuizen, G.A.A.M. (1983).
This paper studies the influence of fraud on macro-economic statistics, especially GDP. The term "fraud" is used as meaning unreporting or underreporting income (e.g. to the tax authorities). The conclusion of the analysis of growth figures is that a bias in the growth of GDP of more than 0.5% is very unlikely.

NA/03 **Secondary activities and the National Accounts: Aspecccts of the Dutch measurement practice and its effects on the unofficial economy**, Van Eck, R. (1985).
In the process of estimating national product and other variables in the National Accounts a number of methods is used to obtain initial estimates for each economic activity. These methods are described and for each method various possibilities for distortion are considered.

NA/04 **Comparability of input-output tables in time**, Al, P.G. and G.A.A.M. Broesterhuizen (1985).
It is argued that the comparability in time of statistics, and input-output tables in particular, can be filled in in various ways. The way in which it is filled depends on the structure and object of the statistics concerned. In this respect it is important to differentiate between coordinated input-output tables, in which groups of units (industries) are divided into rows and columns, and analytical input-output tables, in which the rows and columns refer to homogeneous activities.

NA/05 **The use of chain indices for deflating the National Accounts**, Al, P.G., B.M. Balk, S. de Boer and G.P. den Bakker (1985).
This paper is devoted to the problem of deflating National Accounts and input-output tables. This problem is approached from the theoretical as well as from the practical side. Although the theoretical argument favors the use of chained Vartia-I indices, the current practice of compilating National Accounts restricts to using chained Paasche and Laspeyres indices. Various possible objections to the use of chained indices are discussed and rejected.

NA/06 **Revision of the system of National Accounts: the case for flexibility**, Van Bochove, C.A. and H.K. van Tuinen (1985).
It is argued that the structure of the SNA should be made more flexible. This can be achieved by means of a system of a general purpose core supplemented with special modules. This core is a fully fledged, detailed system of National Accounts with a greater institutional content than the present SNA and a more elaborate description of the economy at the meso-level. The modules are more analytic and reflect special purposes and specific theoretical views.

NA/07 **Integration of input-output tables and sector accounts; a possible solution**, Van den Bos, C. (1985).
The establishment-enterprise problem is tackled by taking the institutional sectors to which the establishments belong into account during the construction of input-output tables. The extra burden on the construction of input-output tables resulting from this approach is examined for the Dutch situation. An adapted sectoring of institutional units is proposed for the construction of input-output tables.

NA/08 **A note on Dutch National Accounting data 1900-1984**, Van Bochove, C.A. (1985).
This note provides a brief survey of Dutch national accounting data for 1900-1984, concentrating on national income. It indicates where these data can be found and what the major discontinuities are. The note concludes that estimates of the level of national income may contain inaccuracies; that its growth rate is measured accurately for the period since 1948; and that the real income growth rate series for 1900-1984 may contain a systematic bias.

NA/09 **The structure of the next SNA: review of the basic options**, Van Bochove, C.A. and A.M. Bloem (1985).
There are two basic issues with respect to the structure of the next version of the UN System of National Accounts. The first is its 'size': reviewing this issue, it can be concluded that the next SNA should contain an integrated meso-economic statistical system. It is essential that the next SNA contains an institutional system without the imputations and attributions that pollute the present SNA. This can be achieved by distinguishing, in the central system of the next SNA, a core (the institutional system), a standard module for non-market production and a standard module describing attributed income and consumption of the household sector.

NA/10 **Dual sectoring in National Accounts**, Al, P.G. (1985).
Following a conceptual explanation of dual sectoring, an outline is given of a statistical system with complete dual sectoring in which the linkages are also defined and worked out. It is shown that the SNA 1968 is incomplete and obscure with respect to the links between the two sub-processes.

NA/11 **Backward and forward linkages with an application to the Dutch agro-industrial complex**, Harthoorn, R. (1985).
Some industries induce production in other industries. An elegant method is developed for calculating forward and backward linkages avoiding double counting. For 1981 these methods have been applied to determine the influence of Dutch agriculture in the Dutch economy in terms of value added and labour force.

NA/12 **Production chains**, Harthoorn, R. (1986).
This paper introduces the notion of production chains as a measure of the hierarchy of industries in the production process. Production chains are sequences of transformation of products by successive industries. It is possible to calculate forward transformations as well as backward ones.

NA/13 **The simultaneous compilation of current price and deflated input-output tables**, De Boer, S. and G.A.A.M. Broesterhuizen (1986).
A few years ago the method of compiling input-output tables underwent in the Netherlands an essential revision. The most significant improvement is that during the entire statistical process, from the processing and analysis of the basic data up to and including the phase of balancing the tables, data in current prices and deflated data are obtained simultaneously and in consistency with each other.

NA/14 **A proposal for the synoptic structure of the next SNA**, Al, P.G. and C.A. van Bochove (1986).

NA/15 **Features of the hidden economy in the Netherlands**, Van Eck, R. and B. Kazemier (1986).
This paper presents survey results on the size and structure of the hidden labour market in the Netherlands.

NA/16 **Uncovering hidden income distributions: the Dutch approach**, Van Bochove, C.A. (1987).

NA/17 **Main national accounting series 1900-1986**, Van Bochove, C.A. and T.A. Huitker (1987).
The main national accounting series for the Netherlands, 1900-1986, are provided, along with a brief explanation.

NA/18 **The Dutch economy, 1921-1939 and 1969-1985. A comparison based on revised macro-economic data for the interwar period**, Den Bakker, G.P., T.A. Huitker and C.A. van Bochove (1987).
A set of macro-economic time series for the Netherlands 1921-1939 is presented. The new series differ considerably from the data that had been published before. They are also more comprehensive, more detailed, and conceptually consistent with the modern National Accounts. The macro-economic developments that are shown by the new series are discussed. It turns out that the traditional economic-historical view of the Dutch economy has to be reversed.

NA/19 **Constant wealth national income: accounting for war damage with an application to the Netherlands, 1940-1945**, Van Bochove, C.A. and W. van Sorge (1987).

NA/20 **The micro-meso-macro linkage for business in an SNA-compatible system of economic statistics**, Van Bochove, C.A. (1987).

NA/21 **Micro-macro link for government**, Bloem, A.M. (1987).
This paper describes the way the link between the statistics on government finance and national accounts is provided for in the Dutch government finance statistics.

NA/22 **Some extensions of the static open Leontief model**, Harthoorn, R.(1987).
The results of input-output analysis are invariant for a transformation of the system of units. Such transformation can be used to derive the Leontief price model, for forecasting input-output tables and for the calculation of cumulative factor costs. Finally the series expansion of the Leontief inverse is used to describe how certain economic processes are spread out over time.

NA/23 **Compilation of household sector accounts in the Netherlands National Accounts**, Van der Laan, P. (1987).
This paper provides a concise description of the way in which household sector accounts are compiled within the Netherlands National Accounts. Special attention is paid to differences with the recommendations in the United Nations System of National Accounts (SNA).

NA/24 **On the adjustment of tables with Lagrange multipliers**, Harthoorn, R. and J. van Dalen (1987).
An efficient variant of the Lagrange method is given, which uses no more computer time and central memory then the widely used RAS method. Also some special cases are discussed: the adjustment of row sums and column sums, additional restraints, mutual connections between tables and three dimensional tables.

NA/25 **The methodology of the Dutch system of quarterly accounts**, Janssen, R.J.A. and S.B. Algera (1988).
In this paper a description is given of the Dutch system of quarterly national accounts. The backbone of the method is the compilation of a quarterly input-output table by integrating short-term economic statistics.

NA/26 **Imputations and re-routeings in the National Accounts**, Gorter, Cor N. (1988).
Starting out from a definition of 'actual' transactions an inventory of all imputations and re-routeings in the SNA is made. It is discussed which of those should be retained in the core of a flexible system of National Accounts. Conceptual and practical questions of presentation are brought up. Numerical examples are given.

NA/27 **Registration of trade in services and market valuation of imports and exports in the National Accounts**, Bos, Frits (1988).
The registration of external trade transactions in the main tables of the National Accounts should be based on invoice value; this is not only conceptually very attractive, but also suitable for data collection purposes.

NA/28 **The institutional sector classification**, Van den Bos, C. (1988).
A background paper on the conceptual side of the grouping of financing units. A limited number of criteria are formulated.

NA/29 **The concept of (transactor-)units in the National Accounts and in the basic system of economic statistics**, Bloem, Adriaan M. (1989).
Units in legal-administrative reality are often not suitable as statistical units in describing economic processes. Some transformation of legal-administrative units into economic statistical units is needed. This paper examines this transformation and furnishes definitions of economic statistical units. Proper definitions are especially important because of the forthcoming revision of the SNA.

NA/30 **Regional income concepts**, Bloem, Adriaan M. and Bas De Vet (1989).
In this paper, the conceptual and statistical problems involved in the regionalization of national accounting variables are discussed. Examples are the regionalization of Gross Domestic Product, Gross National Income, Disposable National Income and Total Income of the Population.

NA/31 **The use of tendency surveys in extrapolating National Accounts**, Oudde-ken, Frank and Gerrit Zijlmans (1989).
This paper discusses the feasibility of the use of tendency survey data in the compilation of very timely Quarterly Accounts. Some preliminary estimates of relations between tendency survey data and regular Quarterly Accounts-indicators are also presented.

NA/32 **An economic core system and the socio-economic accounts module for the Netherlands**, Gorter, Cor N. and Paul van der Laan (1989).
A discussion of the core and various types of modules in an overall system of economy related statistics. Special attention is paid to the Dutch Socio-economic Accounts. Tables and figures for the Netherlands are added.

NA/33 **A systems view on concepts of income in the National Accounts**, Bos, Frits (1989).
In this paper, concepts of income are explicitly linked to the purposes of use and to actual circumstances. Main choices in defining income are presented in a general system. The National Accounts is a multi-purpose framework. It should therefore contain several concepts of income, e.g. differing with respect to the production boundary. Furthermore, concepts of national income do not necessarily constitute an aggregation of income at a micro-level.

NA/34 **How to treat borrowing and leasing in the next SNA**, Keuning, Steven J. (1990).
The use of services related to borrowing money, leasing capital goods, and renting land should not be considered as intermediate inputs into specific production processes. It is argued that the way of recording the use of financial services in the present SNA should remain largely intact.

NA/35 **A summary description of sources and methods used in compiling the final estimates of Dutch National Income 1986**, Gorter, Cor N. and others (1990).
Translation of the inventory report submitted to the GNP Management Committee of the European Communities.

NA/36 **The registration of processing in make and use tables and input-output tables**, Bloem, Adriaan M., Sake De Boer and Pieter Wind (1993).
The registration of processing is discussed primarily with regard to its effects on input-output-type tables and input-output quotes. Links between National Accounts and basic statistics, user demands and international guidelines are examined. Net recording is in general to be preferred. An exception has to be made when processing amounts to a complete production process, e.g. oil refineries in the Netherlands.

NA/37 **A proposal for a SAM which fits into the next System of National Accounts**, Keuning, Steven J. (1990).
This paper shows that all flow accounts which may become part of the next System of National Accounts can be embedded easily in a Social Accounting Matrix (SAM). In fact, for many purposes a SAM format may be preferred to the traditional T-accounts for the institutional sectors, since it allows for more flexibility in selecting relevant classifications and valuation principles.

NA/38 **Net versus gross National Income**, Bos, Frits (1990).
In practice, gross figures of Domestic Product, National Product and National Income are most often preferred to net figures. In this paper, this practice is challenged. Conceptual issues and the reliability of capital consumption estimates are discussed.

NA/39 **Concealed interest income of households in the Netherlands; 1977, 1979 and 1981**, Kazemier, Brugt (1990).
The major problem in estimating the size of hidden income is that total income, reported plus unreported, is unknown. However, this is not the case with total interest income of households in the Netherlands. This makes it possible to estimate at least the order of magnitude of this part of hidden income. In this paper it will be shown that in 1977, 1979 and 1981 almost 50% of total interest received by households was concealed.

NA/40 **Who came off worst: Structural change of Dutch value added and employ-- ment during the interwar period**, Den Bakker, Gert P. and Jan de Gijt (1990).
In this paper new data for the interwar period are presented. The distribution of value added over industries and a break-down of value added into components is given. Employment by industry is estimated as well. Moreover, structural changes during the interwar years and in the more recent past are juxtaposed.

NA/41 **The supply of hidden labour in the Netherlands: a model**, Kazemier, Brugt and Rob van Eck (1990).
This paper presents a model of the supply of hidden labour in the Netherlands. Model simulations show that the supply of hidden labour is not very sensitive to cyclical fluctuations. A tax exempt of 1500 guilders for second jobs and a higher probability of detection, however, may substantially decrease the magnitude of the hidden labour market.

NA/42 **Benefits from productivity growth and the distribution of income**, Keuning, Steven J. (1990).
This paper contains a discussion on the measurement of multifactor productivity and sketches a framework for analyzing the relation between productivity changes and changes in the average factor remuneration rate by industry. Subsequently, the effects on the average wage rate by labour category and the household primary income distribution are studied.

NA/43 **Valuation principles in supply and use tables and in the sectoral accounts**, Keuning, Steven J. (1991).
In many instances, the valuation of transactions in goods and services in the national accounts poses a problem. The main reason is that the price paid by the purchaser deviates from the price received by the producers. The paper discusses these problems and demonstrates that different valuations should be used in the supply and use tables and in the sectoral accounts.

NA/44 **The choice of index number formulae and weights in the National Accounts. A sensitivity analysis based on macro-economic data for the interwar period**, Bakker, Gert P. den (1991).
The sensitivity of growth estimates to variations in index number formulae and weighting procedures is discussed. The calculations concern the macro-economic variables for the interwar period in the Netherlands. It appears, that the use of different formulae and weights yields large differences in growth rates. Comparisons of Gross Domestic Product growth rates among countries are presently obscured by the use of different deflation methods. There exists an urgent need for standardization of deflation methods at the international level.

NA/45 **Volume measurement of government output in the Netherlands; some alternatives**, Kazemier, Brugt (1991).
This paper discusses three alternative methods for the measurement of the production volume of government. All methods yield almost similar results: the average annual increase in the last two decades of government labour productivity is about 0.7 percent per full-time worker equivalent. The implementation of either one of these methods would have led to circa 0.1 percentage points higher estimates of economic growth in the Netherlands.

NA/46 **An environmental module and the complete system of national accounts**, Boo, Abram J. De, Peter R. Bosch, Cor N. Gorter and Steven J. Keuning (1991).
A linkage between environmental data and the National Accounts is often limited to the production accounts. This paper argues that the consequences of economic actions on ecosystems and vice versa should be considered in terms of the complete System of National Accounts (SNA). One should begin with relating volume flows of environmental matter to the standard economic accounts. For this purpose, a so-called National Accounting Matrix including Environmental Accounts (NAMEA) is proposed. This is illustrated with an example.

NA/47 **Deregulation and economic statistics: Europe 1992**, Bos, Frits (1992).
The consequences of deregulation for economic statistics are discussed with a view to Europe 1992. In particular, the effects of the introduction of the Intrastat-system for statistics on international trade are investigated. It is argued that if the Statistical Offices of the EC-countries do not respond adequately, Europe 1992 will lead to a deterioration of economic statistics: they will become less reliable, less cost effective and less balanced.

NA/48 **The history of national accounting**, Bos, Frits (1992).
At present, the national accounts in most countries are compiled on the basis of concepts and classifications recommended in the 1968-United Nations guidelines. In this paper, we trace the historical roots of these guidelines (e.g. the work by King, Petty, Kuznets, Keynes, Leontief, Frisch, Tinbergen and Stone), compare the subsequent guidelines and discuss also alternative accounting systems like extended accounts and SAMs.

NA/49 **Quality assessment of macroeconomic figures: The Dutch Quarterly Flash**, Reininga, Ted, Gerrit Zijlmans and Ron Janssen (1992).
Since 1989-IV, the Dutch Central Bureau of Statistics has made preliminary estimates of quarterly macroeconomic figures at about 8 weeks after the end of the reference quarter. Since 1991-II, a preliminary or "Flash" estimate of GDP has been published. The decision to do so was based on a study comparing the Flash estimates and the regular Quarterly Accounts figures, which have a 17-week delay. This paper reports on a similar study with figures through 1991-III.

NA/50 **Quality improvement of the Dutch Quarterly Flash: A Time Series Analysis of some Service Industries**, Reininga, Ted and Gerrit Zijlmans (1992).
The Dutch Quarterly Flash (QF) is, just like the regular Quarterly Accounts (QA), a fully integrated statistic based on a quarterly updated input-output table. Not all short term statistics used to update the QA's IO-table are timely enough to be of use for the QF, so other sources have to be found or forecasts have to be made. In large parts of the service industry the latter is the only possibility. This paper reports on the use of econometric techniques (viz. series decomposition and ARIMA modelling) to improve the quality of the forecasts in five parts of the service industry.

NA/51 **A Research and Development Module supplementing the National Accounts**, Bos, Frits, Hugo Hollanders and Steven Keuning (1992).
This paper presents a national accounts framework fully tailored to a description of the role of Research and Development (R&D) in the national economy. The framework facilitates to draw macro-economic conclusions from all kinds of data on R&D (also micro-data and qualitative information). Figures presented in this way can serve as a data base for modelling the role of R&D in the national economy.

NA/52 **The allocation of time in the Netherlands in the context of the SNA; a module**, Kazemier, Brugt and Jeanet Exel (1992).
This paper presents a module on informal production, supplementing the National Accounts. Its purpose is to incorporate informal production into the concepts of the SNA. The relation between formal and informal production is shown in the framework of a Social Accounting Matrix (SAM). To avoid a controversial valuation of informal production, the module constists of two SAMs. One expressed in actual prices with informal labour valued zero, and one which expresses the embedded informal labour input measured in terms of hours worked.

NA/53 **National Accounts and the environment: the case for a system's approach**, Keuning, Steven J. (1992).
The present set of main economic indicators should be extended with one or a few indicators on the state of the environment. This paper lists various reasons why a so-called Green Domestic Product is not suitable for this purpose. Instead, a system's approach should be followed. A National Accounting Matrix including Environmental Accounts (NAMEA) is presented and the way to derive one or more separate indicators on the environment from this information system is outlined.

NA/54 **How to treat multi-regional units and the extra-territorial region in the Regional Accounts?**, De Vet, Bas (1992).
This paper discusses the regionalization of production and capital formation by multi-regional kind-of-activity units. It also examines the circumstances in which a unit may be said to have a local kind-of-activity unit in the extra-territorial region and what should be attributed to this "region".

NA/55 **A historical Social Accounting Matrix for the Netherlands (1938)**, Den Bakker, Gert P., Jan de Gijt and Steven J. Keuning (1992).
This paper presents a Social Accounting Matrix (SAM) for the Netherlands in 1938, including related, non-monetary tables on demographic characteristics, employment, etc. The distribution of income and expenditure among household subgroups in the 1938 SAM is compared with concomittant data for 1987.

NA/56 **Origin and development of the Dutch National Accounts**, Den Bakker, Gert P. (1992).
This paper describes the history of national accounting in the Netherlands. After two early estimates in the beginning of the nineteenth century, modern national accounting started in the 1930s on behalf of the Tinbergen model for the Dutch economy. The development spurred up after World War II to provide data to the government for economic planning purposes. In the 1980s, the development was towards a flexible and institutional approach.

NA/57 **Compiling Dutch Gross National Product (GNP); summary report on the final estimates after the revision in 1992**, Bos, Frits (1992).
This summary report describes the sources and methods used for compiling the final estimate of Dutch Gross National Product after the revision of the Dutch National Accounts in 1992. Attention is focused on the estimation procedures for 1988. A more extensive report is also available.

NA/58 **Major changes and results of the revision of the Dutch National Accounts in 1992**, Department of National Accounts (1992, forthcoming).
The revision in 1992 has improved the Dutch National Accounts in three ways. First, new and other data sources have been used, like Production statistics of service industries, the Budget Survey and Statistics on fixed capital formation. Secondly, the integration process has been improved by the use of detailed make- and use-tables instead of more aggregate input-output tables. Thirdly, several changes in bookkeeping conventions have been introduced, like a net instead of a gross registration of processing to order.

NA/59 **A National Accounting Matrix for the Netherlands**, Keuning, Steven and Jan de Gijt (1992).
Currently, the national accounts typically use two formats for presentation: matrices for the Input-Output tables and T-accounts for the transactions of institutional sectors. This paper demonstrates that presently available national accounts can easily be transformed into a National Accounting Matrix (NAM). This may improve both the transparency and analytic usefulness of the complete set of accounts.

NA/60 **Integrated indicators in a National Accounting Matrix including environmental accounts (NAMEA); an application to the Netherlands**, De Haan, Mark, Steven Keuning and Peter Bosch (1993).
In this paper, environmental indicators are integrated into a National Accounting Matrix including Environmental Accounts (NAMEA) and are put on a par with the major aggregates in the national accounts, like National Income. The environmental indicators reflect the goals of the environmental policy of the Dutch government. Concrete figures are presented for 1989. The NAMEA is optimally suited as a data base for modelling the interaction between the national economy and the environment.

NA/61 **Standard national accounting concepts, economic theory and data compilation issues; on constancy and change in the United Nations-Manuals on national accounting (1947, 1953, 1968 and 1993)**, Bos, Frits (1993).
In this paper, the four successive guidelines of the United Nations on national accounting are discussed in view of economic theory (Keynesian analysis, welfare, Hicksian income, input-output analysis, etc.) and data compilation issues (e.g. the link with concepts in administrative data sources). The new guidelines of the EC should complement those of the UN and be simpler and more cost-efficient. It should define a balanced set of operational concepts and tables that is attainable for most EC countries within 5 years.

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