



Centraal Bureau voor de Statistiek/ Statistics Netherlands

Department of National Accounts
P.O. Box 4000
2270 JM Voorburg

Present status and future developments of the Dutch NAMEA

Sjoerd Schenau and Rutger Hoekstra

**Paper for the International Workshop for
Interactive Analysis on Economy and Environment**

March 4th 2006, Tokyo

Abstract

Environmental accounting relates environmental data to the national accounts. This enables consistent comparison of environmental and economic indicators. Work areas range from accounts for natural resources such as the extraction of oil and gas to material use and emissions data such as CO₂ and waste. The environmental accounts are internationally comparable through common frameworks, concepts and methods.

Statistics Netherlands has a long history in environmental accounting at the national accounts department. This culminated in the introduction of the National Accounting Matrix including Environmental Accounts (NAMEA) in 1991. In this paper the history and theory of the NAMEA are discussed, as well as the future extensions which are currently envisaged.

At present, the core publication of the Dutch environmental accounts consist of three parts, namely the NAMEA-matrix, detailed emission accounts for NAMEA and the water accounts (NAMWA). The NAMEA consists of a conventional National Accounts Matrix (NAM), extended with two accounts on the environment: a substance account and an account for environmental themes. NAMWA is a further specification of NAMEA for water, using the same accounting structure.

At present, Statistics Netherlands is extending the system of environmental accounts based on the System of Environmental and Economic Accounting (SEEA). This extension includes projects on subsoil accounts, physical accounts, water accounts, eco-industry accounts, dispersion accounts, waste accounts, energy accounts, land use accounts, environmental tax en subsidy accounts as well as macro-economic analyses.

Contents

Abstract	2
1. Introduction	4
2. History of the Dutch NAMEA	5
3. Present status of the Dutch environmental accounts	6
3.1 Introduction	6
3.2 The NAMEA	6
3.3 Air emission accounts	10
3.4 Water accounts (NAMWA)	12
4. New developments	13
4.1 Introduction	13
4.2 Energy accounts	13
4.3 Extension of the air emission accounts	14
4.4 Extension of the water accounts.....	14
4.5 Waste accounts	15
4.6 Subsoil accounts.....	15
4.7 Physical accounts	16
4.8 Dispersion accounts.....	16
4.9 Land use accounts	17
4.10 Environmental tax and subsidy accounts	17
4.11 Eco-industry accounts	17
4.12 Analyses	18
5. Conclusions	19
References	20

1. Introduction

Environmental accounting integrates environmental data with the national accounts. Accordingly environmental data can be directly compared with macro-economic indicators such as GDP. Work areas range from accounts for natural resources such as the extraction of oil and gas to material use and emissions data such as CO₂ and waste. The environmental accounts are internationally comparable through common frameworks, concepts and methods.

Environmental accounting has a long history of international coordination culminating in the System of Integrated Environmental and Economic Accounting (SEEA, 2003). The SEEA handbook was produced to provide an overview of a variety of environmental accounts. Recently, the *UN Committee of Experts on Environmental-Economic Accounting* (UNCEEA) was established. The main objectives of this committee are to elevate the system of environmental accounts to an international statistical standard and to advance the implementation of SEEA in all countries. In Europe, Eurostat has indicated to give high priority to the further development of the environmental accounts (Eurostat, 2005). On the national level there is also much interest in the environmental accounts, as environmental institutes and ministries use this data for environmental-economic analyses and policy development.

The environmental accounts are used for policy assessment, modelling and for deriving sustainable development indicators. The policy trends relevant for environmental statistics and accounts include (EU, 2003):

- Policy focuses on problems that require longer-term attention and where regular observation of changes over time and in structure is important (e.g. energy use and climate change, transport, resource productivity), including observing sectoral developments over time (e.g., eco-efficiency of industries in time series).
- Policies are moving towards using state of the environment indicators as targets in some areas (e.g., biodiversity, water quality) thus requiring integrated data-sets that link the economic actors, the environmental pressures, the societal actions and the state of the environment.
- Integrated assessment of policies increases in importance (cost – benefit analyses, joint assessment of economic, social and environmental consequences of policies).
- The concepts of decoupling, eco-efficiency and resource productivity receive increased attention.
- New policy fields focusing on products are evolving, such as Integrated Product Policy, analysis of the impacts of international trade and chemicals policy.
- Increasingly, the focus is on theme-specific reporting (transport and environment, waste and natural resource use, etc.), on the contribution of economic development and structural change as key drivers of environmental change and on international aspects such as the environmental burden displaced through imports and exports. All these require integrated data sets.

In the 1990s Statistics Netherlands developed the 'National Accounting Matrix including Environmental Accounts' (NAMEA). In the NAMEA a link has been established between the national accounts and environmental statistics. By doing so, the NAMEA reveals the interrelation between macro-indicators for the economy (net domestic product, net saving, external balance

etc.) and the environment. The NAMEA can function as an instrument for all kinds of analysis. For example, the direct and indirect environmental effects of consumption or export of certain products can be demonstrated. The NAMEA can also be used as a data source for applied general equilibrium analyses. As such, the framework can be used to calculate the consequences of policy measures such as energy levies on environmental themes (like the greenhouse effect) and economic indicators (such as domestic product and national income). Another type of macro-economic model estimates a national income in a sustainable situation in which domestic product has been maximised, where at the same time a number of technical and economical constraints are satisfied and (as well as) pollution levels that do not exceed certain targets.

Since the initial work on the NAMEA in the early 1990s, Statistics Netherlands has gradually extended the environmental accounts. This paper provides an overview of the current status of the NAMEA-framework in the Netherlands and new developments in this area. This paper proceeds as follows. In Chapter 2 the history of environmental accounting in the Netherlands is discussed. Chapter 3 further elaborates on the current status of the Dutch environmental accounts, namely the NAMEA and its two principle components the air emission accounts and the water accounts,. In Chapter 4 a summary is presented of new projects that are currently under way. Finally, conclusions are drawn in Chapter 6.

2. History of the Dutch NAMEA

In 1991 an illustrative NAMEA was presented for the first time (De Boo, Bosch, Gorter and Keuning, 1993), according to the conceptual design by Keuning (1993). The original design contained a complete system of national flow accounts, including a full set of income distribution and use accounts, accumulation accounts and changes in balance sheet accounts. At a conceptual level, not only emissions of pollutants and extraction of natural resources are represented, but also their effects.

A distinction was made between effects of current emissions that are absorbed in the current period (noise, stench, etc.), current effects of emissions in the past (e.g. leakage from a garbage dump), net capital losses due to natural causes (e.g. a severe drought), referable damage - to economic assets and to other, natural assets - due to environmental effects, and non-referable degradation to non-economic, natural assets. All these transactions were summarized in additional balancing items, culminating in a new total for the changes in net worth.

Soon, it became clear that insufficient data were available for an immediate operationalization of this conceptual framework. For that reason, it was decided to compile a more modest pilot-NAMEA, making use of the work done at the Dutch Ministry of Housing, Spatial planning and the Environment (1989). This Ministry had developed a so-called national environment policy plan, in which a number of environmental themes were distinguished. For each of these themes a single indicator had been designed, by weighing together the emissions that contributed to each theme (Adriaanse, 1993). The conversion of emissions into theme equivalents was based on the expected contribution of each polluting substance to a particular environmental theme. By the time the first NAMEA was compiled, this environment policy plan had been approved by Dutch

Parliament. In 1993, the first NAMEA became available (De Haan, Keuning and Bosch, 1994), and the present NAMEAs largely maintained this format (see for example De Haan and Keuning, 1996).

Statistics Netherlands has published detailed NAMEAs for the years 1990 to 2004 (for the most recent publication see CBS, 2005). In these publications, the following themes are considered: the greenhouse effect, ozone layer depletion, acidification, eutrophication, waste, wastewater and the exploration of crude oil and natural gas.

During the 1990s and the early 2000s, a number of pilot projects were performed to extend the system of environmental accounts. Following a pilot project in 1997, the Dutch system of environmental accounts was extended in 2002 with the National Accounting Matrix including Water Accounts (NAMWA). NAMWA is a further specification of NAMEA for water, using the same basic structure as the NAMEA. Other pilot projects have focussed on energy (Verduin, 2000), land use (Leurs and van Dalen, 1998), subsoil accounts (Van den Berg and van de Ven, 2001), dispersion of toxic substances (Seegers et al., 2000), material flow accounts (Konijn et al., 1995, 1997) and environmental taxes (De Haan, 2004).

3. Present status of the Dutch environmental accounts

3.1 Introduction

At present, the core publication of the Dutch environmental accounts consist of three parts:

1. The NAMEA-matrix
2. Detailed emission accounts for NAMEA, including a bridge table for air emissions
3. The water accounts (NAMWA)

The first two items are published every year simultaneously with the National accounts publication. The NAMWA is published annually together with the Integrated Water Management and Wastewater Treatment (RIZA). In the following section, the three components will be discussed in further detail.

3.2 The NAMEA

The NAMEA consists of a conventional National Accounts Matrix (NAM), extended with two accounts on the environment: a substance account and an account for environmental themes. These accounts do not express transactions in monetary terms but include information on the environmental pressures as they are observed in reality: that is, in physical units. The pollution caused by producers and consumers is shown, as well as the balance of cross-border pollution

from and to the rest of the world. For the greenhouse effect and the ozone layer depletion only the pressure on the global environment is shown.

In addition to the environmental accounts, the other accounts in the NAMEA contain, in an aggregated form, the usual transactions of the NAM. However, in a number of cases, the receipts and outlays with a typical 'environmental character' have been singled out and reported separately, e.g. the environmental cleansing services in the goods and services account. Like in the NAM, in the NAMEA the receipts are registered on the row and the outlays in the column.

The accounts are balanced: the balancing item being the totals of the receipts minus the outlays. This item has been shaded in the column of the account concerned. In this way the totals for the rows and columns are equal for all accounts and a consistent system emerges. In Figure 1 an overview is shown of the structure of the NAMEA as published in the Netherlands.

In the goods and services accounts intermediate and final use of goods and services are shown in the row, and domestic and foreign supply in the column. Supply and use of environmental cleansing services are shown separately (not shown in figure 1). In order to provide a complete picture of the industries' environmental expenses in the NAMEA, these services consist of external and internal environmental cleansing services. External cleansing services are services which are furnished by one production unit to another or to a final expenditure category. Internal environmental cleansing services are produced by the same establishment that uses them within its own production process. To get an overall impression of the financial efforts made by different economic activities for the environment, these deliveries have to be recorded in the NAMEA. As intra-establishments deliveries are not considered output in the standard national accounts statistics, both production and intermediate consumption are higher in the NAMEA than in the conventional national accounts. Clearly, this affects neither the Net Domestic Product (NDP) nor any other balancing item.

In a specific consumption account the consumption expenditures by households are re-allocated to consumption purposes. The latter are connected to specific pollution patterns. Consumer goods that are purchased in order to protect the environment are presented separately. This concerns, for example, the costs of catalytic converters in cars. These costs reflect, together with the environmental taxes paid by households, an indication of the financial efforts by households on behalf of the environment.

The production account shows on the row the production of goods and services and the related emissions of polluting substances. The column contains, except for intermediate consumption, consumption of fixed capital and net value added at factor costs, data for a number of inputs in the production process measured in physical units for which in fact no payment has been made. These concern extraction of natural resources in the Netherlands but also waste reprocessed in incineration plants and wastewater in the wastewater treatment plants.

In the separate tax account of the NAMEA a variety of taxes are represented; taxes (less subsidies) on products, other taxes on production, taxes on income and wealth, and so forth. In the detailed NAMEA, all kinds of environmental taxes such as energy levies, levies on pollution of surface waters and levies on wastewater drain-offs are presented separately.

Figure 1. The NAMEA matrix (shaded areas are physical accounts)

ACCOUNT (classification)	Goods and services (product-groups)	Consumption of households (purposes)	Production (industry)	Generation of income (value added categories)	Distribution of income and consumption (sectors)	Capital	Taxes (types)	Rest of the world, current	Rest of the world, capital	Substances	Environmental themes	TOTAL
Goods and services (product groups)		Consumption of households	Intermediate consumption		Consumption of government	Gross capital formation		Exports (job)				Use at purchasers' prices
Consumption of households					Consumption of households					Emission of pollutants by consumers		Consumption of households
Production	Output at basic prices									Emission of pollutants by producers		Output at basic prices
Generation of income (value added categories)			Net value added				VAT not handed over to the government	Compensation of employees from r.o.w.				Origin of generated income
Distribution of income and consumption				Net national generated income	Property income and current transfers		Taxes less subsidies	Property income and current transfers from r.o.w.				Current receipts
Capital			Consumption of fixed capital		Net national savings				Capital transfers from r.o.w.	Other domestic emission of pollutants and changes in natural resources		Capital receipts
Financial balance						National net lending (+) or net borrowing (-)		Net lending from the rest of the world				
Taxes (types)	Taxes less subsidies on products		Other taxes less subsidies on production		Current taxes on income and wealth			Current taxes on income and wealth from r.o.w.				Tax payments (less subsidies)
Rest of the world, current	Imports (cif)			Compensation of employees to r.o.w.	Property income and current transfers to r.o.w.		Current taxes on income and wealth to r.o.w.		Surplus of the nation on current transactions	Cross border pollution from r.o.w.		Current payments to the rest of the world
Rest of the world, capital						Capital transfers to r.o.w.						Capital payments to the rest of the world
Substances			Absorption by producers					Cross border pollution to r.o.w.			Contribution to environmental themes	Destination Of substances
Environmental themes						Environmental indicators						Theme-equivalents
TOTAL	Supply at purchasers' prices	Consumption of households	Input at basic prices	Destination of generated income	Current expenditures	Capital expenditures	Tax receipts (less subsidies)	Current receipts from the rest of the world	Capital receipts from the rest of the world	Origin of substances	Theme-equivalents	Theme-equivalents

The relations with the rest of the world are treated in two accounts, a current account and a capital account. The row of the current account presents imports, not only of goods and services, but also of polluting substances. Similarly, the column reviews exports of goods and services, as well as pollutants. The figures in the current external balance of the rest of the world with the Netherlands show for most of the polluting substances that exports exceed imports.

On the row of the substance account the final destination of total pollution is shown. Part of it ends up in the rest of the world. Of the pollution which ends up in the Netherlands itself, that part which is re-absorbed in the economic process, is shown separately. This includes the extraction of the natural resources crude oil, natural gas and wood. The rest of the pollutants is re-allocated to a number of environmental themes: the greenhouse effect, the depletion of the ozone layer, acidification, eutrophication, accumulation of waste and wastewater. The depletion of natural resources has been summarised into one theme for crude oil and natural gas. In the column of the substance account the origin of the pollutants is registered. This pollution is caused by producers, consumers and the rest of the world. Besides this, this column registers addition to proven reserves and other changes in natural resources because of changing market prices. Next to the annual extraction these factors determine the initial and final stocks.

The so-called 'environmental themes' are represented in a separate account. The concept of the themes has been adopted from the (second) Netherlands' 'National Environmental Policy Plan' (Netherlands Ministry of Housing, Spatial Planning and the Environment) where they are used as an integrating framework of current environmental problems in the Netherlands. The weights reflect for each theme the potential relative stress of each substance on the environment. The substance units are converted into theme-related stress equivalents and are largely based on international research on the effects of different substances on the quality of the environment. Figure 2 shows the development of the NAMEA indicators for 1990 to 2004. During this period GDP gradually increased while the indicators for acidification, eutrophication and solid waste production decreased. Only the indicator for greenhouse gasses is still increasing.

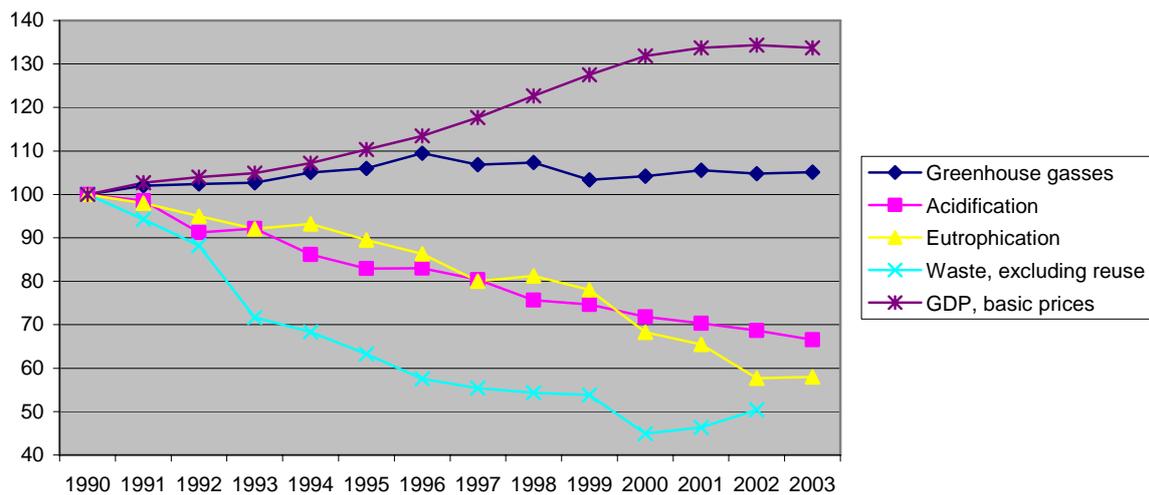


Figure 2: Gross domestic product vs environmental indicators in the Netherlands over the period 1990-2004 (1990=100)

3.3 Air emission accounts

As yet, the most developed environmental accounts in the Netherlands are the air emission accounts. The air emission accounts show the origin and destination of air emissions of CO₂, CH₄, N₂O, CFK's, NO₃, SO₂ and NH₃.

In the Netherlands air emissions are centrally recorded in a database called the Dutch Pollutant Emission Registration. Several institutes take part in the gathering of emission data and the composition of the database. A number of statistical sources are used to compute the emissions and to add more detail by specifying the data by branch of industry. The interrelationship between the different sources is shown in Figure 3.

Air emissions caused by stationary and mobile sources are recorded separately as for both sources a different methodology is followed. Physical data on the use of energy play a crucial role in the final estimations of the air emissions. In the case of the stationary sources Statistics Netherlands is responsible for the estimation of emission totals specified by industry classification. As the major part of air emissions are related to the combustion of fossil energy sources the statistic on Energy supply in the Netherlands is used to gross up the data which were originally measured at the polluting location.

Air emissions related to mobile sources are mainly based on transport statistics. For example in the case of road vehicles the emissions are modelled from data on the annual distance travelled by type of vehicle combined with specific use and technical data on the related amount of emissions. Still there is a strong relation with the energy statistics as the overall use of transport fuels is a result of the Dutch energy balance sheet.

Still there is a difference in definition. The registration of emissions and energy is restricted to the area within the Dutch borders. However due to international transport activity part of emissions aboard are caused by Dutch residents. These emissions have to be taken into account following the rules of the National accounts. Using several statistical sources on the purchase of fuels aboard, the distances travelled aboard and so on, these emissions are composed and attributed to the responsible economic activity. From the results it turns out that 10 % of the CO₂ emissions caused by Dutch residents are produced aboard. The difference between the emissions in the Netherlands and the emissions caused by the residents are made visible in a bridge table (Table 1).

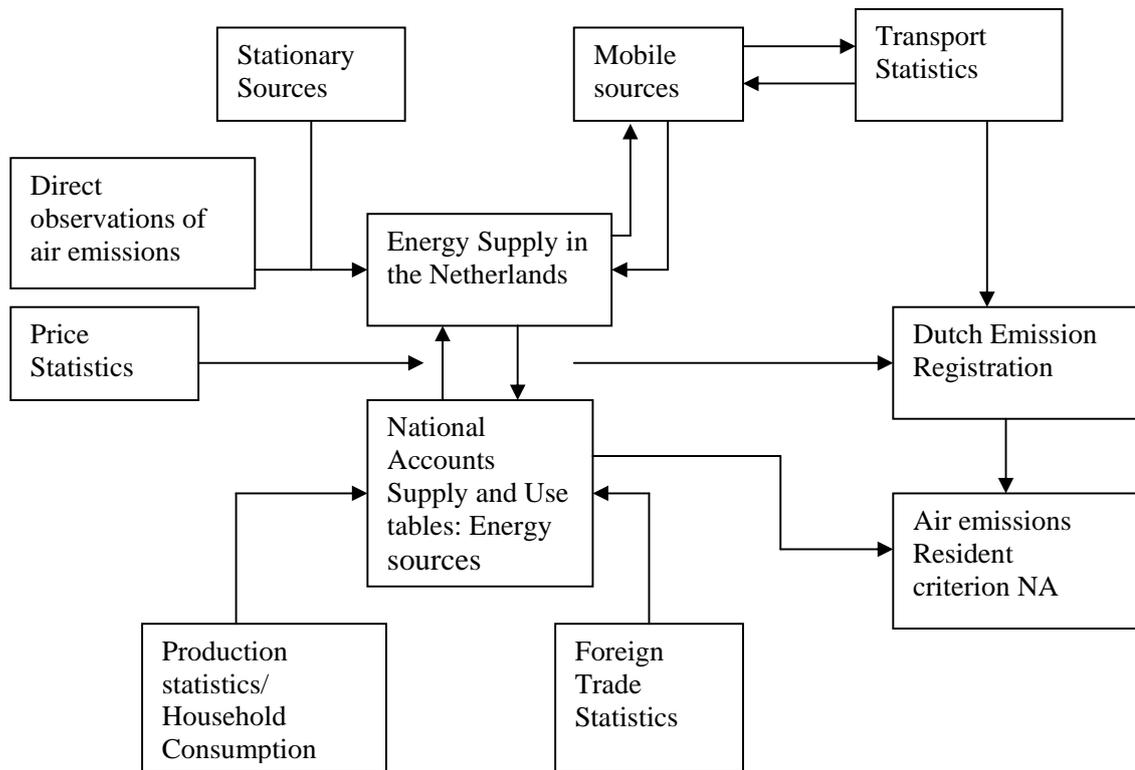


Figure 3. Schematic overview of the data sources of the air emission accounts

Table 1: Bridge table for CO₂ emissions for the Netherlands

		2001	2002	2003*	2004*
Emissions by residents	1	202187	201258	203732	206253
Residents in the rest of the world	2=3+4+5	22173	21722	20967	21016
Transport by road	3	5165	5236	5129	5363
Air transport (incl. defence activities)	4	11445	11289	10998	10380
Water transport	5	5564	5197	4839	5273
Non-residents in the Netherlands	6=7+8+9	6846	6962	7043	6987
Transport by road	7	1918	1925	1844	1794
Air transport	8	278	308	317	316
Water transport	9	4650	4729	4882	4878
Emissions in the Netherlands	10=1-2+6	186860	186498	189808	192224

3.4 Water accounts (NAMWA)

Since a number of years, the demand for information about the economic value of water and the wider economic consequences of water policy and management has increased rapidly. In Europe, the introduction of the European Water Framework Directive (WFD) has given this demand an important impulse. The Water Framework Directive is one of the first European directives in the domain of water, which explicitly acknowledges the important role of economics in water policy and management. In order to meet this growing demand, Statistics Netherlands has developed an integrated water economics information system called the National Accounting Matrix including Water Accounts (NAMWA).

Following a pilot project in 1997 (De Haan, 1997), the Dutch system of environmental accounts was extended in 2002 with the water accounts. Statistics Netherlands (CBS) and the National Institute for Integrated Water Management and Wastewater Treatment (RIZA) are working together on the development of a new integrated river basin information system. NAMWA is a further specification of NAMEA for water, using the same accounting structure. The Dutch water accounts presents information at the level of the four main river basin districts in the Netherlands: Meuse, Scheldt, Ems, Rhine-North, Rhine-West, Rhine-East and Rhine-Centre. The Dutch water accounts are published annually by Statistics Netherlands. The Institute for inland water management and wastewater treatment (RIZA) uses the water accounts for making reports for the Water Framework Directive.

The NAMWA-matrix consists of 10 monetary accounts and 4 physical accounts. The first two physical accounts for the emission of substances and water extraction and discharge represent the flows. The third physical account for water extraction and discharge describes changes in stocks, while the fourth physical account for emissions describes the contribution of various substances to 'environmental themes' such as eutrophication or the dispersion of heavy metals in water. Figure 4 shows the development of water emissions indicators for 1996-2001 .

By linking water and substance flows to economic flows and doing this systematically for a number of years, insight is gained into the (nature of the) relationship between our physical water systems and the economy. The integration of physical and economic information also allows the construction of integrated indicators. For instance, water use by various economic sectors can be related to the economic interests involved. It is this integration of water and economy at river basin level, which makes NAMWA an important information tool to support policy and decision-making in the field of integrated water management as advocated by the WFD. By linking information about the physical pressures exerted on the water system by economic agents and the associated economic interests, NAMWA enables policy makers and water managers at national and river basin scale in a consistent way to assess the necessary measures to reduce these pressures and meet the environmental objectives in the WFD in an integrated way. NAMWA offers opportunities to analyse the trade-offs between environmental goals and the economic interests involved at the relevant level of analysis, i.e. river basins.

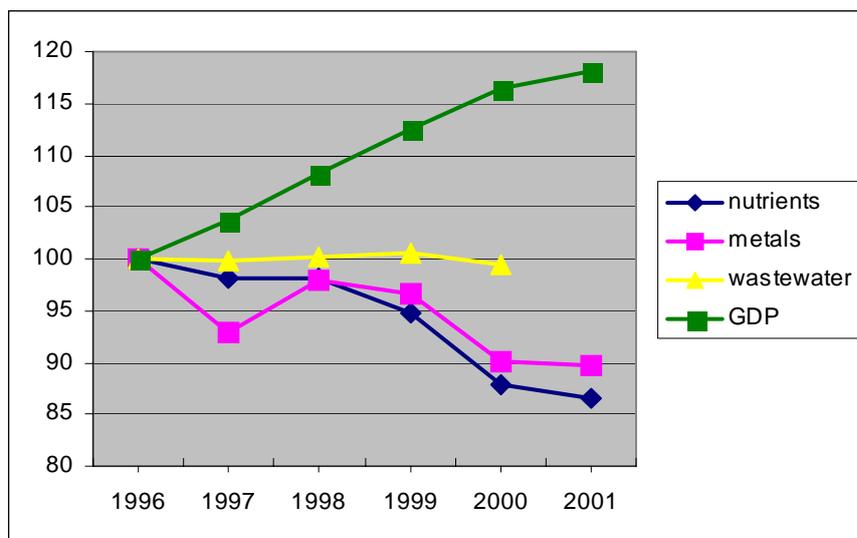


Figure 4: GDP vs. environmental water indicators (excluding import) in the Netherlands over the period 1996-2001 (1996=100)

4. New developments

4.1 Introduction

Statistics Netherlands has also decided to expand the depth and breadth of the environmental accounts by producing a number of accounts that are also described in the SEEA. This culminated in a plan to extend the Dutch environmental accounts which will be implemented in the period 2005-2009. This section gives an overview of the new projects that are in the new work program.

4.2 Energy accounts

The energy accounts represent a system in which energy data, in both monetary and physical terms, have been integrated into the national accounting framework. The supply and use tables, part of the system of National Accounts, provide an overall accounting structure for the energy accounts in values and quantities. The energy accounts can be used, either directly or via calculations using economic modelling, to analyse energy use and production in relation to different economic activities in society. The energy accounts constitute an integrated part of the SEEA.

In this project a new methodology is developed to compile the energy accounts for the Netherlands. Physical data, derived from the energy statistics, have been combined with price information to calculate the monetary energy values. These energy values have subsequently been implemented into the national accounts. By combining these two data sources, a systematic framework is created containing consistent and harmonised monetary and physical energy data.

4.3 Extension of the air emission accounts

As described in Section 3.3, a transport module was developed for the NAMEA to allocate the air emissions from mobile sources to the different kind of industries and households. Mobile sources represent the different transport modes that generate emissions of a number of air emissions. In the transport module the energy use from mobile sources (road transport, water transport, air transport) is determined by distributing the total energy use over the industries and households. The emission factors for the different gases are applied to the energy subdivision in order to be able to calculate the emissions from mobile sources. In the transport module, the emissions are calculated according to the definitions of the National accounts. Therefore both the emissions produced within the national territory as emissions produced outside the national territory will be determined.

4.4 Extension of the water accounts

One of the new projects that will be initiated in 2006 are the compilation of the physical water accounts (water balances). The water balance shows the quantitative input and output flows of ground, surface and tap water. In previous years the water balance was compiled using data from the National Water Survey conducted by Statistics Netherlands once every five years. The most recent survey was conducted over 2001. This survey comprised business level data on water use by industry, mining and electricity companies. However, at present, this survey has been stopped and therefore it is necessary to investigate alternative data sources and their potential for the compilation of the water balance.

A promising source for compiling the water balance might be found in the annual environmental reports by enterprises. These reports include a brief section on used water quantities divided into tap water, ground water and surface water. Further, a distinction is made between ground and surface water for cooling purposes and non-cooling purposes.

It is intended to compare the results of the National Water Survey 2001 with the environmental reports of 2001 in order to determine the suitability of these data for compiling the water balance. Further, an attempt will be made to estimate lacking data. An interesting additional advantage of the environmental reports is that they are prepared on a yearly basis, allowing the making of the water balance on a more regular basis than before.

4.5 Waste accounts

One substance account in the current NAMEA considers solid waste. Solid waste may contribute to a range of environmental problems and therefore the composition of waste is relevant. Statistics Netherlands has decided to update the waste accounts of the NAMEA. In comparison to the waste accounts in the current NAMEA several improvements in the coverage of waste flows were made. Firstly, the number of reported NACE categories increase from about 40 to about 60. Secondly, about 70 different waste types, divided in hazardous and non-hazardous waste, are distinguished. The categorization of waste types is according to the new European waste regulation. This waste harmonized categorization facilitates comparisons between countries. Thirdly, another main extension to the current waste accounts is the implementation of cross-boundary waste flows. Fourthly, a distinction between residuals and waste products is made. As a result complete residual supply and use tables, thus including recycled residuals, can be presented in the NAMEA.

Finally, monetary waste accounts will be composed. The monetary supply table shows waste products with an economic value and services that involve either monetary transfers between establishments or expenditure for internal treatment of residuals. The use table includes columns for intermediate consumption (including expenditure for internal treatment), final consumption, gross fixed capital formation, export and residents abroad. The physical supply and use tables can be linked to monetary supply and use tables of waste.

4.6 Subsoil accounts

According to the 1995 ESA, subsoil assets (AN.212) are defined as proven reserves of mineral deposits located on or below the earth's surface that are economically exploitable given current technology and relative prices. In the absence of market prices, the value of the reserves usually has to be determined by the present value of expected net returns resulting from the commercial exploitation of those assets.

To estimate expected net returns in relation to subsoil assets, in practice, two alternative methods can be applied: the 'net resource rent method' and the 'government appropriation method'. In this context, 'net resource rent' stands for net operating surplus plus specific taxes less the return to fixed capital. The latter item is to be calculated as the normal rate of return to fixed capital times total net stock of fixed capital.

In this project new physical and monetary subsoil asset accounts for the Netherlands will be compiled for oil and gas.

4.7 Physical accounts

The SEEA introduces three physical accounts that cover all material flows in the economy: Physical Supply and Use Tables (PSUT), Physical Input-Output Tables (PIOT) and Material Flows Accounts (MFA). The former two are similar to the monetary supply and use tables (SUT) and input-output tables except that the tables adhere to physical balances rather than monetary balances. They therefore contain all materials that are extracted or emitted from/to the environment. They also include the physical flows of products in the economy, including recycling and packaging products (Konijn et al., 1995; Konijn et al., 1997; Hoekstra, 2005; and Hoekstra and van den Bergh, 2006).

Economy-wide MFA provide an aggregate overview, in tonnes, of the annual material inputs and outputs of an economy including inputs from the national environments and outputs to the environment and the physical amounts of imports and exports (reference). Material flow accounts are one of the priority areas recommended for harmonised reporting in the EU.

At the end of 2006 Statistics Netherlands will tackle all 3 physical accounts simultaneously so that they are mutually consistent. This data set will provide detailed insight about the structure of the physical economy and could serve as a data source for detailed policy analysis on products and materials.

4.8 Dispersion accounts

Presently, the Dutch NAMEA contains several environmental themes like “greenhouse effect” or “eutrophication”, but not the theme “dispersion of toxic substances”. This theme covers pollution of air, water and soil by pesticides and about 60 other substances, like heavy metals and dioxins. To include this theme in the NAMEA two problems have to be solved. Firstly, for the emissions have to be estimated for each industry and secondly, it is desirable to aggregate the emissions into an indicator. From a pilot study for 1995 it was concluded that it is possible to compose a NAMEA for dispersion of toxic substances with a limited number of indicators. However, there is still no consensus about the weighting scheme to be used.

In 1998 a pilot study was successfully complete, which was based on the 1995 study. This feasibility study reviewed a number of methodologies to compile aggregated environmental indicators for the emission of toxic substances to air, water and soils by the different economic activities as being represented in the NAMEA. Although this methodological discussion still continues, the pilot study clearly set out the data-requirements in order to cover this new environmental theme. The results make it possible to compare the indicator on the dispersion of toxic substances with other economic and environmental indicators covered in the time series NAMEA 1990-1997. A sensitivity analysis will be performed concerning three different weighting procedures related to the potential toxicity threats for terrestrial ecosystems, aquatic ecosystems and human health.

A new project will be initiated to produce new accounts for toxic substances. With the time series in the database, the sensitivity of these different weighing schemes with respect to levels

and changes of the aggregate dispersion indicator, as well as its distribution by economic activity will be analysed.

4.9 Land use accounts

Integrated asset accounts for land in physical and monetary units, including balance sheets and changes in balance sheets, will be linked to economic activities in a new land use accounting system. Land cover and land use changes are described and classified according to their economic, natural or other functions. This core set of accounts is the basis for the development of supplementary accounts focusing on, e.g., productivity and partitioning of land and biodiversity.

Using the results of a pilot project (Leurs and van Dalen, 1998) land use accounts will be assembled. Using new data based on GIS-formation new and more detailed land use accounts can be compiled.

4.10 Environmental tax and subsidy accounts

The environmental taxes account identify taxes in the national accounts that are related to the environment, using the definition and criteria set by the OECD and Eurostat. The tax revenues are classified by category (energy, transport, pollution and resource taxes) and also by industry/final use and environmental domain. Integration of environmental taxes within an overall framework will constitute the second stage of the development of the account. In the Netherlands, environmental taxes can be directly obtained from the national accounts.

Other economic instruments cover environmental subsidies, emissions permits and environmental liabilities. Contrary to the environmental tax account, they cannot be directly obtained from the national accounts as no subdivision for the subsidies is made. Therefore, the environmental subsidies have to be obtained from additional data sources like registers. Additional problems occur when classifying certain subsidies as environmental or not.

4.11 Eco-industry accounts

In order to reduce environmental pressure, environmental measures that are imposed on companies and households become increasingly stringent. The consequences of environmental measures and environmental concerns for the economy show a large interest by policymakers. On the one hand this interest focuses on the financial burden on the polluting sectors which have to invest in pollution abatement control. On the other hand they want information on the new growth sector consisting of enterprises which produce goods and services to measure, prevent, limit, minimise or correct environmental damage – the so called eco-industries. These two aspects are often referred to as the *demand and supply side* of the ‘environmental market’.

On the *demand side* Statistics Netherlands already collects extensive (but not complete) data on environmental protection expenditure. However, no clear picture exists of the *supply side* of the eco-industry. In order to draw such a picture data are needed on the size (in terms of employment and sales), the structure and the competitiveness of these eco-industries. These data would describe the economic significance of the sector.

The aim of this project is to compile eco-industry accounts, analysing the employment, value-added and environmental expenditure. The accounts will be implemented in our NAMEA (National Accounting Matrix including Environmental Accounts) framework. The NAMEA contains data on environmental burdens in relation to economic developments as reflected in the National accounts. Specifying eco-industry in the NAMEA will show its contribution of economic activities to economic and environmental indicators. This study would follow up a study by Statistics Netherlands on environment-related employment in the Netherlands for the year 1997 (Dietz et al., 2000).

4.12 Analyses

The environmental accounts have two advantages which make them very useful for analysis. Firstly, the data is collected in a consistent manner with the National Accounts and time series of both the monetary or labour accounts can therefore be depicted alongside the environmental indicators (see for example Figure 2). Secondly, the environmental data can easily be linked to the input-output data for the Netherlands. This allows for a number of input-output modelling techniques to be used for analysis of the relationship between the economy and environment. These applications include:

1. Imputation to final demand categories. This application allows for the attribution of environmental indicators to final demand categories such as consumption and exports. The method does not only attribute the direct emissions but also the indirect emissions that were created as a result of feedback effect of the production process.
2. Impact analysis. In this type of model a “what if” question can be answered. For example, it could answer the question: “what would happen to waste generation if consumption increased by 10%”.
3. Structural decomposition analysis. In this type of analysis input-output tables from 2 years are used to identify the underlying sources of changes in emissions of waste flows. Through this method, growth of environmentally damaging emissions can be attributed to growth in technology or final demand categories.

The NAMEA can also be used for more advanced environmental-economic models such as General Equilibrium models and other macro-economic models. However, since these models are beyond the scope of expertise of Statistics Netherlands these are not discussed further.

5. Conclusions

Environmental accounting relates environmental data to the national accounts. This enables consistent comparison of environmental and economic indicators. Work areas range from accounts for natural resources such as the extraction of oil and gas to material use and emissions data such as CO₂ and waste. The environmental accounts are internationally comparable through common frameworks, concepts and methods.

Statistics Netherlands has a long history in environmental accounting at the national accounts department. This culminated in the introduction of the National Accounting Matrix including Environmental Accounts (NAMEA) in 1991. In this paper the history and theory of the NAMEA are discussed, as well as the future extensions which are currently envisaged.

At present, the core publication of the Dutch environmental accounts consist of three parts, namely the NAMEA-matrix, detailed emission accounts for NAMEA and the water accounts (NAMWA). The NAMEA consists of a conventional National Accounts Matrix (NAM), extended with two accounts on the environment: a substance account and an account for environmental themes. NAMWA is a further specification of NAMEA for water, using the same accounting structure.

At present, Statistics Netherlands is extending the system of environmental accounts based on the System of Environmental and Economic Accounting (SEEA). This extension includes projects on subsoil accounts, physical accounts, water accounts, eco-industry accounts, dispersion accounts, waste accounts, energy accounts, land use accounts, environmental tax en subsidy accounts as well as macro-economic analyses.

Acknowledgements – The authors like to thank Martine ten Ham, Roel Delahaye and Cor Graveland for their contributions to this paper.

References

- Adriaanse, A. (1993), *Environmental policy performance indicators*, The Netherlands Ministry of Housing, spatial planning and the environment, The Hague.
- Brouwer, R. Schenau S.J. and van der Veeren, R. (2005), *Scale issues in an integrated hydro-economic river basin accounting system*. UNECE Statistical Journal ECE 22, 111–131
- CBS, (Statistics Netherlands) (2005), *National Accounts 2004*, SDU-publishers, The Hague.
- CBS, (1996), *Accounts and indicators for the economy and the environment; the 1986-1992 NAMEAs* [in Dutch], Statistics Netherlands, Voorburg/Heerlen.
- De Boo, A.J. Bosch, P.R., Gorter, C.N., and Keuning, S.J., (1993), An Environmental module and the complete system of national accounts, in: A. Franz and C. Stahmer (eds.), *Approaches to environmental accounting*, Physica-Verlag, Heidelberg.
- De Boo, A.J. (1995), Accounting for the costs of clean technologies and products, in: *Conference papers from the second meeting of the London group on natural resources and environmental accounting*, US Bureau of Economic Analysis, Washington D.C..
- De Haan, M., Keuning, S.J. and Bosch, P.R., (1994), *Integrating indicators in a National Accounting Matrix including Environmental Accounts (NAMEA); an application to the Netherlands*, National accounts occasional papers, NA-60, Statistics Netherlands.
- De Haan M. and S.J. Keuning, (1996), Taking the environment into account; the NAMEA-approach, *The Review of Income and Wealth*, Series 42, Number 2.
- De Haan, M. (1997), *Water accounts in the Dutch NAMEA: A “NAMWA” for 1991*. Internal report, Statistics Netherlands, Voorburg
- De Haan, M (2004), *Accounting for goods and for bads – measuring environmental pressure in a national accounts framework*, PhD thesis, Universiteit Twente, Twente.
- Dietz, E. Kuipers, R. and Salomons, R. (2000), *Environment-related employment in the Netherlands, 1997*. Eurostat Working Papers 2/2000/B/3
- Eurostat (2003), *Environmental Accounts 2003 – Present state and future development*, Doc. ENV/072/8, Joint Meeting of the Working Groups “Environmental Statistics” and “Environmental Accounts” Joint Eurostat/EFTA group, 10-12 September 2003, Eurostat (Luxemburg).
- EU (2003), *The European Strategy for Environmental Accounting Report to the Statistical Programme Committee*
- Hoekstra, 2006. *Economic growth, material flows and the environment. New applications of structural decomposition analysis and physical input-output tables*. Edward Elgar Publishers, Cheltenham, UK.
- Hoekstra, R. and J.C.J.M van den Bergh, 2006. Constructing physical input-output tables for environmental modeling and accounting: Framework and illustrations. *Ecological Economics*, (forthcoming).
- Keuning, S.J., (1993), An information system for environmental indicators in relation to the national accounts in: W.F.M. de Vries, G.P. den Bakker, M.B.G. Gircour, S.J. Keuning and A. Lenson (eds.), *The value added of national accounting*, Statistics Netherlands, Voorburg/Heerlen.
- Keuning, S.J. (1996), *The NAMEA experience; an interim evaluation of the Netherlands integrated accounts and indicators for the environment and the economy*, Paper presented at the international symposium on integrated environmental and economic accounting in theory and practice, Tokyo, March 5-8, 1996.

- Keuning, S.J. and J. de Gijt (1992), *A National Accounting Matrix for the Netherlands*, National accounts occasional paper series No. 59, Statistics Netherlands, Voorburg.
- Keuning, S.J. and J.G. Timmerman (1995), *An information system for economic, environmental and social statistics: integrating environmental data into the SESAME* in: Conference papers from the second meeting of the London group on natural resources and environmental accounting, US Bureau of Economic Analysis, Washington D.C.
- Konijn, P.J.A., De Boer, S. and Van Dalen, J. (1995), *Material flows, energy use and the structure of the economy*, National accounts occasional paper series No. 77, Statistics Netherlands, Voorburg.
- Konijn, P.J.A., De Boer, S. and Van Dalen, J. (1997) Input-output analysis of material flows with the application to iron, steel and zinc. *Structural Change and Economic Dynamics*: 8 129-153.
- Leurs, B. and van Dalen, J. (1998), *Land use accounting*. Internal Report, Statistics Netherlands, Voorburg.
- Netherlands Ministry of Housing, spatial planning and the environment, (1989), *National Environmental Policy Plan* [in Dutch], Netherlands Ministry of Housing, spatial planning and the environment, The Hague.
- Netherlands Ministry of Housing, spatial planning and the environment, (1993), *Second National Environmental Policy Plan* [in Dutch], Netherlands Ministry of Housing, spatial planning and the environment, The Hague.
- SEEA, 2003. *System of integrated environmental and economic accounting 2003*, Commission of the European Communities, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations & World Bank (2003). Final draft circulated for information prior to official editing, United Nations, New York.
- Seegers, R., Verduin, H. and Dijkerman, H.J., (2000), *Extension of the Dutch Namea with the dispersion of toxic substances*. Final report of the EU, grant sub99-39123
- Timmerman, J.G. and P. van de Ven (1994), *A SAM for the Netherlands, concepts and results*, National accounts occasional paper series No. 68, Voorburg.
- Van den Berg, A., and van de Ven, P. (2001), *Valuation of oil and gas reserves*. European Commission, Eurostat Working Paper No. 2/2001/B/3
- Van der Veeren, R., Brouwer, R., Schenau, S. and van der Stegen, R. (2004), *NAMWA: a new integrated river basin information system*. RIZA report 2004.032. RIZA, Lelystad, The Netherlands.
- Verduin, H. (2000), *Integration of energy statistics in the National Accounts*. Statistics Netherlands, Voorburg.