National Accounts

Environmental Economic Accounts

Environmental Economic Account Indicators: 2002 – 2009/2010

Discussion document: D0405.2.1
February 2013

Statistics South Africa

Environmental Economic Account Indicators: 2002 – 2009/2010

Discussion document D0405.2.1
February 2013

Published by Statistics South Africa, Private Bag X44, Pretoria 0001

Discussion document: Environmental Economic Account Indicators: 2002 – 2009/2010
Discussion document (D0405.2.1) Statistics South Africa
Pretoria: Statistics South Africa, February 2013

A complete set of Statistics South Africa publications is available at the Statistics South Africa Library and the following libraries:

National Library of South Africa, Pretoria Division
National Library of South Africa, Cape Town Division
Library of Parliament, Cape Town
Bloemfontein Public Library
Natal Society Library, Pietermaritzburg
Johannesburg Public Library
Eastern Cape Library Services, King William's Town
Central Regional Library, Polokwane
Central Reference Library, Nelspruit
Central Reference Collection, Kimberley
Central Reference Library, Mmabatho

This discussion document is available on the Stats SA website: www.statssa.gov.za

Contents

Abbreviations and acronyms

CH_4	Methane
CO_2	Carbon dioxide
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DoE	Department of Energy
DPSIR	Driver-pressure-state-impact-response
DWA	Department of Water Affairs
EEA	Environmental Economic Accounts
Eskom	Electricity Supply Commission of South Africa
GDP	Gross domestic product
GWP	Global warming potential
H^+	Hydrogen
Kg	Kilogram
km	Kilometres
km^2	Square kilometres
MARAM	Marine Resource Assessment and Management
MDG	Millennium Development Goals
NH_3	Ammonia
N_2O	Nitrous oxide
NO_X	Nitrogen oxides
PSR	Pressure-state-response
SEEA	System of Integrated Environmental and Economic Indicators
SO_2	Sulphur oxide
Stats SA	Statistics South Africa
TAC	Total allowable catch
UNEP	United Nations Environment Programme
UNSD	United Nations Statistics Division

Figures and tables

[a] Driver-pressure-state-impact-response framework used in state of environment reporting

Environmental Economic Account Indicators

1. Introduction and background

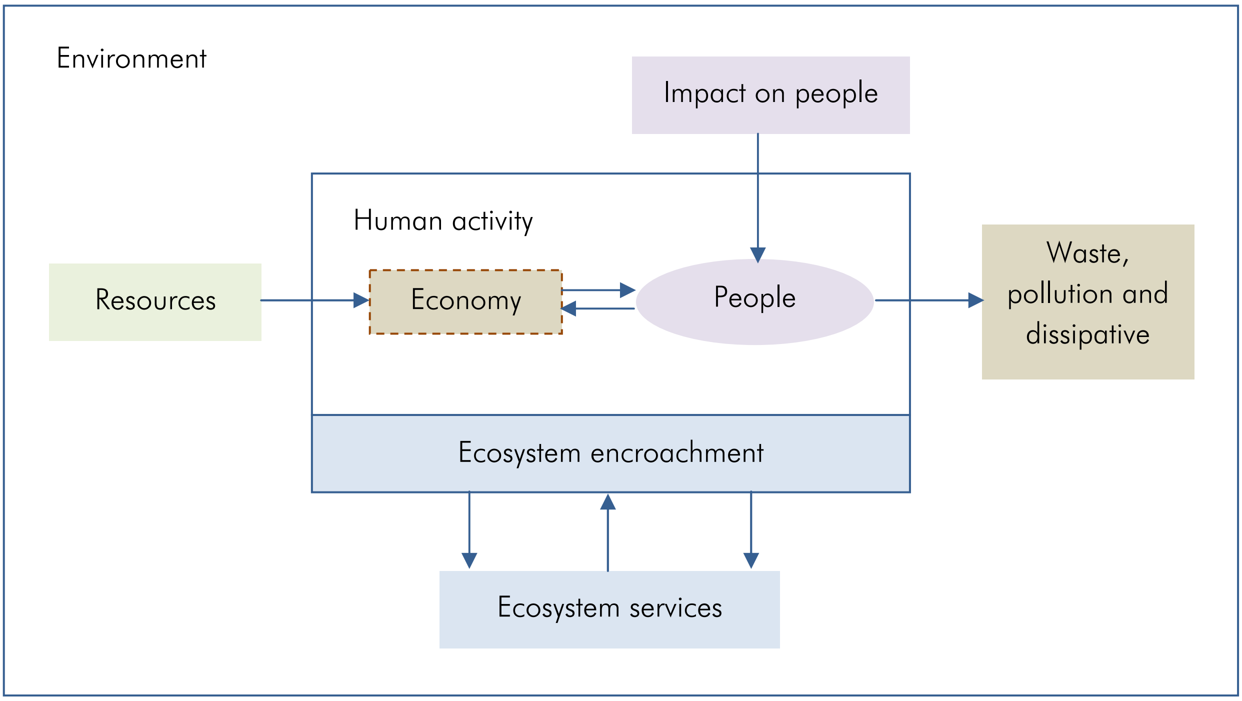
In 1992, the first United Nations Conference on Sustainable Development, popularly known as the Rio Earth Summit, was convened in Rio de Janeiro, Brazil to address the state of the environment and sustainable development. The Rio Earth Summit yielded several important agreements including 'Agenda 21', a plan of action adopted by over 178 governments to address human impacts on the environment at local, national and global levels, and key treaties on climate change, desertification and biodiversity. At the second conference in 2002 in Johannesburg, South Africa – the World Summit on Sustainable Development – governments agreed on the Johannesburg Plan of Implementation, reaffirming their commitment to Agenda 21. In 2012, the United Nations Conference on Sustainable Development, or Rio+20 Earth Summit, focused on the Green Economy in the context of sustainable development, poverty eradication, and the institutional framework for sustainable development. The objective is to renew political commitment to sustainable development, review progress and identify implementation gaps, and address new and emerging challenges. One of the responses to provide an update on achievements since the Earth Summit of 1992 is the publication, 'Keeping Track of Our Changing Environment' that is leading up to the publication of the 'Global Environment Outlook-5 (GEO-5)' in 2012. This innovative report is based entirely on statistical data and indicators and shows where the world stands on many social, economic and environmental issues as we enter the second decade of the 21st century. This is one of many attempts made since the publication of the Brundtland Report in 1987 to capture sustainable development in statistics. Globally, policy and decision-makers are trying to identify indicators that would reflect prosperity, well-being and sustainable use of resources. Numeric and time-bound targets have certainly aided in progress made towards the Millennium Development Goals (MDGs), for example, and should be applied towards environmental objectives as well.[1]

2. Indicator characteristics

Indicators need to provide simple and clear information on progress towards specific goals and targets. Indicators are physical, biological or socio-economic measures that best represent the key elements of a complex ecosystem or environmental issue. The primary goal of indicators is to measure and monitor on sustainability progress. Indicators communicate specific information about the environment and the effect of human activities (refer to Figures 1 and 2).[2] The indicators that are embedded in a well-developed interpretive framework has meaning well beyond the measure it represents. The environment here is referred as a holistic approach covering the social, economic, institutional as well as biophysical components. Indicators should also be administratively practical and cost-effective to populate.[3] The 'SMART' concept of indicators is summarised below:

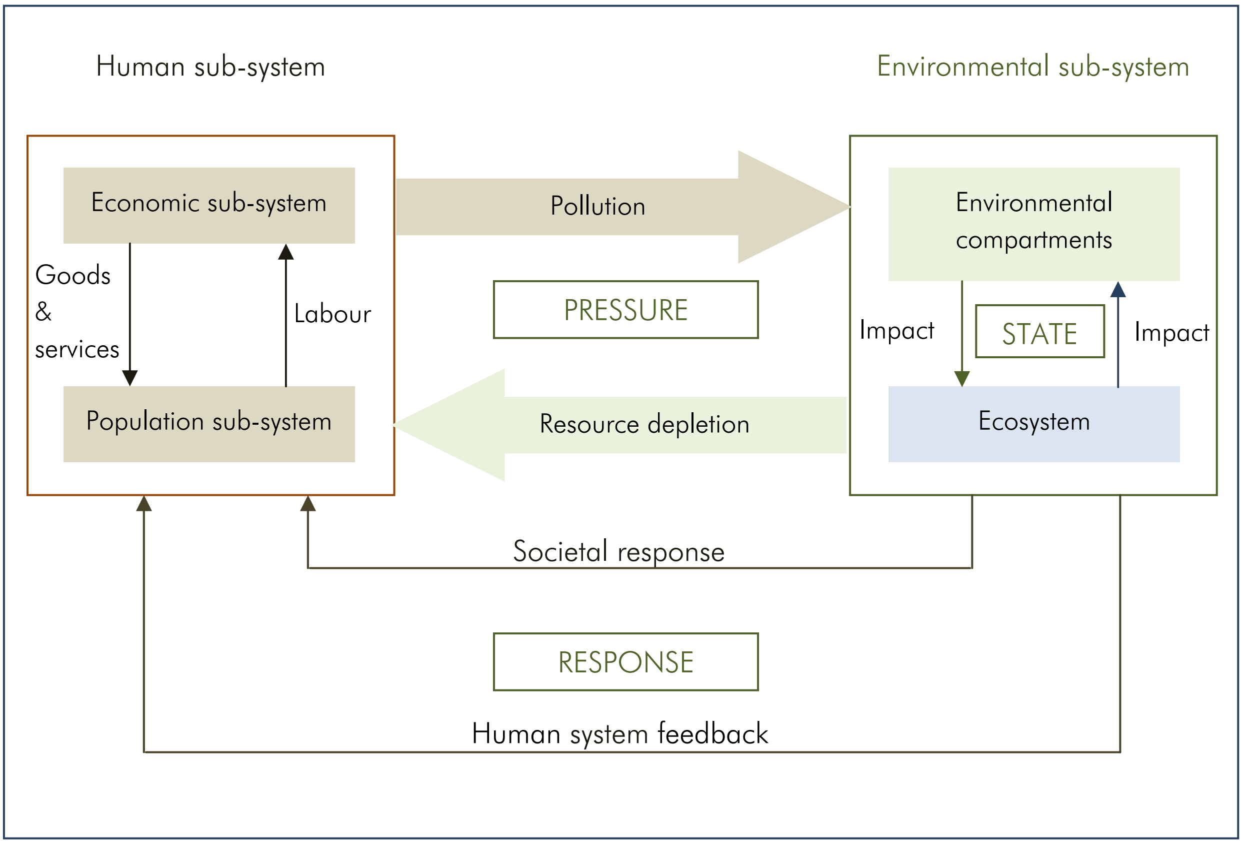
- Simple – easily interpreted and monitored;
- Measurable – statistically verifiable, reproducible and show trends;
- Accessible – regularly monitored, cost effective and consistent;
- Relevant – directly address issues or agreed objectives, such as those of the matters for target for biodiversity conservation; and
- Timely – provide early warning of potential problems.

Figure 1: A model of human interaction with the environment



Source: United Nations Environment Programme (UNEP), 1995. Scanning the global environment; a framework and methodology for UNEP's reporting functions. UNEP Environment Assessment Technical Report 95-01. Nairobi, Kenya.

Figure 2: Pressure-state-response (PSR) frameworks for indicators



Source: United Nations Environment Programme (UNEP), 1995. Scanning the global environment; a framework and methodology for UNEP's reporting functions. UNEP Environment Assessment Technical Report 95-01. Nairobi, Kenya.

Not all environmental indicators are suitable indicators for all purposes. Some measures are important for certain purposes in a specific region but lack national significance. Indicators should:

- Reflect a valued element of the environment or important environmental issues;
- Have relevance to policy and management needs;
- Be useful for tracking environmental trends at a range of spatial scales from the local to the continental;
- Be scientifically credible;
- Serve as a robust indicator of environmental change;
- Be readily interpretable;
- Be monitored regularly, either by existing programs or by new programs that might be established in the future at reasonable cost; and
- Reflect national programs and policies.[2]

In order to be useful it is preferable if an indicator displays the following characteristics:

- The indicator definition is closely linked to a policy goal, objective and/or target. Indicators are most helpful when objectives have been specified in terms of targets or milestones that apply to the definition of the indicator.
- The indicator is measured regularly. It is helpful to have time series information where the precise indicator definitions have been applied consistently. Ideally data should be available from prior to the adoption or implementation of the intervention. However, interventions may require for new data to be collected.
- Steps are taken to ensure data gathered are reliable.

In practice indicators rarely exhibit all of the above characteristics and it is often necessary to gather evidence from a variety of disparate sources including:

- The inputs to the programming process;
- Secondary sources;
- Primary sources, including stakeholder surveys; and
- Administrative information.

Much of this information may have been gathered for purposes other than evaluation.

An indicator may have several values over time. The extraction rate of gold, for example, may have a different value at the outset from a value taken mid-way through the implementation of a programme. Variations over time constitute trends.[4]

3. Indicators linked to environmental economic accounts

Environmental objectives cannot be pursued without an awareness of the consequential socio-economic effects. The understanding of these linkages is achieved by integrating environmental and socio-economic information. Robust measurement frameworks are required to show the bigger picture, identify gaps and draw connections with other socio-economic statistics. On the information side, data items flow into standard tables and supplementary tables of the System of Integrated Environmental and Economic Accounting (SEEA). From these tables headline indicators and indicators on specific subjects or industries are developed. Data users are managers, analysts and researchers who provide advice and research findings to decision makers and the wider public (refer to Figure 3).

The SEEA is an internationally adopted framework with analytical potential that lends itself to the development of indicators calling on a wide range of data, which can provide insight and guidance to policy makers in both the economic and environmental sectors. While the SEEA do not attempt to define a given set of indicators of sustainable development, compiling such sets is now common in many countries and international organisations. Often the SEEA framework can provide relevant information and provide the background for a set of indicators that is more consistent than independently selected indicators, and which provides better linkages between indicators of environmental pressures and responses. Similar to the main national accounts, the SEEA accounts provide a score-keeping function from which key indicators can be derived and used in the analysis of policy options. The accounts provide a sound basis for the calculation of measures, which may already be included in sets of sustainable development indicators, but they may also be used to develop new indicators, such as environmentally-adjusted macro-aggregates which would not otherwise be available. The United Nations Statistics Division (UNSD) has on-going development with regard to SEEA Parts 2 and 3. Part 2 of the SEEA deal with applications and extensions to the central framework. As countries are encouraged by the UNSD to implement the SEEA, it is a valuable and practical framework.

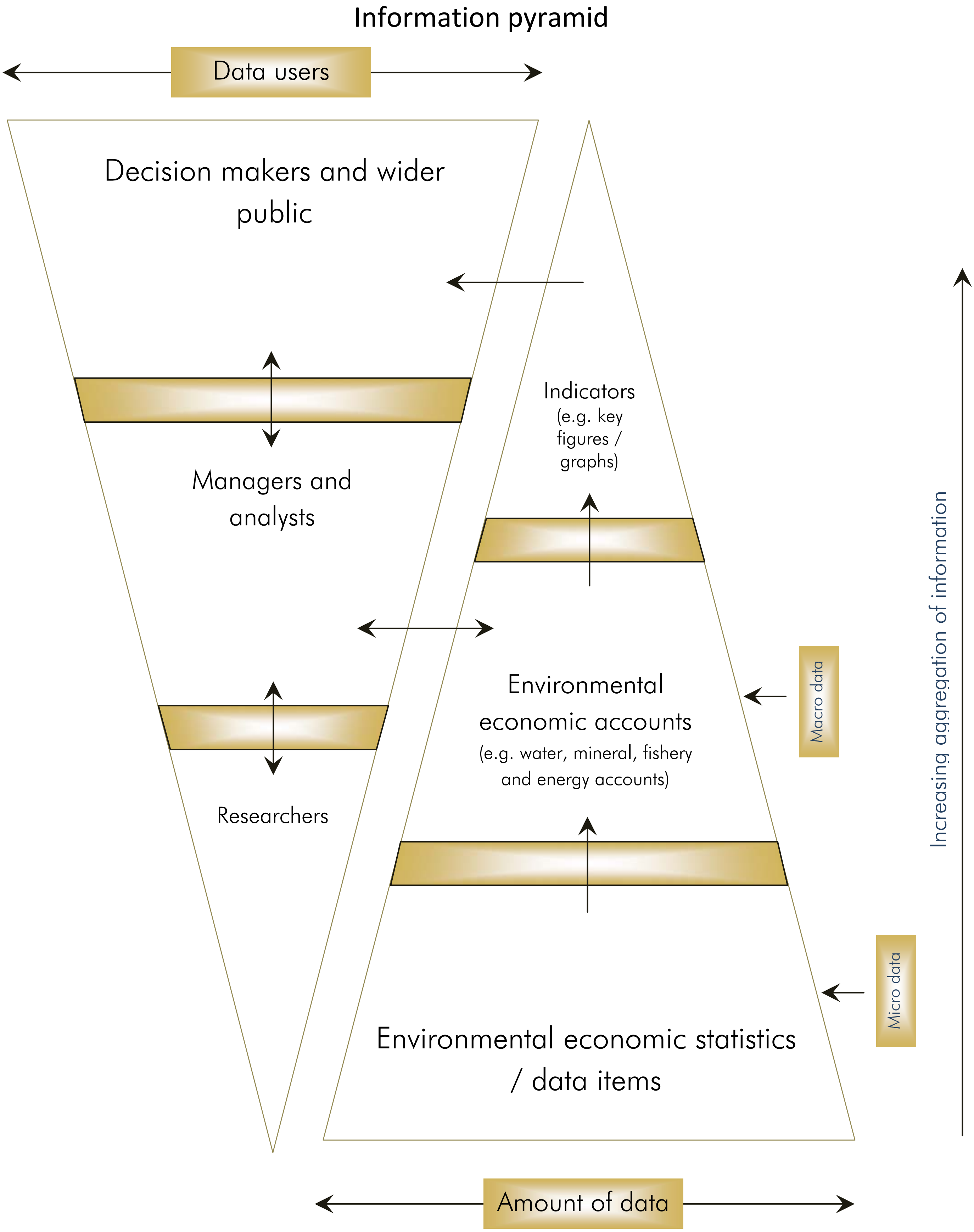
3.1 Physical Accounts

The physical accounts bring a set of common measuring tools to harmonise different data sets that are collected for a wide spectrum of environmental resources. If common units can be used, aggregation and the presentation of simple indicators are facilitated. Figure 3 shows the increasing hierarchy of aggregation, starting with data feeding into environmental accounts in turn providing indicators. With asset accounts, indicators show to what extent stock of a given asset is being sustained or not in both physical and monetary terms.

3.2 Ecosystems

Few attempts have been made to establish asset accounts for ecosystems globally. For example, physical and monetary estimates could be provided for each of the services offered by woodlands and thickets. When it is not possible or not desirable to provide individual estimates for each service of an ecosystem, it may only be possible to present a single set of statistics that incorporates all the services offered by the system. This might consist of a physical estimate of the extent of the woodlands and thickets, and a corresponding monetary estimate of its value to the population (aside from the value of the timber they contain, which is classified as a natural resource asset). The deficiencies of such a solution should however be clearly recognised. Natural resources can be measured in physical terms and valued, albeit with some practical problems. On the basis of this, analyses can be made to show whether these assets are being used by the economy in a sustainable way or not. Ecosystems are by their nature less amenable to 'economic' measurement or valuation and thus extremely difficult (or may even be misleading) to make judgements on the ecological sustainability of a course of action based on economic accounts. In order to have a more rounded and complete view of ecological sustainability, indicators reflecting ecological conditions should be used to complement the environmental economic accounts (EEA).[5]

Figure 3: Information pyramid[6]



Sources: United Nations, 2012. *International Recommendations for Water Statistics*. United Nations, New York, 2012. Australian Bureau of Statistics, 2012. A systems approach to supporting environmental sustainability, Canberra, Australia.

3.3 Environmental themes

In order to assess the cumulative impact of a number of different flows on the same environmental phenomenon, it is possible to introduce alternative classifications to units of account to represent certain quality aspects of these flows. One example is to use conversion factors to show how much of one substance has the same impact as a single unit of another substance. In this way, these substance-based quantity units can indicate the relative potential stress on the environment caused by individual substances in relation to particular environmental concerns. Subsequently, these equivalents can be used for weighting and aggregating a number of substances into one indicator, also called environmental theme indicators. Such theme indicators underline the multiple characters of environmental concerns, as shown in Table 1 below. The theme indicators reflect the potential stress on the environment and thus contribute to a compact representation of environmental pressures without the necessity of oversimplification. The development of theme indicators is complex and will not be attempted any time soon by Stats SA. Such an effort will have to be in collaboration between different partners to Stats SA, i.e. the Department of Environmental Affairs (DEA), the Department of Energy (DoE), the Department of Mineral Resources (DMR), the Department of Agriculture, Forestry and Fisheries (DAFF), and the Department of Water Affairs (DWA).

Table 1: Conversion of residuals by weight into theme-equivalents

Global warming theme				
	Emissions (kg)	Global warming potential (GWP) factor (CO_2 conversion factor)	CO_2 equivalents (kg)	Shares %
CO_2				
N_2O				
CH_4				
Total				
Acidification theme				
	Accumulation (kg)	Acidification equivalent	Acid equivalents (moles of H^+ ions)	Shares %
NO_X				
SO_2				
NH_3				
Total				

Source: United Nations, *et. al.*, 2003. Integrated Environmental and Economic accounting, 2003.

3.4 Economic and environmental-economic indicators

Already in some countries such as Norway and Canada, environmental indicators regularly supplement the national accounts aggregates. Aggregate indicators such as gross domestic product (GDP), unemployment and environmental theme indicators together provide a compact set of indicators which review the economic performance at the macro level. These indicators can also be presented at a sectoral level and provide the basis for environmental-economic profiles. Besides monitoring the developments of environmental and economic indicators in detail, these profiles also demonstrate the importance of the economic structure. Economies dominated by services industries will show totally different residual emission patterns when compared to economies where agriculture or manufacturing industries predominate.

Environmental indicators drawn from the hybrid accounts framework supplement the time trends of national accounts figures with comparable time trends of resource use, residual emissions, and environmental degradation, both in total and by industry. The overview of economic and environmental trends helps to assess whether national goals are achieved typically set in terms of total figures for residual emissions or resource use.

3.5 Environmental-economic profiles

While the aggregated figures provide a useful overview of trends in the economy, more detailed information tells us where progress has been made over time and where obstacles still remain for future action. Norway uses environmental-economic profiles for 'benchmarking' industry performance, a useful tool for national environmental policy and environmental management. The first set of benchmark indicators for Norway was developed for air pollutants and this approach is now being expanded to include environmental issues such as solid waste and waste water. An example is a Nordic profile that includes economic contributions of that industry, the input factors (employment and energy use) and the environmental consequences, i.e. carbon dioxide (CO_2) emissions as a percent of the national total. Within the European Union benchmarking may be quite useful as a means to monitor progress of member countries toward common environmental goals.[5]

4. Selection criteria

There are no hard-and-fast rules for the selection criteria. The following serves as an indication of what could be a set of practical selection criteria to determine the indicator set.

Measurable
An indicator can be quantified and measured using some scale. Quantitative indicators are numerical. Qualitative indicators are descriptive observations. While quantitative indicators are not necessarily more objective, their numerical precision is conducive to agreement on interpretation of results data, making them usually preferable.

Practical
Data can be collected on a timely basis and at reasonable cost. Managers require data that can be collected frequently enough to inform them of progress and influence decisions. Organisations should expect to incur reasonable but not exorbitant costs for obtaining useful information. A general rule is to plan on allocating 3 to 10 percent of total program resources for monitoring and evaluation.

Reliable
Data can be measured repeatedly with precision by different people. While the data that a program manager needs to make reasonably confident decisions about a program do not have to be held to the same rigorous standards research scientists use, all indicators should be able to be measured repeatedly with relative precision by different people.

Relevant
Indicator programme receiving institutional and budget support. A result is caused to some extent by project-supported activities. Attribution exists when the links between the project outputs and the results being measured are clear and significant.

Useful to policy and decision management
Information provided by the measure is critical to decision-making. Avoid collecting and reporting information that is not used to support program management decisions.

Direct
The indicator closely tracks the result it is intended to measure. An indicator should measure as closely as possible the result it is intended to measure. If using a direct measure is not possible, proxy indicators might be appropriate, e.g. sometimes reliable data on direct measures are not available at a frequency that is useful. Proxy measures are indirect measures linked to the result by one or more assumptions, e.g. in rural areas it is often difficult to measure income levels directly. Measures such as percentage of village households with roofs (or radios or bicycles) may be a useful, if a somewhat rough proxy. The assumption is

that when villagers have higher income, they tend to purchase certain goods. Select proxy indicators for which convincing evidence exists of the link to the result (e.g. research data).

Sensitive
The indicator serves as an early warning of changing conditions. A sensitive indicator will change proportionately and in the same direction as changes in the condition or item being measured, thus sensitive proxy indicators can be used as an indication (or warning) of results to come. For example, household rice consumption is a sensitive proxy indicator for income if the amount of rice consumed always rises with the level of income.

Responsive
Indicators should reflect change as a result of project activities and thus indicators reflect results that are responsive to management action.

Objective
The measure is operationally precise and one-dimensional. An objective indicator has no ambiguity about what is being measured. That is, there is general agreement on the interpretation of the results. It is both one-dimensional and operationally precise. To be one-dimensional means that it measures only one phenomenon at a time. Avoid trying to combine too much in one indicator.

Data comparability
The data that supports the indicator can be compared to existing data sets and/or past conditions.[7]

5. Template fields

The following is a list of fields that could be included in the indicator fact sheet. An internal selection process as discussed in paragraph 4, based on available information pertaining to each indicator will determine which fields will be used. The following list will assist with the selection of fields to be included:

- Indicator name and number;
- Indicator type, i.e. Driver-Pressure-State-Impact-Response (DPSIR)
- Description of indicator;
- Issue (i.e. resource management, energy);
- Units of measurement (i.e. tons, terajoules);
- Spatial scale (i.e. national/regional);
- Frequency (i.e. annual/5-yearly);
- What does the indicator measure;
- What is the relevance of the indicator;
- What are the trends;
- References and other information;
- Graph and/or map;
- Linkages to other indicators;
- Selection criteria;
- Reason for selection;
- Data sources;
- Data storage: (where, how, security);
- Assumptions;
- Methodology;
- Cost of indicator; and
- Responsibility (i.e. Stats SA, DAFF, etc.).

6. Environmental economic accounts indicators

The following list is an initial selection of indicators derived from environmental economic accounts (EEA) that could be developed in future. This is only an indication of possibilities, and much simpler physical stock indicators may be the starting blocks for developing a series of indicators. This list will be continually revised and updated for each planning cycle to inform which indicators will be added to the suite.

Energy:

- Energy intensity per industry in South Africa. This is showing the amount of energy in relation to the GDP and the efficiency of energy use for each industrial sector.

- Annual production by energy source. Serves as a proxy for energy intensity and an economic driver as well as showing the energy mix required to feed different sectors.

- Annual consumption by energy source. This is important in terms of showing the requirements of the different economic sectors and as a planning tool.

- Energy imports and exports. Shows reliance on imports and South Africa's ability to export in the energy market.[8]

Fisheries:

- Fish resource depletion. Hake (*Merluccius paradoxus* and *M. capensis*) closing stock (exploitable mass) and catches. Serves as an indication of the amount of fish being caught (economic activity) and as well as the pressure on the fish stocks.

- Correlation between fish stock and total allowable catch (TAC). The hake (*Merluccius paradoxus* and *M. capensis*) TAC and closing stock (exploitable mass). This indicates whether the set TAC levels are effective in ensuring sustainability of the fish stocks. It is also an indication if the policy implementation is effective.

- Share of world fish catches. This shows what the share of the South African fish catch is in comparison to other countries (percentages).[9]

Minerals:

- Minerals – employment rate compared to production, and total earnings in the minerals sector.

- Comparison between actual tax collection and resource rent. Indicator shows how much royalties should government collect compared to how much is actually collected.

- Percentage of mining tax to be re-invested. This indicator would show the percentage of the mining tax (resource rent) that government could re-invest in alternative priorities to benefit the strategic growth of the country.

- Split of total tax between income component and capital component. This would show how much of the total tax collected should be consumed as current income (income component) or re-invested to insure a current stream of income (capital component).

- Mineral resource depletion. The resource depletion will show whether the mining sector is operating in a sustainable manner.[10]

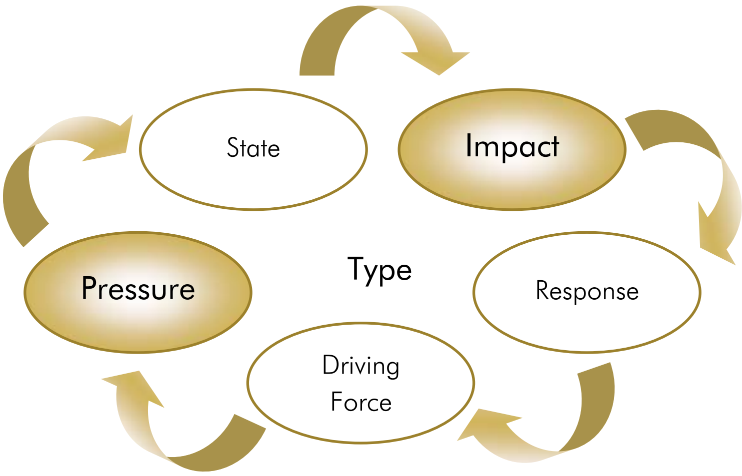
Water:

- Water river health (water quality) – dependant on information released by the DWA and/or the Water Research Commission (WRC). The quality is an indication or proxy of the quantity available for various uses, i.e. human consumption, irrigation, waste water, etc.[11]

Three indicators have been developed based on current EEAs. One each of the energy, fishery and mineral accounts was selected due to data availability and serving as rough examples. These three indicators could be the first selection, but will need refinement before they are published as part of the EEA compendium.

6.1 EEA Indicators: Energy – Energy intensity for manufacturing in South Africa, 2002–2009

Figure 4: Energy intensity for manufacturing in South Africa, 2002–2009 placement in DPSIR[b] framework



Description
The indicator shows the amount of energy used by the manufacturing sector in South Africa. The amount of energy used in relationship to the GDP total value added shows the manufacturing sector's energy intensity.

Linkages
This indicator could be linked to minerals, since mineral deposits are extracted to fuel electricity generation. It is possible to determine how much energy is used during a certain extraction period of a given mineral resource. There is a link to the economy and specifically the GDP.

Selection criteria
The indicator met the following criteria:

- Data available at no cost;
- Provides information to measure important issues;
- Information presented can be easily understood;
- Relate to goals, targets and objectives;
- Provide timely information to allow for responses;
- Addresses key issues and is relevant to policy and management needs in South Africa;
- Data available and accessible in the long term;
- Data of correct spatial and temporal extent, and time series; and
- Data collection process has minimal environmental impact.

Measurement

Units	Spatial scale	Frequency
Terajoules Gross domestic product	National	Annually

[b] Driver-pressure-state-impact-response framework used in state of environment reporting

Basic information

The manufacturing sector includes basic iron and steel, fabricated and metal products, food and beverages, machinery, electrical machinery, appliances and electrical supplies, vehicle parts and accessories, and chemicals. Petrochemical plants such as Sasol II and III are part of the manufacturing sector. The manufacturing sector has a number of subsectors, i.e. textiles, furniture, agricultural processing and products (such as raw forestry material), jewellery and engineering products.[12]

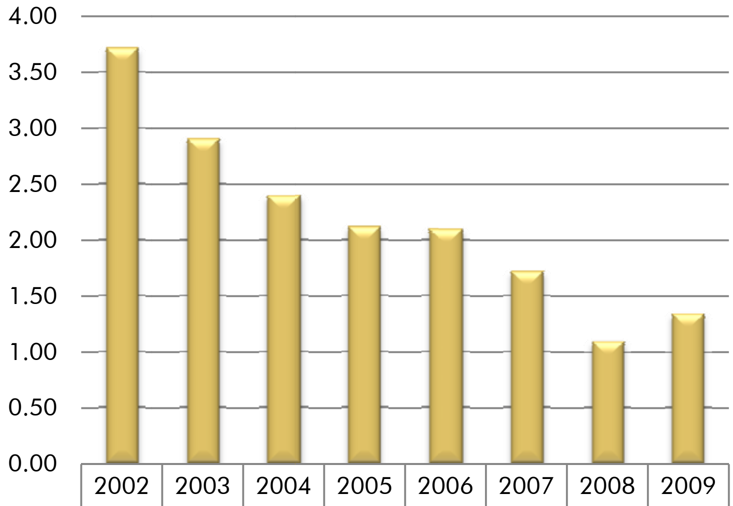
Manufacturing is the largest consumer of energy from 2002 to 2009. In 2002 the manufacturing industry used 4 462 893 terajoules (TJ) or 74,7% of energy supplied and the energy used dropped to 2 103 786 TJ or 49,1% of energy supplied in 2009. The iron and steel industry is the biggest energy user within the manufacturing sector. Table 2 shows the amount of energy in TJ used by the manufacturing sector, and the total value added to the GDP at constant prices from 2002 to 2009. (Refer to Figure 5). High energy intensities indicate a high price or cost of converting energy into GDP. Low energy intensity indicates a lower price or cost of converting energy into GDP.

Table 2: Energy intensity for manufacturing in South Africa, 2002–2009[8]

2002	2003	2004	2005	2006	2007	2008	2009
Manufacturing energy use (Terajoules)							
4 462 893	3 602 037	3 109 626	2 888 487	3 036 673	2 619 092	1 732 371	2 103 786
GDP, total value added at basic prices (R millions)							
1 200 444	1 237 059	1 294 010	1 363 665	1 443 133	1 524 775	1 577 595	1 556 364
Energy intensity for the manufacturing sector (Terajoules per Rand)							
3,72	2,91	2,40	2,12	2,10	1,72	1,10	1,35

Sources: Statistics South Africa, 2012. *Gross Domestic Product, P0441 2nd Quarter 2012*. Statistics South Africa, 2012. *Energy Accounts for South Africa, 2002–2009*, discussion document: D0405.1.1.

Figure 5: Energy intensity for manufacturing in South Africa, 2002–2009[8]



	2002	2003	2004	2005	2006	2007	2008	2009
Energy intensity (Terajoules per Rand)	3.72	2.91	2.40	2.12	2.10	1.72	1.10	1.35

Sources: Statistics South Africa, 2012. Gross *Domestic Product, P0441 2nd Quarter 2012*. Statistics South Africa, 2012. *Energy Accounts for South Africa, 2002–2009*, discussion document: D0405.1.1.

Data sources and references

The main data source is:

Statistics South Africa, 2012. *Energy Accounts for South Africa: 2002–2009*. Discussion document: D0405.1.1.

References include:

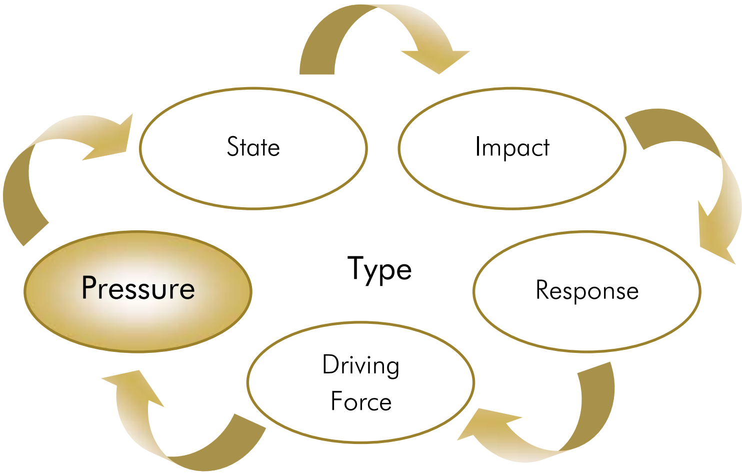
Department of Energy, 2011. *Energy Balances, 2009*.

Government Communications Information System. *South Africa Yearbook 2010/11, Energy*.

Statistics South Africa, 2012. *Gross Domestic Product, P0441, 2nd Quarter 2012*.

6.2 EEA Indicators: Fisheries – sustainability of hake (*Merluccius paradoxus and M. capensis*) stocks, 1990–2010

Figure 6: Fisheries – sustainability of hake (*Merluccius paradoxus* and *M. capensis*) stocks, 1990– 2010 placement in DPSIR framework



Description
Catch levels and closing stock for hake (*Merluccius paradoxus* and *M. capensis*) and output for fish and fish farming.

Linkages
This indicator is linked to biodiversity themes and the United Nations Convention on the Law of the Sea of 10 December 1982, as well as the Commission for Sustainable Development indicator 'Maximum sustained yield for fisheries'.

Selection criteria
The indicator met the following criteria:
- Good quality data, available at minimal cost;
- Provides information to measure important issues;
- Information presented to be easily understood;
- Relate to goals, targets and objectives;
- Provide timely information to allow for responses;
- Relevant to policy and management needs in South Africa;
- Accurate, reliable, and scientifically sound data;
- Data available and accessible in the long term;
- Data of correct spatial and temporal extent, and time series; and
- Data collection process has minimal environmental impact.

Measurement

Units	Spatial scale	Frequency
Thousands tons Rand millions output	National	Annually

Basic information

Location:	South East Atlantic within the South Africa 200 nautical mile Economic Exclusion Zone.
Fishing gear:	Bottom trawl.
Season:	Year-round.
Products:	Whole, headed & gutted, fillets, steaks, portions, minced, chilled, coated, frozen block, marinated, loins, pickled, ready meal, and smoked.

Trawl fisheries targeting hake provide over half of the value of all fisheries in South Africa. The main export markets are Europe, Australia and the United States of America. The offshore trawl fishery mostly targets deepwater *M. paradoxus* on the shelf edge from the Namibian border southwards. Shallow water *M. capensis* is the target of the inshore trawl fishery, which operates mostly on the Agulhas Bank off the south coast. The two species overlap in their depth distribution, and both are found around the entire South African coast. Growth in both species is slow, and fish can reach 115 centimeters (cm) in size. Hake are piscivorous as adults, feeding at night, whereas they aggregate near the bottom during the day, when they are targeted by trawlers.

The South African hake fishery has become more inclusive and consultative recently. All fishing right holders have signed Codes of Conduct, committing them to compliance procedures and accepting the concept of sustainable harvesting. An Operational Management Plan is in place to allow the recovery of *M. paradoxus* stocks to sustainable levels within 20 years.[9]

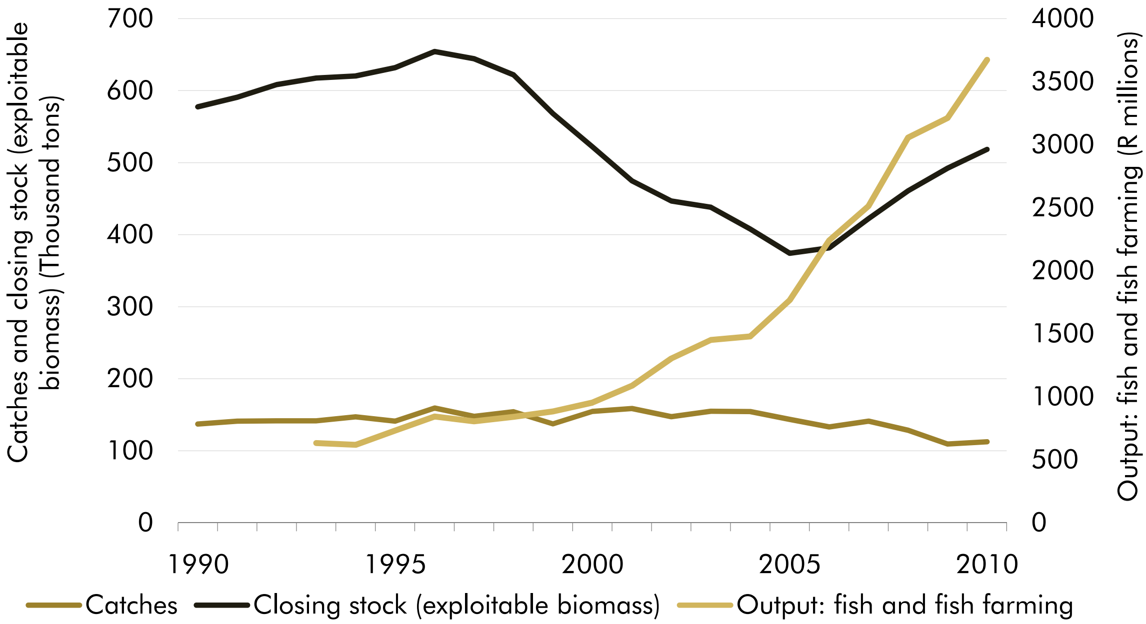
Table 3: Closing stock, catches and output of hake (*Merluccius paradoxus* and *M. capensis*), 1990– 2010[9]

Year	Closing stock (exploitable biomass)			Catches	Output: fish and fish farming
	M. paradoxus	*M. capensis*	Species combined		
		(Thousand tons)			(R millions)
1990	281	296	577	137	-
1991	286	305	591	141	-
1992	295	314	608	142	-
1993	293	324	618	141	632
1994	283	338	620	147	618
1995	293	339	632	141	732
1996	324	331	654	159	843
1997	320	325	644	148	805
1998	301	320	622	154	840
1999	255	313	568	137	883
2000	221	301	522	155	953
2001	201	274	475	159	1 087
2002	204	243	447	147	1 304
2003	214	224	438	155	1 451
2004	204	204	408	154	1 479
2005	190	184	374	144	1 766
2006	206	176	382	133	2 241
2007	242	180	422	141	2 513
2008	263	198	461	128	3 056
2009	263	229	492	109	3 211
2010	251	267	519	112	3 673

Source: Statistics South Africa, *Fishery Accounts for South Africa, 1990–2010*, discussion document: D0405.0.

Figure 7 shows the inverse relationship between catch data and the closing stock (exploitable biomass). In 2004 the catches started to decrease to a level of 154 thousand tons and continued the trend to 109 thousand tons in 2009. From 2006 the closing stock for the combined species began to recover to a level of 382 thousand tons, increasing to 519 thousand tons in 2010.[9] Fish and fish farming for the fishing industry as a whole showed an increasing output from 1993 (R632 million) to 2010 (R3 673 million). As fish and fish farming increased there was a corresponding drop in closing stock (exploitable biomass) until 2004 when closing stock (exploitable biomass) started to recover, which may be due to the catch levels slowing down from 2003.

Figure 7: Closing stock, catches and output of hake (*Merluccius paradoxus* and *M. capensis*), 1990– 2010[9]



Source: Statistics South Africa, *Fishery Accounts for South Africa, 1990–201,* discussion document: D0405.0.

Data sources and references

The main data source is:

Statistics South Africa, 2012. *Fishery Accounts for South Africa: 1990–2010,* discussion document: D0405.0.

References include:

Department of Agriculture, Forestry and Fisheries (DAFF), Marine Resource Assessment and Management (MARAM), and the University of Cape Town, Department of Mathematics and Applied Mathematics.

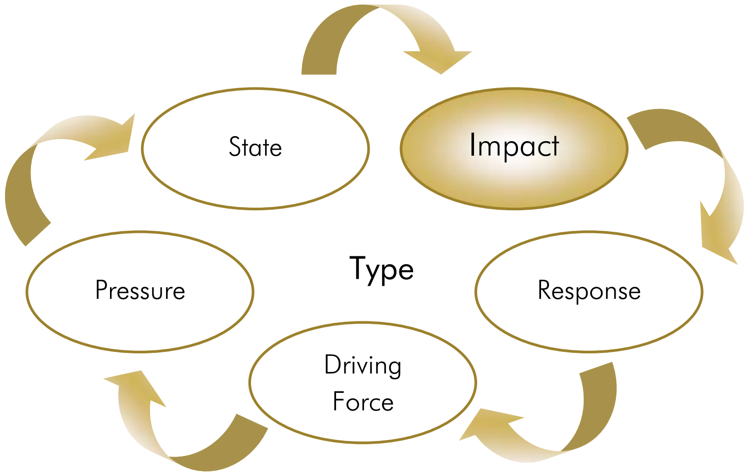
Marine Stewardship Council (MSC), 2009. *MSC Fishery Fact Sheet: South Africa hake trawl fishery, 2009*. Website: www.msc.org

Limitations

The data is currently limited to two fisheries, namely hake (*M. paradoxus and M. capensis*) and west coast rock lobster (*J. lallandi*).

6.3 EEA Indicators: Minerals – employment rate compared to production, and total earnings in the minerals sector (gold production and extraction), 1990–2010

Figure 8: Minerals – employment rate compared to production, and total earnings in the minerals sector (gold production and extraction), 1990–2010 placement in DPSIR framework



Description

The production/extraction of gold, number of workers employed and the total earnings in the minerals sector.

Linkages

This indicator is linked to South Africa's labour force and the employment rate in the country as well as compensation of employees for the gold industry.

Selection criteria

The indicator met the following criteria:

- Good quality data, available at minimal cost;
- Provides information to measure important issues;
- Information presented to be easily understood;
- Relate to goals, targets and objectives;
- Provide timely information to allow for responses;
- Able to detect small changes in the system;
- Relevant to policy and management needs in South Africa;
- Accurate, reliable, and scientifically sound data;
- Data available and accessible in the long term;
- Data of correct spatial and temporal extent, and time series; and
- Data collection process has minimal environmental impact.

Measurement

Units	Spatial scale	Frequency
Number of employees Tons of gold extraction R millions earnings	National	Annually

Basic information

South Africa's gold mining industry has been and remains a major contributor to the economy and the country's socio-economic development. In the 1980s, the gold sector accounted dominantly for all mineral-related income. However, gold has fallen from its eminent position as the main contributor to mineral sales, as a result of which employment in the mining industry has contracted significantly since 1986. Over 50% of all gold reserves are found in South Africa, where the Witwatersrand holds the world's largest gold reef deposit.[10, 12]

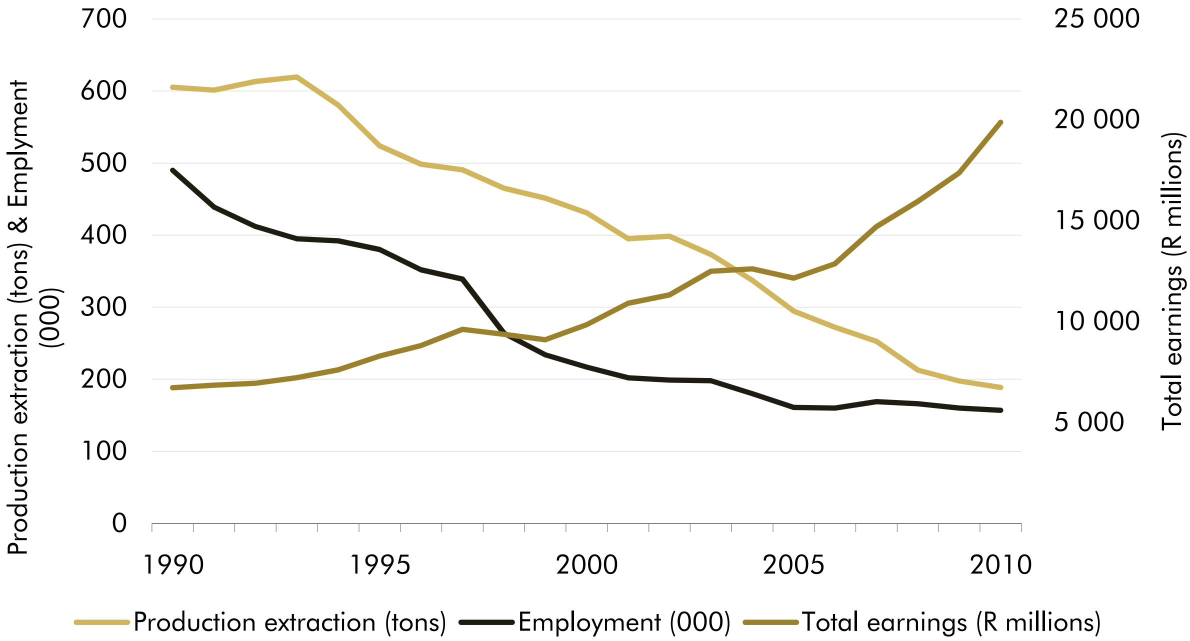
Table 4 shows the production/extraction of gold, the number of employees in the gold mining industry and total earnings from 1990 to 2010. Gold production/extraction is showing a gradual decrease over the period from 1990 to 2010. In 1990 gold production was 605 tons and has decreased to 187 tons in 2010. Employment in the gold mining industry is also decreasing from 490 000 in 1990 to 157 000 in 2010. It seems that there is a cause and effect between gold production/extraction and the number of employees. Refer to Figure 9 for the trend in gold production/extraction and employment in the gold mining industry. Total earnings increased from R6 720 million in 1990 to R19 878 million in 2010.

Table 4: Production/extraction of gold, employment and total earnings (compensation of employees) in the gold mining industry, 1990–2010[10, 12]

Year	Production / extraction (tons)	Number of employees (thousands)	Total earnings (Rand millions)
1990	605	490	6 720
1991	601	439	6 849
1992	613	412	6 940
1993	619	395	7 217
1994	580	392	7 612
1995	524	380	8 292
1996	498	352	8 807
1997	491	339	9 613
1998	465	264	9 372
1999	451	234	9 100
2000	431	217	9 846
2001	395	202	10 904
2002	399	199	11 324
2003	373	198	12 496
2004	337	180	12 610
2005	295	161	12 153
2006	272	160	12 865
2007	253	169	14 709
2008	213	166	15 960
2009	198	160	17 371
2010	187	157	19 878

Source: Statistics South Africa, *Mineral Accounts for South Africa, 1980–2009*, discussion document D0405.2.

Figure 9: Production/extraction of gold and employment, and total earnings in the gold mining industry, 1990–2010[10, 12]



Source: Statistics South Africa, *Mineral Accounts for South Africa, 1980–2009*, discussion document: D0405.2.

Data sources and references

The main data source is:

Statistics South Africa, 2012. *Mineral Accounts for South Africa: 1980–2009*, discussion document: D0405.2.

References include:

Department of Mineral Resources, 2011. *South African Minerals Industry*.

Government Communication Information System. *South Africa Yearbook, 2010/11. Minerals*.

7. References

1 United Nations Environment Programme (UNEP), 2011. *Keeping Track of Our Changing Environment. From Rio to Rio+20 (1992 – 2012)*. Division of Early Warning and Assessment (DEWA), UNEP, Nairobi, Kenya.

2 United Nations Environment Programme (UNEP), 1995. *Scanning the global environment; a framework and methodology for UNEP's reporting functions*. UNEP Environment Assessment Technical Report 95-01, Nairobi, Kenya.

3 Department of the Environment and Heritage, 2006. Environmental Indicators for reporting, Canberra, Australia.

4 European Commission website: http://ec.europa/regional_policy/sources/docgener/evaluation/evalsed/guide/methods_techniques/indicators/indicators_en.htm

5 United Nations Statistics Division, 2003. System of Integrated Environmental and Economic Accounts (SEEA).

6 United Nations Statistics Division (UNSD), 2012. International Recommendations for Water Statistics. UNSD, New York, 2012.

7 World Bank.
Website:
http://gaetlibrary.worldbank.org/files/1035_Criteria%20for%20assessing%20indicators%20Annex%20O.pdf

8 Statistics South Africa, 2012. *Energy Accounts for South Africa: 2002–2009*. Discussion document D0405.1.1. Website: www.statssa.gov.za.

9 Statistics South Africa, 2012. *Fishery Accounts for South Africa: 1990–2010*. Discussion document: D0405.0. Website: www.statssa.gov.za.

10 Statistics South Africa, 2012. *Mineral Accounts for South Africa: 1980–2009*. Discussion document: D0405.2. Website: www.statssa.gov.za.

11 Statistics South Africa, 2000. *Water Accounts for South Africa: 2000*. Discussion document: D0405.1. Website: www.statssa.gov.za.

12 Government Communications Information System, 2012. *South Africa Yearbook 2010/11*. Government Communications Information System, Pretoria.

13 Marine Stewardship Council (MSC), 2009. *MSC Fishery Fact Sheet: South Africa hake trawl fishery, 2009*. Website: www.msc.org