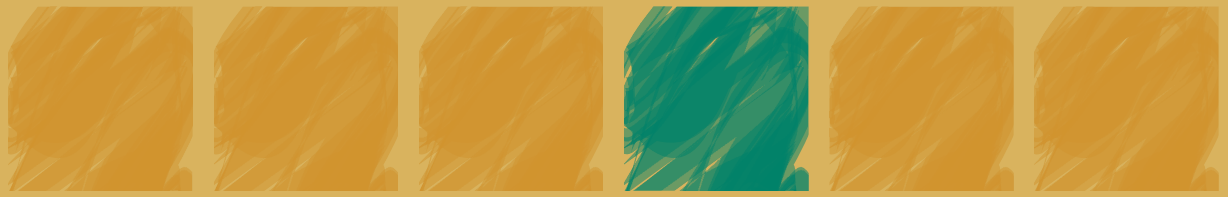
National Accounts



Environmental Economic Accounts

Water Accounts for South Africa: 2000

Statistics South Africa
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Discussion document: D0405.1
March 2009

Water Accounts for South Africa: 2000

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List of Abbreviations and Acronyms

AFS	Annual Financial Statistics Survey
C	Consumption
CEC	Commission of the European Communities
CS	Community Survey
DEAT	Department of Environmental Affairs and Tourism
DME	Department of Minerals and Energy
DWAF	Department of Water Affairs and Forestry
EEA	Environmental Economic Accounts
GDP	Gross domestic product
GHS	General Household Survey
GI	Gross investment
ha	Hectares
IB	Irrigation Boards
IES	Income and Expenditure Survey
IMF	International Monetary Fund
IUCN	International Union for Conservation of Nature
LSS	Large Sample Survey
m^3	Cubic metres
M	Import
MA	Millennium Ecosystem Assessment
MAR	Mean annual runoff
MCM	Marine and Coastal Management
MDG	Millennium Development Goals
MOU	Memorandums of Understanding
NDP	Net domestic product
NI	Net investment
NWA	National Water Act of 1998
NWRS	National Water Resources Strategy
OECD	Organisation for Economic Co-operation and Development
PPI	Production Price Index
QFS	Quarterly Financial Statistics Survey
RDM	Resource Directed Measure
ROW	Rest of the World
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks

SASQAF	South African Statistical Quality Assessment Framework
SEEA	System of Integrated Environmental and Economic Accounts
SEEAW	System of Environmental Economic Accounting for Water
SIC	Standard Industrial Classification of All Economic Activities
1993 SNA	1993 System of National Accounts
Stats SA	Statistics South Africa
SU-table	Supply and Use Table
UN	United Nations
UNCP	United Nations Statistical Commission
UNEP	United Nations Environment Programme
UNSD	United Nations Statistics Division
WB	Water Boards
WMA	Water Management Area
WUA	Water User Associations
X	Export

Executive Summary

Statistics South Africa (Stats SA) developed various environmental economic accounts (EEA) in the form of discussion documents for minerals, water and energy.

EEA measure the contribution of the environment to the economy and the impact of the economy on the environment. EEA therefore provide important data and information on the sustainable use of natural resources and their contribution to human well-being. EEA are consistent with the Millennium Ecosystem Assessment (MA) from the Millennium Ecosystem Assessment Organization, including partner institution groups such as the United Nations Environment Programme (UNEP), the World Bank, the International Union for Conservation of Nature (IUCN), and others that contribute valuable information to the measurement of the Millennium Development Goals (MDG).

The Stats SA EEA discussion documents have been developed according to the United Nations (UN) standard of the 1993 System of National Accounts (1993 SNA). Although the 1993 SNA does not explicitly include the development of environmentally oriented statistics, the United Nations Statistical Division (UNSD) has developed the System for Integrated Environmental and Economic Accounting (SEEA) as well as the System for Integrated Environmental and Economic Accounting for Water (SEEAW) to extend the asset boundary of the 1993 SNA. These are referred to as EEA.

One of the key constraints to the development of EEA in South Africa is the reliance on other government departments and statutory bodies as primary sources of EEA data. This reliance has limited Stats SA in the development of EEA in the following ways:

- It has required the use of data that do not necessarily qualify as official statistics (as defined according to the South African Statistical Quality Assessment Framework (SASQAF))
- It has limited Stats SA to the compilation of physical water accounts as the data provided by line departments and statutory bodies are expressed in physical units
- Data from line departments and statutory bodies are not classified according to the Standard Industrial Classification of all Economic Activities (SIC) in all cases.

The above constraints have prevented Stats SA from publishing regular EEA updates as well as making the accounts official reports.

In working towards addressing this constraint, Stats SA initiated a data audit of its internal data bases. Key Stats SA questionnaires (Annexure 1) were analysed to identify possible questions which could possibly provide EEA data. Within these questionnaires, supply and use data questions were identified to possibly

provide relevant information to EEA. The identified questions were communicated to the relevant survey areas responsible for the questionnaires and they provided the data relating to the list of identified questions from the questionnaires. In addition, preliminary questions were identified for alteration and new questions were suggested for inclusion in the questionnaires.

The overall project adopted a case study approach which was an attempt to try and update the national EEA for Water with data from various Stats SA data sources.

This discussion document is the culmination of a project which had, as its primary objective, the assessment of the potential of:

- Extracting existing incidental environmental data from Stats SA data bases
- Adapting Stats SA census and survey questionnaires to collect additional environmental data in future
- Proposing a framework for regular EEA reports by Stats SA.

Key Findings

In a semi-arid country, water availability is one of South Africa's key limitations to development. Water resources are vital for economic development and for people's health and well-being. Despite positive changes, such as the development of a legal and policy framework for water resources, there is less water available than before. Available water resources are used increasingly, with most exploitable resources tapped into, resulting in decreased freshwater river flows. Water quality is variable, linking to loss of quantity. South Africa's main approach to integrated water resource management is the key principle of balancing protection of water resources with social and economic development. The 2004 First Edition National Water Resources Strategy (NWRS) support internationally groundbreaking legal provisions. Although South Africa has a surplus of water in the various water management areas (WMA), deficits exist in available water in more than half of these areas with transfers between them impacting on the ecological systems. The NWRS estimates that there should be sufficient water to meet all needs in the near future, provided there is careful management. But allowances for the ecological component of the reserve are not currently being met in many cases, and the effects of climate change on water availability have not been factored into these calculations. Thus this prognosis may change[1].

South Africa has a well-developed agricultural sector, which makes it particularly sensitive to changes in climate. Climate change and its predicted effects would influence the availability of water in South Africa. Increased rainfall variability, increased floods and droughts, and reduced runoff in the western parts of the country, need to be factored into water resources planning. The quality, quantity, and sustainability of water resources depend on good land-management practices within catchments, underlining the need for an integrated approach to land and water management[1].

Water use by irrigation in the agriculture sector was 6 907 million cubic metres (m^3) in 2002. This was 87% of the total irrigation water allocation of 7 920 million m^3 reported by the Department of Water Affairs and Forestry (DWAF). The total irrigated area actively farmed was 763 million hectares (ha). Of the total agricultural production of R23 119 million in 2002, irrigation agriculture produced 55% of agricultural produce by value, making this water use of key importance to South Africa. Of this production 75% consisted of horticultural crops. Dryland agriculture relies on the natural moisture content of the soil (soil water) in which it is planted. In 2002, the total estimated use of soil water by dryland crops was 20 447 million m^3 – nearly three times as much as irrigation water use. The total area under dryland crops in South Africa was 3 million ha and dryland production 16 million tons.

[1] Department of Environmental Affairs and Tourism, 2006. South Africa Environment Outlook, a report on the state of the environment. *Executive Summary and key findings.* Department of Environmental Affairs and Tourism, Pretoria.

Municipalities play a key role in the treatment and supply of water to industry and households. Total water sold by municipalities to industry and households in 2006 was 1 847 million m^3. Municipalities also supplied free basic water of 347 million m^3. A further 35 million m^3 was used for own use, which mostly included irrigation of park and recreation facilities. Water losses suffered by municipalities amounted to 715 million m^3 – more than the amount of free basic water supplied (347 million m^3).

While rivers and dams supply most of South Africa's water needs, groundwater is important in rural and arid areas. Significantly, most of the 9 million people supplied with water since 1994 have been supplied from groundwater resources. Recharge of groundwater is difficult to quantify and makes a precise assessment of available groundwater complicated. In some areas, there has been over-abstraction of groundwater. Data is urgently needed on usage and recharge rates, to ensure sustainable use[2].

Total water use by the mining sector was valued at R340 million. This was down from a value of R357 million, in nominal terms, in the 2002 Supply and Use Tables (SU-tables) (*Stats SA, Supply and Use Tables, Final Supply and Use Tables, 2002 (Report No. 04-04-01)*). The construction sector is a relatively small water user, consuming water to the value of R21 million in 2004. Assuming a municipal water price of R5,29 per m^3, the construction sector consumed about 4 million m^3 of water in 2004. The business services sector consumed water to the value of R323 million in 2006 and consumed about 61 million m^3 of water in 2006. The accommodation sector is also a relatively small water user, consuming water to the value of R6 million in 2004 and it only consumed about 1 million m^3 of water in 2004. The personal services sector consumed water to the value of R144 million in 2004 (it consumed about 27 million m^3 of water in 2004).

The multitude of demands – ecological, domestic, industrial, and agricultural – needs to be balanced equitably, and the release of the NWRS in 2004 is seen by the DWAF as the main driver for ensuring that the balance can be achieved. To ensure sufficient water of suitable quality to meet South Africa's expectations of maintaining a strong economy, improving social standards, and sustaining healthy aquatic ecosystems for the near future the resources need to be wisely allocated and responsibly managed, in line with the NWRS. All water-use sectors need to focus on the water and waste management hierarchy, which states that minimization at source is the first priority, followed by maximized re-use or recycling, as far as possible; treating to a suitable standard; and disposing or discharging to the environment only where no techno-economically feasible alternative exists[2]. All stakeholders have a role to play, and Stats SA will strive with future EEA for water to bring the information contained in these accounts to as broad and high level of awareness possible.

[2] Department of Environmental Affairs and Tourism, 2006. South Africa Environment Outlook, a report on the state of the environment. *Executive Summary and key findings*. Department of Environmental Affairs and Tourism, Pretoria.

1. Introduction

The EEA for Water discussion document (*Updated Water Accounts for South Africa: 2000 D0405*) is constructed according to the recommendations of the UN as set out in the SEEAW and data tables on water use and supply for various sectors and various periods.

This discussion document forms part of the ongoing work of Stats SA on EEA. Through initiatives such as this, Stats SA is collaborating with stakeholders to contribute to the principles of sustainable development and sustainable water management.

The accounts are presented as a Satellite Account to the 1993 SNA. Satellite accounts provide a framework linked to the central accounts and enable attention to be focused on a certain field or aspect of economic and social life in the context of national accounts, i.e. satellite accounts for the environment, tourism, or unpaid household work.

The first set of water accounts for South Africa (*Water Accounts for Nineteen Water Management Areas* (*Report No. 04-05-01 (2000)*), was published in 2004. An updated version of the 2000 accounts (*Updated Water Accounts for South Africa: 2000* (*D0405*)) was published in December 2006. All these publications made exclusive use of water data provided by DWAF. Subsequent to these publications, Stats SA conducted a large data mining initiative where archived Stats SA data were explored with the purpose of regularly updating water accounts, both in physical and monetary terms. The key Stats SA surveys used as data sources are listed in Annexure 1.

This discussion document firstly presents the importance of EEA for Water in South Africa. In Section 3, a brief description of the methodological notes is given along with the extent of the contribution of Stats SA data to the update of the EEA for Water. An explanation of how this document responds to the recommendations provided in the previous EEA for Water (*Updated Water Accounts for South Africa: 2000 (D0405)*) is given, and the salient features of the updated EEA for Water are mentioned. In Section 4, data tables are presented where the data that were collected from the various Stats SA surveys and censuses are analysed. Finally, in Section 5, the recommendations for future EEA for Water and other EEA are presented. Discussions in Section 5 focus on data gaps and additional data sources for EEA for Water.

2. The importance of Environmental Economic Accounts for Water

EEA for Water in South Africa is of particular value to water authorities for a number of reasons:

- It shows the industries and areas using the most water, and together with additional data on population and economic growth, could be used to forecast future water demand or help answer particular questions, i.e. if the mining boom continues, how much water will be used by mines? Where will this water come from and which sectors may receive less water as a result?
- EEA for Water provides an initiative for improved water data collection, representation and interpretation. The water data are of a physical (volumetric and quality parameters) and monetary nature and may be sourced from databases from DWAF, Stats SA, Water Boards (WB), Water User Associations (WUA), Irrigation Boards (IB), and/or local government municipalities.
- The National Water Act of 1998[3] (Act No. 36 of 1998) (NWA) requires the establishment of a national water information system, to which DWAF has responded by initiating an Information System Development Process. EEA for Water provides an opportunity for formalising both physical and monetary water to the information system.
- EEA for Water provides valuable policy and other management information to South Africa's water allocation reform process, initiated through the NWA and with increasing water scarcity in a number of priority areas. This information relates to the analysis and re-planning of administered water tariff structures and comparative analysis of economic costs and benefits related to water use.
- It allows for international comparisons with countries that have water constraints (e.g. Australia). South Africa, Botswana and Namibia have already produced water accounts, while other countries in the region are investigating the development of water accounts. If countries in the region adopt the SEEAW, this will also facilitate the management of shared water resources.

3. Methodological notes for Environmental Economic Accounts for Water compilation

This Section discusses the methodological notes for the compilation of the EEA for Water. Firstly, the processes that were followed to analyse the data from existing Stats SA databases were scrutinised. Secondly, the extent to which the data contributed to improving the EEA for Water was analyzed.

[3] DWAF Internet Site:-http://www.dwaf.gov.za/documents.asp?Legislation

3.1 General

A case study was undertaken by Stats SA on EEA for Water with the objective of identifying possible new data sources for the water accounts. The data sources discussed in Section 3.2 were extracted from Stats SA databases and tested for relevance. Data were extracted at the highest possible resolution and then presented by WMA. The data mining activity required:

- The submission of detailed data requirements to every individual official custodian of Stats SA data
- The transformation of data stored in different databases, to Excel format.

In spite of the relative complexity involved in data collection, the contribution of this data to EEA in general was highly valuable.

3.2 Extent of data contribution

The Stats SA data contributed significantly to the improvement of the EEA for Water in the following ways:

- Through the improvement on DWAF physical data sources
- Through the provisioning of monetary data
- Through the representation of data at a WMA level.

The 2000 EEA for Water Input-output tables (refer to Table 1, which is a combined SU-table) contain 46 key data points that describe water transactions in South Africa for the reference year 2000. Of these, data for 33 of the data points could be sourced from Stats SA data. The remaining 13 data points resulted from hydrological modelling and are officially provided by DWAF.

Monetary data were found to be available for each of these 34 data points. The 2000 EEA for Water could, however, not be updated as Stats SA data were available for a range of specific years only, from 2002 to 2006, depending on the year in which the particular Census or Large Sample Survey (LSS) was conducted.

In all cases, data could be expressed at a WMA level.

Table 1: Data points in the physical Environmental Economic Accounts for Water, 2000

Water Flow Accounts: Input-output Tables for South Africa (2000)

		Environment						Distribution				
		Atmosphere and sea	Natural MAR	Surface water yield	Ground-water	Soil water	Ecological reserve	DWAF (Total yield)	Irrigation Boards	Water Boards	Municipalities	ROW and other WMA
Environment	Atmosphere and sea		49 040		1 088	55 400						
	Natural MAR (including storage)	29 683		19 357								
	Surface water (including reserve)						9 545	9 812				
	Groundwater							1 088				
	Soil water											
	Ecological reserve	9 545										
Distribution	DWAF (available total yield)	186							7 921	4 094	116	170
	Irrigation Boards											
	Water Boards										3041	
	Municipalities							1 223				
	ROW and other WMAs	170										
Production	Agriculture	62 957		428				676				
	Dryland and irrigation	52 244						676				
	Livestock and game	313										
	Plantation forestry	10 400		428								
	Mining	326									62	
	Electricity	234									63	
	Other bulk (industrial)	238									129	
	Other commercial and industrial	784									415	
	Total domestic	1 405									554	
	Domestic – urban	1 144									554	
	Domestic – rural	261										
Theoretical ecological reserve							9 545					
Water balance							186					

Physical data source from Department of Water Affairs and Forestry (DWAF)
Physical data source from Statistics South Africa

Table 1: Data points in the physical Environmental Economic Accounts for Water, 2000 (concluded)

Water Flow Accounts: Input-output Tables for South Africa (2000)

		Production											
		Agriculture											
		Dryland and irrigation	Livestock and game	Plantation forestry	Total	Mining	Electricity	Other bulk (industrial)	Other commercial and industrial	Domestic – urban	Domestic – rural	Domestic – total	Total
Environment	Atmosphere and sea												105 528
	Natural MAR (including storage)												49 040
	Surface water (including reserve)			428	428								19 785
	Groundwater												1 088
	Soil water	45 000		10 400	55 400								55 400
	Ecological reserve												9 545
Distribution	DWAF (available total yield)		313		313								12 799
	Irrigation Boards	7 921			7 920								7 920
	Water Boards					388	297	367					4 094
	Municipalities								1 199	1 698	261	1 959	4 381
	ROW and other WMA												170
Production	Agriculture												64 061
	Dryland and irrigation												52 920
	Livestock and game												313
	Plantation forestry												10 828
	Mining												388
	Electricity												297
	Other bulk (industrial)												367
	Other commercial and industrial												1 199
	Total domestic												1 959
	Domestic – urban												1 698
	Domestic – rural												261
Theoretical ecological reserve													9 545
Water balance													186

Physical data source from Department of Water Affairs and Forestry (DWAF)
Physical data source from Statistics South Africa

3.3 Response to recommendations[4]

The EEA for Water publication (*Updated Water Accounts for South Africa: 2000 (D0405)*) recommended a number of improvements to the EEA for Water. These included:

- Improvement of data (as envisaged in SASQAF)
- Development of monetary accounts
- Provisioning of water data per WMA.

These objectives are achievable through the existing Stats SA data sources. In addition, the publication recommended further development of the water quality account. The matter of the water quality account is dealt with in a separate report, and is summarised in Section 3.5 below.

3.4 Salient features of the updated Environmental Economic Accounts for Water

The updated EEA for Water report generated as part of this study presents various data sets that have previously not been available to water management decision-makers. These include:

For agricultural water use:

- An accurate summary of actual irrigation water use and irrigated area
- An improved estimate of soil water use by dryland crops
- An analysis of agricultural water use by major crop type (further disaggregation is possible)
- A summary of irrigation water price.

For municipal water supply and use:

- A breakdown of municipal water sources
- A breakdown of where municipalities supply water to
- A breakdown of municipal water costs and selling prices.

[4] Updated Water Accounts for South Africa, 2000 (D0405)

For the mining, construction, business services, personal services and accommodation sectors, detailed breakdowns of water use and price data. For the household sector, an analysis of time spent collecting water, and the associated opportunity cost of labour.

All these water data could be expressed as a ratio of contribution to gross domestic product (GDP).

3.5 Salient features of the Water Quality Account

Water quality was analysed through contextualising it in the South African setting, and by investigating how water quality affects human well-being. An analysis of how the UN approaches water quality, as well as an analysis of how DWAF manages water quality, and a summary of the availability of water quality data in South Africa was done.

Broad conclusions drawn from the above analyses were as follows:

- Water quality is an input variable (or intermediate consumption) to final-use goods and services (defined as ecosystem services by the MA and does therefore not have a direct monetary account associated with it)
- Water quality is measured by a complex set of indicators and can therefore not be simplified in a single set of physical accounting data
- Water quality management and monitoring is an extremely complex field, influenced by many variables and may change (positively or negatively) along the length of a river and over time, complicating accounting
- Human activity pollutes water either through point-source pollution which may be directly measurable as an emission, and/or non-point source pollution which is not directly measurable
- The SEEAW approaches water quality through an asset account, but does not provide definitive methods for its construction
- The overall concern of DWAF with respect to managing aquatic ecosystems is water resource quality, of which water quality is but one component. A water resource quality account is therefore theoretically of more use than a water quality account
- DWAF has numerous water quality monitoring programmes in place which generate a large amount of water quality data, which are used for many purposes.

From this analysis the potential role of Stats SA in water quality accounting becomes clearer. DWAF currently does water quality accounting through its River Health Programme in the 'State of Rivers' reports. DWAF remains the department responsible for water resource quality management, monitoring and reporting. However, Stats SA, through its numerous surveys, could collect important physical and monetary data referred to in this report as environmental statistics, which may contribute to the water resource quality monitoring initiatives of DWAF. Examples include data on municipal effluent volume and quantity, the nature and cost of its treatment and the quality of the treated effluent. Similar data may be gathered from large industrial water users.

In addition, Stats SA can publish various aspects of the 'State of Rivers' report as official statistics as soon as it is certified through the National Statistics Systems division. An example of this would be a regular reporting of the official categorisation of rivers in terms of the DWAF resource directed measures (RDM).

Stats SA therefore has a definite and valuable role to play in water quality accounting through the collection of environmental statistics, but has to establish a close collaboration and partnership with DWAF.

4. Water data tables

The following water data tables (Tables 2–15) represent data that were collected from the *Stats SA, Census of Commercial Agriculture, 2002 (P1101)*, *Non-financial survey of municipalities 2005 and 2006 (P9115)*, *Financial survey of municipalities 2006 (P9114)*, *LSS mining industry, 2004 (P2001)*, *LSS Construction Industry, 2004 (P5001)*, *LSS Real estate and business services industry, 2006 (P8004)*, *LSS Accommodation Industry, 2004 (P6411)*, *LSS Personal Services Industry, 2004 (P9001)* and the *General household Surveys (GHS), 2005 and 2006 (P0318)*.

4.1 Agriculture sector

The source of this data is the *Stats SA, Census of Commercial Agriculture, 2002 (P1101)*.

The total area under dryland crops in South Africa was 3 million ha and dryland production totalled 16 million tons.

Of the total agricultural production of R23 119 million in 2002, irrigation agriculture produced 55% of agricultural produce by value, making this water use of key importance to South Africa. Horticultural crops comprised 75% of this production.

Table 2: Summary of agricultural production for South Africa, 2002

Crops	Dryland area (ha)	Dryland production (tons)	Irrigated area (ha)	Irrigated production (tons)	Dryland production (R)	Irrigated production (R)	Total production (R)
Field crops	3 159 670	14 995 096	471 262	6 050 873	8 803 400 205	3 136 438 795	11 939 839 000
Horticultural crops	109 576	1 401 291	291 417	6 024 464	1 570 311 153	9 608 364 447	11 178 675 600
Total	3 269 246	16 396 387	762 679	12 075 336	10 373 711 358	12 744 803 242	23 118 514 600

Source: *Stats SA, Census of Commercial Agriculture, 2002*

Table 3 shows a summary of horticultural crops production for South Africa for the year 2002. The data presented are disaggregated to a WMA level[5].

The Olifants/Doorn WMA had the highest total production for horticultural crops of R2 179 million for 2002. The Olifants/Doorn WMA also had the largest irrigated area of 0,058 million ha which in turn gave it the highest irrigated production of 1 331 million tons to the value of R2 006 million. This in turn gave the Olifants/Doorn WMA the highest estimated irrigation water use of 960 million m^3 (refer to Table 6).

Table 3: Summary of horticultural crops production for the South Africa, 2002 by Water Management Area

Horticultural crops	Dryland area	Dryland production	Irrigated area	Irrigated production	Dryland production	Irrigated production	Total production
Water Management Area	(ha)	(tons)	(ha)	(tons)	(R)	(R)	(R)
Limpopo	336	2 167	7 866	168 421	3 401 782	198 896 018	202 297 800
Luvuvhu to Letaba	4 879	38 887	8 110	116 278	66 477 802	183 657 498	250 135 300
Crocodile West Marico	1 023	26 823	5 952	120 436	26 934 091	191 108 409	218 042 500
Olifants	12 875	137 175	49 045	997 626	262 157 402	1 692 734 698	1 954 892 100
Inkomati	2 248	15 887	18 517	406 815	36 026 596	610 283 504	646 310 100
Usutu to Mhlatuze	4 239	14 298	5 221	126 303	27 018 930	150 592 670	177 611 600
Thukela	925	11 264	1 732	43 106	12 245 767	55 825 133	68 070 900
Upper Vaal	10 523	550 522	14 127	316 473	190 402 250	482 957 150	673 359 400
Middle Vaal	2 429	34 949	2 050	39 150	46 130 340	51 878 060	98 008 400
Lower Vaal	1 860	17 925	16 869	385 662	38 805 232	701 034 468	739 839 700
Mvoti to Umzimkulu	1 452	28 028	4 078	75 370	25 095 121	117 481 479	142 576 600
Mzimvubu to Keiskamma	2 699	46 394	2 167	56 641	72 344 289	81 321 211	153 665 500
Upper Orange	4 453	87 228	5 795	227 354	75 690 672	182 638 228	258 328 900
Lower Orange	1 004	1 730	2 973	31 591	5 689 118	74 883 382	80 572 500
Fish to Tsitsikamma	6 076	91 122	14 966	298 738	75 466 889	349 203 211	424 670 100
Gouritz	7 847	52 031	17 788	319 872	77 384 800	510 507 700	587 892 500
Olifants/Doorn	19 435	107 044	57 901	1 331 445	172 678 229	2 006 153 071	2 178 831 300
Breede	18 710	91 832	47 678	808 996	220 963 409	1 709 261 391	1 930 224 800
Berg	6 563	45 988	8 585	154 186	135 398 432	257 947 168	393 345 600
Total	109 576	1 401 291	291 417	6 024 464	1 570 311 153	9 608 364 447	11 178 675 600

Source: *Stats SA, Census of Commercial Agriculture, 2002*

[5] Please refer to Annexure 4 for a detailed map of the WMAs

For field crops, the Upper Vaal WMA had the highest total production of R2 669 million for 2002. The Upper Vaal WMA also had the largest dryland area of 0,866 million ha. The Upper Vaal WMA had the second highest dry land production of 2 520 million tons to the value of R2 408 million. This in turn gave the Upper Vaal WMA the highest estimated dryland water use of 5 447 million m^3 (refer to Table 7).

Table 4: Summary of field crops production for South Africa, 2002 by Water Management Area

Field crops	Dryland area	Dryland production	Irrigated area	Irrigated production	Dryland production	Irrigated production	Total production
Water Management Area	(ha)	(tons)	(ha)	(tons)	(R)	(R)	(R)
Limpopo	12 020	23 427	13 959	65 675	38 911 224	113 476 076	152 387 300
Luvuvhu to Letaba	1 291	3 512	848	10 915	1 789 987	3 980 213	5 770 200
Crocodile West Marico	4 718	10 144	15 239	71 292	11 153 292	126 073 208	137 226 500
Olifants	192 896	468 296	62 418	323 340	500 510 821	573 482 979	1 073 993 800
Inkomati	1 376	45 286	17 237	1 295 050	8 233 096	252 775 104	261 008 200
Usutu to Mhlatuze	127 889	1 984 646	36 752	1 100 309	538 349 716	254 866 284	793 216 000
Thukela	57 219	1 517 093	16 077	504 871	290 247 974	109 828 226	400 076 200
Upper Vaal	866 917	2 520 092	49 096	255 583	2 408 057 767	260 897 433	2 668 955 200
Middle Vaal	740 394	1 830 119	24 648	128 313	2 043 345 425	160 910 375	2 204 255 800
Lower Vaal	143 991	327 411	39 983	242 077	341 596 409	242 163 191	583 759 600
Mvoti to Umzimkulu	110 204	4 056 273	12 662	503 519	754 541 888	88 535 912	843 077 800
Mzimvubu to Keiskamma	23 160	263 431	7 216	154 202	59 794 738	35 058 762	94 853 500
Upper Orange	378 899	921 359	77 681	419 067	787 206 120	481 849 180	1 269 055 300
Lower Orange	10 049	27 966	23 835	158 983	31 819 189	195 911 711	227 730 900
Fish to Tsitsikamma	15 206	40 273	13 244	74 662	21 532 479	41 766 321	63 298 800
Gouritz	69 311	130 161	25 911	75 424	79 078 304	29 277 396	108 355 700
Olifants/Doorn	158 580	296 662	22 090	633 209	303 295 294	135 617 506	438 912 800
Breede	101 395	231 464	3 953	13 712	223 077 047	8 712 353	231 789 400
Berg	144 155	297 483	8 414	20 671	360 859 437	21 256 563	382 116 000
Total	3 159 670	14 995 096	471 262	6 050 873	8 803 400 205	3 136 438 795	11 939 839 000

Source: *Stats SA, Census of Commercial Agriculture, 2002*

For all crops, the Upper Vaal WMA had the highest total production of R3 342 million. The Upper Vaal WMA had the largest dryland area of 0,877 million ha which in turn gave it the second highest dryland production of 3 071 million tons to the value of R2 599 million. For irrigation, the Upper Vaal WMA had the forth largest irrigated area of 0,063 million ha with the ninth highest irrigated production of 0,572 million tons. This in turn gave the Upper Vaal WMA an estimated total water use of 5 902 million m^3 (refer to Tables 6 and 7).

Table 5: Summary of all crops production for South Africa, 2002, by Water Management Area

All crops Water Management Area	Dryland area (ha)	Dryland production (tons)	Irrigated area (ha)	Irrigated production (tons)	Dryland production (R)	Irrigated production (R)	Total production (R)
Limpopo	12 355	25 594	21 825	234 096	42 313 007	312 372 093	354 685 100
Luvuvhu to Letaba	6 170	42 399	8 958	127 193	68 267 789	187 637 711	255 905 500
Crocodile West Marico	5 741	36 967	21 191	191 728	38 087 383	317 181 617	355 269 000
Olifants	205 771	605 471	111 463	1 320 967	762 668 223	2 266 217 677	3 028 885 900
Inkomati	3 624	61 172	35 753	1 701 865	44 259 691	863 058 609	907 318 300
Usutu to Mhlatuze	132 128	1 998 945	41 973	1 226 611	565 368 646	405 458 954	970 827 600
Thukela	58 145	1 528 357	17 809	547 976	302 493 741	165 653 359	468 147 100
Upper Vaal	877 440	3 070 614	63 223	572 056	2 598 460 018	743 854 582	3 342 314 600
Middle Vaal	742 823	1 865 067	26 697	167 462	2 089 475 765	212 788 435	2 302 264 200
Lower Vaal	145 850	345 336	56 852	627 739	380 401 641	943 197 659	1 323 599 300
Mvoti to Umzimkulu	111 657	4 084 300	16 740	578 889	779 637 009	206 017 391	985 654 400
Mzimvubu to Keiskamma	25 859	309 825	9 383	210 843	132 139 027	116 379 973	248 519 000
Upper Orange	383 351	1 008 587	83 476	646 421	862 896 792	664 487 408	1 527 384 200
Lower Orange	11 053	29 696	26 808	190 574	37 508 307	270 795 093	308 303 400
Fish to Tsitsikamma	21 282	131 395	28 210	373 400	96 999 368	390 969 532	487 968 900
Gouritz	77 158	182 192	43 699	395 296	156 463 104	539 785 096	696 248 200
Olifants/Doorn	178 015	403 706	79 991	1 964 655	475 973 523	2 141 770 577	2 617 744 100
Breede	120 105	323 295	51 631	822 708	444 040 456	1 717 973 744	2 162 014 200
Berg	150 719	343 471	16 999	174 857	496 257 869	279 203 731	775 461 600
Total	3 269 246	16 396 387	762 679	12 075 336	10 373 711 358	12 744 803 242	23 118 514 600

Source: *Stats SA, Census of Commercial Agriculture, 2002*

Water use by irrigation in the agriculture sector was 6 907 million m^3 in 2002. This was 87% of the total irrigation water allocation of 7 920 million m^3 reported by the DWAF NWRS. The total irrigated area actively farmed was 763 million ha (refer to Table 2). The distribution of water use per WMA is reported in Figure 1.

Irrigation water payments varied between R0,60 per m^3 water in the Luvuvhu to Letaba WMA to R6,90 per m^3 water in the Breede WMA. Irrigation production per water use was R1,80 per m^3 for the country as a whole and varied from a low of R0,90 per m^3 in the Usutu to Mhlatuze WMA to R4,60 per m^3 in the Breede WMA (refer to Figure 2).

Table 6: Summary of irrigation water use data by Water Management Area for 2002

All crops	Weighted average irrigation allocation	Estimated irrigation water use	Irrigation Water purchased	Cost of irrigation water	Irrigated production per water use
Water Management Area	m^3/ha	m^3	(R)	R/m^3	R/m^3
Limpopo	7 725	168 602 202	1 819 400	1,1	1,9
Luvuvhu to Letaba	9 622	86 190 884	528 900	0,6	2,2
Crocodile West Marico	6 977	147 858 418	5 932 700	4,0	2,1
Olifants	8 300	925 196 793	17 034 400	1,8	2,4
Inkomati	10 064	359 810 260	5 381 600	1,5	2,4
Usutu to Mhlatuze	11 150	468 008 927	7 883 800	1,7	0,9
Thukela	7 700	137 126 990	1 193 000	0,9	1,2
Upper Vaal	7 211	455 888 149	8 009 900	1,8	1,6
Middle Vaal	6 762	180 540 943	5 026 000	2,8	1,2
Lower Vaal	9 111	517 983 239	23 137 500	4,5	1,8
Mvoti to Umzimkulu	4 600	77 002 620	2 558 100	3,3	2,7
Mzimvubu to Keiskamma	7 642	71 706 660	761 300	1,1	1,6
Upper Orange	9 975	832 631 624	19 595 000	2,4	0,8
Lower Orange	14 347	384 614 358	4 809 600	1,3	0,7
Fish to Tsitsikamma	11 651	328 673 347	11 031 600	3,4	1,2
Gouritz	6 987	305 340 806	9 444 000	3,1	1,8
Olifants/Doorn	12 000	959 890 800	26 451 300	2,8	2,2
Breede	7 223	372 918 774	25 685 500	6,9	4,6
Berg	7 467	126 921 070	5 517 300	4,3	2,2
Total		6 906 906 864	181 800 900	2,6	1,8

Source: *Stats SA, Census of Commercial Agriculture, 2002*

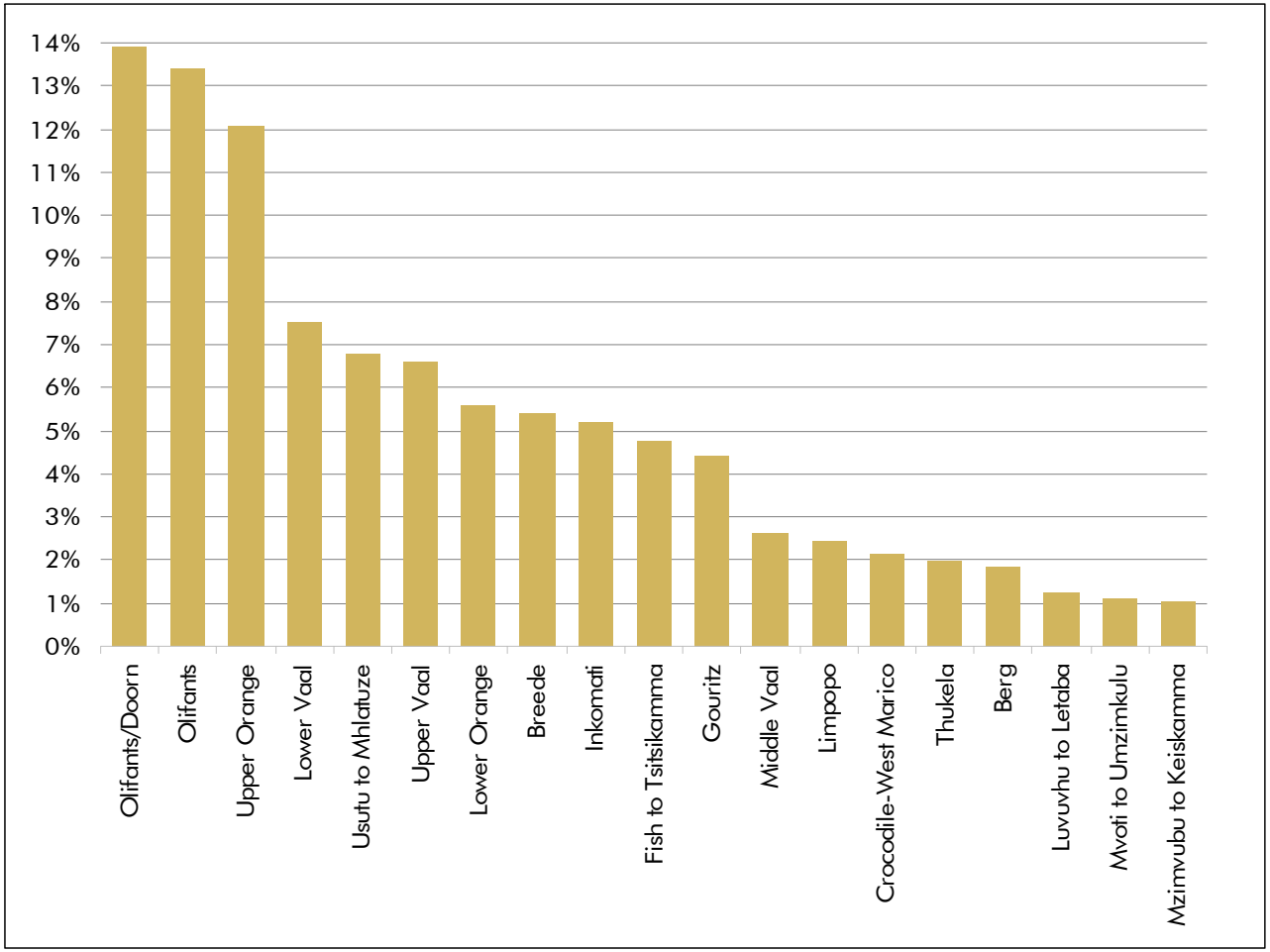
Dryland agriculture relies on the natural moisture content of the soils (soil water) in which it is planted. In 2002, the total estimated use of soil water by dryland crops was 20 447 million m^3; nearly three times as much as irrigation water use.

Table 7: Summary of data on soil water use by dryland crops, by Water Management Area for 2002

All crops	Estimated dryland water use	Dryland production per water use
Water Management Area	m^3	R/m^3
Limpopo	70 504 312	0,6
Luvuvhu to Letaba	9 657 084	7,1
Crocodile West Marico	29 068 557	1,3
Olifants	1 133 854 460	0,7
Inkomati	10 093 916	4,4
Usutu to Mhlatuze	838 456 870	0,7
Thukela	410 095 326	0,7
Upper Vaal	5 446 559 364	0,5
Middle Vaal	4 605 494 357	0,5
Lower Vaal	909 203 583	0,4
Mvoti to Umzimkulu	827 406 370	0,9
Mzimvubu to Keiskamma	158 032 809	0,8
Upper Orange	2 486 890 521	0,3
Lower Orange	73 476 337	0,5
Fish to Tsitsikamma	124 369 443	0,8
Gouritz	506 552 345	0,3
Olifants/Doorn	1 048 459 826	0,5
Breede	753 587 521	0,6
Berg	1 004 860 796	0,5
Total	20 446 623 797	0,5

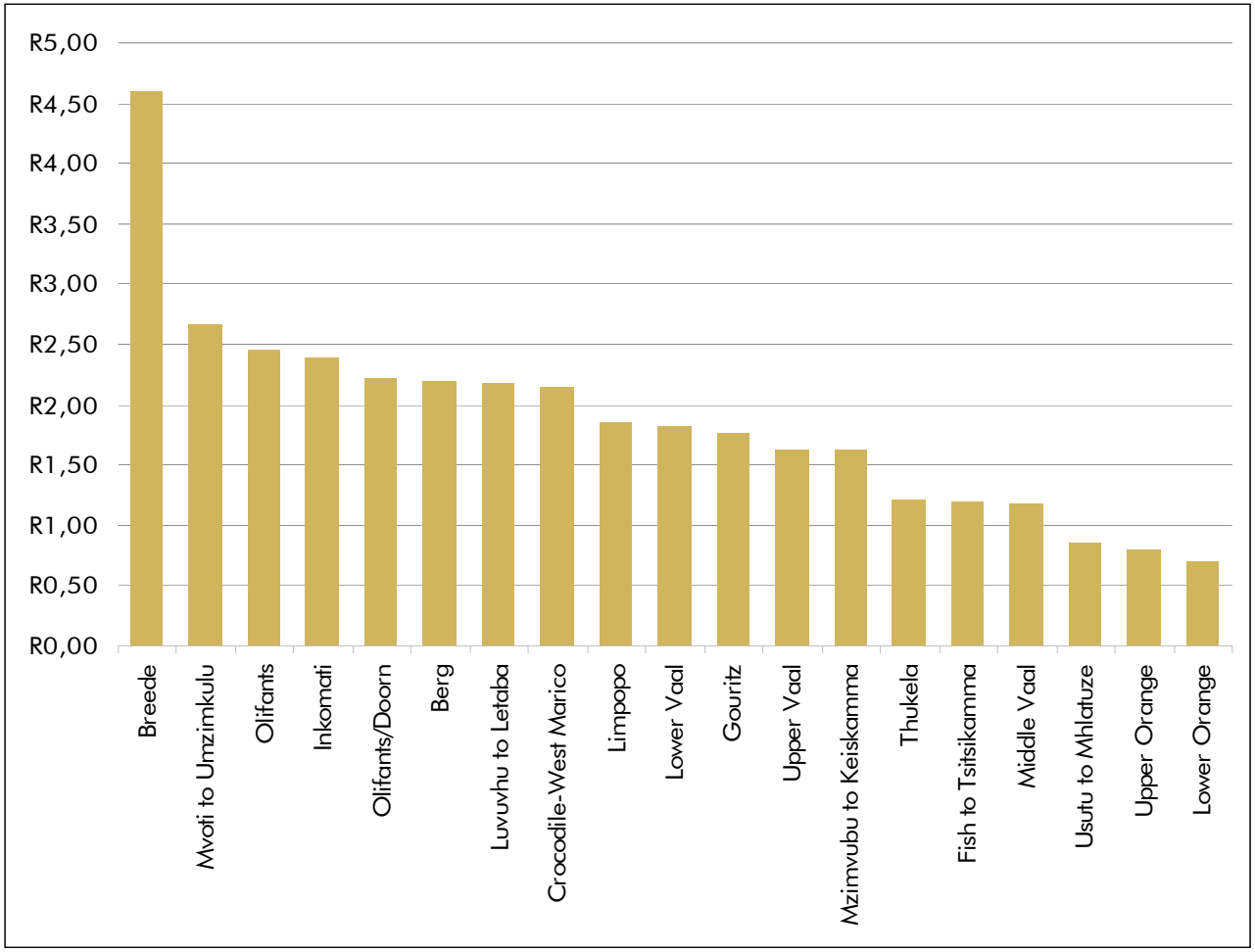
Source: *Stats SA, Census of Commercial Agriculture, 2002*

Figure 1: Distribution of irrigation water use by Water Management Area, 2002 (%)



Source: *Stats SA, Census of Commercial Agriculture, 2002*

Figure 2: Distribution of irrigation water cost by Water Management Area, 2002 (R/m^3)



Source: *Stats SA, Census of Commercial Agriculture, 2002*

4.2 Municipal water

The sources of data used were the *Non-financial Census of Municipalities, 2005 and 2006 (P9115)* and the *Financial Census of Municipalities, 2006 (P9114)*. Water supply and use data are presented in Tables 8 and 9 for 2005 and Tables 10 and 11 for 2006.

Municipalities obtained their water primarily from WB (1 668 million m^3) with the balance obtained from other service providers (233 million m^3) and own sources (1 181 million m^3).

Table 8: Water supply to municipalities by Water Management Area, 2005 (million m^3)

Water Management Area	Water Boards	Other service providers	Own sources	Total
Limpopo	16 394 852	3 998 950	38 756 737	59 150 538
Luvuvhu to Letaba	6 790 524	1 656 310	16 052 512	24 499 346
Crocodile West Marico	383 308 401	26 953 389	37 932 262	448 194 053
Olifants	184 924 038	9 568 478	61 062 058	255 554 574
Inkomati	11 019 842	2 291 570	36 181 346	49 492 758
Usutu to Mhlatuze	147 253 612	1 764 383	91 399 756	240 417 751
Thukela	115 122 379	847 568	63 974 249	179 944 197
Upper Vaal	538 099 659	25 228 730	67 818 335	631 146 724
Middle Vaal	32 112 898	12 344 369	30 115 991	74 573 259
Lower Vaal	18 900 044	31 752 458	32 538 266	83 190 768
Mvoti to Umzimkulu	96 343 470	2 033 816	55 843 103	154 220 389
Mzimvubu to Keiskamma	25 460 160	25 934 601	64 061 400	115 456 161
Upper Orange	46 956 838	18 055 954	56 699 130	121 711 922
Lower Orange	19 190 085	4 129 058	34 494 613	57 813 756
Fish to Tsitsikamma	14 346 251	36 785 409	114 975 571	166 107 230
Gouritz	4 681 294	13 415 788	165 267 608	183 364 691
Olifants/Doorn	4 438 003	8 201 680	104 506 092	117 145 775
Breede	1 706 596	5 020 303	64 958 950	71 685 848
Berg	1 154 781	3 397 027	43 954 982	48 506 790
Total	1 668 203 727	233 379 841	1 180 592 963	3 082 176 531

Source: *Stats SA, Non-financial Census of Municipalities, 2005*

Total water sold by municipalities to sector and households in 2005 was 1 967 million m^3. Municipalities also supplied free basic water of 359 million m^3. A further 35 million m^3 was used for own use, which mostly included irrigation of park and recreation facilities. Water losses suffered by municipalities amounted to 647 million m^3 – more than the amount of free basic water supplied (359 million m^3).

Table 9: Water distribution by municipalities by Water Management Area, 2005 (million m^3)

Water Management Area	Water lost	Water sold	Free basic water supplied	Water for own use	Total
Limpopo	5 386 391	33 634 437	14 822 314	362 804	54 205 945
Luvuvhu to Letaba	2 230 970	13 930 925	6 139 200	150 269	22 451 363
Crocodile West Marico	94 814 165	313 996 416	52 296 953	2 499 040	463 606 575
Olifants	49 317 448	173 815 369	29 534 535	1 942 325	254 609 678
Inkomati	7 175 484	31 896 463	3 854 700	925 758	43 852 404
Usutu to Mhlatuze	50 842 887	138 356 695	28 134 078	2 231 111	219 564 770
Thukela	38 860 576	102 648 717	21 638 700	1 545 415	164 693 407
Upper Vaal	137 344 224	435 024 625	68 375 252	3 867 919	644 612 020
Middle Vaal	17 896 635	41 808 687	8 319 101	1 213 989	69 238 412
Lower Vaal	14 377 844	58 888 803	11 887 670	1 535 448	86 689 765
Mvoti to Umzimkulu	32 883 810	88 220 317	18 623 948	1 348 908	141 076 983
Mzimvubu to Keiskamma	16 262 315	71 262 716	14 894 925	1 563 990	103 983 946
Upper Orange	26 692 430	68 909 467	13 355 767	1 878 042	110 835 705
Lower Orange	11 773 119	47 525 455	5 611 973	1 004 466	65 915 012
Fish to Tsitsikamma	27 258 096	102 342 052	20 200 617	2 936 943	152 737 708
Gouritz	49 435 128	106 344 329	18 002 915	4 515 120	178 297 493
Olifants/Doorn	31 461 461	69 243 938	11 438 535	2 862 700	115 006 634
Breede	19 493 808	41 492 831	7 002 792	1 776 455	69 765 886
Berg	13 190 638	28 076 449	4 738 494	1 202 052	47 207 633
Total	646 697 426	1 967 418 690	358 872 470	35 362 753	3 008 351 339

Source: *Stats SA, Non-Financial Census of Municipalities, 2005*

In 2006, municipalities obtained their water primarily from WB (1 745 million m^3) with the balance obtained from other service providers (148 million m^3) and own sources (2 146 million m^3).

Table 10: Water supply to municipalities by Water Management Area, 2006 (million m^3)

Water Management Area	Water Boards	Other service providers	Own sources	Total
Limpopo	26 322 247	4 705 623	31 344 392	62 372 262
Luvuvhu to Letaba	10 902 316	1 949 005	12 982 420	25 833 741
Crocodile West Marico	392 234 981	11 566 596	134 106 019	537 907 597
Olifants	190 627 310	3 475 378	100 181 685	294 284 373
Inkomati	13 736 244	722 943	33 814 494	48 273 681
Usutu to Mhlatuze	150 165 752	12 088 650	50 925 712	213 180 114
Thukela	116 827 475	9 530 970	32 292 657	158 651 103
Upper Vaal	540 727 755	8 617 318	363 713 368	913 058 441
Middle Vaal	39 080 216	9 372 272	265 191 098	313 643 586
Lower Vaal	38 860 355	20 623 786	79 424 358	138 908 499
Mvoti to Umzimkulu	97 860 301	8 213 045	30 023 826	136 097 171
Mzimvubu to Keiskamma	28 027 501	6 594 882	73 001 481	107 623 864
Upper Orange	51 929 457	9 834 714	391 184 335	452 948 507
Lower Orange	18 555 884	4 097 529	63 781 214	86 434 627
Fish to Tsitsikamma	17 304 026	9 963 440	129 264 131	156 531 596
Gouritz	4 493 851	11 788 270	154 105 766	170 387 888
Olifants/Doorn	4 201 484	7 570 627	99 015 998	110 788 109
Breede	1 606 176	4 614 544	60 333 394	66 554 114
Berg	1 086 832	3 122 467	40 825 063	45 034 362
Total	1 744 550 163	148 452 059	2 145 511 412	4 038 513 634

Source: *Stats SA, Non-financial Census of Municipalities, 2006*

Municipalities play a key role in the treatment and supply of water to industry and households. Total water sold by municipalities to industry and households in 2006 was 1 847 million m^3. Municipalities also supplied free basic water of 347 million m^3. A further 35 million m^3 was used for own use, which mostly included irrigation of park and recreation facilities. Water losses suffered by municipalities amounted to 715 million m^3 – more than the amount of free basic water supplied (347 million m^3).

Table 11: Water distribution by municipalities by Water Management Area, 2006 (million m^3)

Water Management Area	Water lost	Water sold	Free basic water supplied	Water for own use	Total
Limpopo	7 734 991	35 474 535	11 509 527	1 086 835	55 805 888
Luvuvhu to Letaba	3 203 728	14 693 069	4 767 089	450 152	23 114 038
Crocodile West Marico	112 968 291	287 330 515	51 740 622	1 032 333	453 071 761
Olifants	60 437 111	149 969 594	32 156 042	1 049 740	243 612 487
Inkomati	10 464 287	25 338 514	7 741 002	508 117	44 051 921
Usutu to Mhlatuze	70 489 284	121 195 834	18 762 523	434 838	210 882 480
Thukela	53 736 005	90 657 902	13 080 574	225 551	157 700 032
Upper Vaal	157 369 290	377 187 254	68 188 262	2 658 536	605 403 342
Middle Vaal	14 489 542	44 424 974	5 774 727	3 028 689	67 717 932
Lower Vaal	19 435 094	85 081 853	14 248 049	2 140 968	120 905 964
Mvoti to Umzimkulu	45 534 712	77 954 910	11 617 250	248 441	135 355 313
Mzimvubu to Keiskamma	23 692 131	63 096 775	16 925 618	1 307 664	105 022 188
Upper Orange	22 581 484	61 781 298	11 081 901	4 428 550	99 873 233
Lower Orange	13 280 720	41 351 049	12 723 192	2 026 197	69 381 158
Fish to Tsitsikamma	29 289 929	97 206 939	24 425 872	2 990 178	153 912 917
Gouritz	30 297 264	119 348 879	18 156 591	5 071 966	172 874 700
Olifants/Doorn	19 689 276	76 822 936	12 186 466	3 299 605	111 998 283
Breede	11 820 715	46 750 441	7 011 650	1 996 803	67 579 609
Berg	7 998 579	31 634 052	4 744 488	1 351 153	45 728 271
Total	714 512 435	1 847 301 323	346 841 443	35 336 316	2 943 991 517

Source: *Stats SA, Non-financial Census of Municipalities, 2006*

The weighted average purchase price of water was R1,43 per m^3 in 2006, and the weighted average selling price was R5,29 per m^3. Total purchases of water by municipalities amounted to R6 million and total sales amounted to R10 million.

Table 12: Municipal purchases and sales of water, and purchase and selling unit costs, 2006

	Value		Price	
Water Management Area	Water purchases	Water sales	Purchase price	Selling price
Limpopo	49 344	114 742	0,79	3,23
Luvuvhu to Letaba	20 438	47 525	0,79	3,23
Crocodile West Marico	1 232 414	2 160 670	2,29	7,52
Olifants	600 689	1 070 460	2,04	7,14
Inkomati	59 895	113 927	1,24	4,50
Usutu to Mhlatuze	408 847	617 005	1,92	5,09
Thukela	311 950	464 823	1,97	5,13
Upper Vaal	1 699 304	2 853 104	1,86	7,56
Middle Vaal	126 988	42 777	0,40	0,96
Lower Vaal	149 093	240 864	1,07	2,83
Mvoti to Umzimkulu	266 573	386 243	1,96	4,95
Mzimvubu to Keiskamma	180 300	62 618	1,68	0,99
Upper Orange	193 640	9 084	0,43	0,15
Lower Orange	44 433	163 636	0,51	3,96
Fish to Tsitsikamma	203 949	147 254	1,30	1,51
Gouritz	96 389	555 172	0,57	4,65
Olifants/Doorn	60 941	359 588	0,55	4,68
Breede	36 598	220 293	0,55	4,71
Berg	24 764	149 063	0,55	4,71
Total	5 766 547	9 778 848	1,43	5,29

Source: *Stats SA, Financial Census of Municipalities, 2006*

4.3 Mining sector

The source of data used was the *LSS mining industry, 2004 (P2001)*.

Total water use by the mining sector was valued at R340 million. This was down from a value of R357 million, in nominal terms, in the 2002 SU-tables (*Stats SA, Supply and Use Tables, Final Supply and Use Tables, 2002 (Report No. 04-04-01)*).

The average price paid for water by the mining sector was estimated at R8,80 per m^3 using the 2000 EEA for Water physical data (sourced from DWAF) of 388 million m^3 (refer to Tables 17 and 18).

The largest water users were gold and uranium, chrome, manganese and other metal ores, the platinum group metals, iron ore and coal.

Table 13: Water use in the mining sector: value, estimated price, and volume

Mining Sector	Water use R' million	Estimated price R/m^3	Water use (million m^3)
Gold and uranium	185 451	8,8	211,51
Chrome, manganese and other metal ores	52 990	8,8	60,43
Platinum Group Metals	43 720	8,8	49,86
Iron ore	24 572	8,8	28,02
Coal	23 512	8,8	26,82
Stone quarrying, clay and sandpits	2 894	8,8	3,30
Diamonds	1 398	8,8	1,59
Phosphate and other chemicals	1 191	8,8	1,36
Limestone	864	8,8	0,99
Dimension stone	422	8,8	0,48
Other mining	3 189	8,8	3,64
Total	340 204		388

Sources: *Stats SA, LSS of Mining, 2004; Stats SA, Updated Water Accounts for South Africa: 2000 (D0405)*

4.4 Construction sector

The source of data used was the *LSS Construction Industry, 2004 (P5001)*.

The construction sector is a relatively small water user, consuming water to the value of R21 million in 2004. Assuming a municipal water price of R5,29 per m^3 (refer to Table 14), this means that the construction sector consumed about 4 million m^3 of water in 2004.

4.5 Business services sector

The source of data used was the *LSS Real estate and business services industry, 2006 (P8004)*

These sectors consumed water to the value of R323 million in 2006. Assuming a municipal water price of R5,29 per m^3 (refer to Table 14), this means that the business services sector consumed about 61 million m^3 of water in 2006.

4.6 Accommodation sector

The source of data used was the *LSS Accommodation Industry, 2004 (P6411)*.

The accommodation sector is a relatively small water user, consuming water to the value of R6 million in 2004. Assuming a municipal water price of R5,29 per m^3 (refer to Table 14), this means that the accommodation sector consumed about 1 million m^3 of water in 2004.

4.7 Personal services sector

The source of data was the *LSS Personal Services Industry, 2004 (P9001)*.

The personal services sector consumed water to the value of R144 million in 2004. Assuming a municipal water price of R5,29 per m^3 (refer to Table 14), this means that the personal services sector consumed about 27 million m^3 of water in 2004.

Table 14: Water use, by value and volume in the construction, business, personal services and accommodation sectors

Sector	Year	Water use (R' million)	Water price (R/m^3)	Water volume (million m^3)
Business	2006	322 818	5,29	61 024
Construction	2004	21 072	5,29	3 983
Personal Service	2004	144 241	5,29	27 267
Accommodation	2004	5 813	5,29	1 099

Source: *Stats SA, LSS, 2004 and 2006*

4.8 Household collection of water

The sources of data were the *GHS, 2005 and 2006 (P0318)*.

The GHS reports data on the average time spent by households collecting water from natural sources, including streams, rivers and dams. In 2006, this amounted to a time equivalent of more than 148 million person days (8 hours). Using a minimum wage rate of R40,00 per day, this translates to an opportunity cost of labour of R6 billion. Comparing the 2006 data to the 2005 data indicates that time spent collecting water increased in 2006.

Table 15: Collection of water by poor households expressed in total days per year and through the opportunity cost of labour

	Total days spent collecting water		Opportunity cost of labour (R' million)		Change
Water Management Area	2005	2006	2005	2006	(%)
Berg	585 322	708 760	23,41	28,35	21%
Breede	123 089	151 092	4,92	6,04	23%
Crocodile (West) and Marico	4 737 004	7 096 756	189,48	283,87	50%
Fish to Tsitsikamma	4 438 859	5 563 450	177,55	222,54	25%
Gouritz	274 374	353 898	10,97	14,16	29%
Inkomati	2 013 454	3 284 174	80,54	131,37	63%
Limpopo	6 748 710	5 646 530	269,95	225,86	-16%
Lower Orange	159 718	288 976	6,39	11,56	81%
Lower Vaal	2 496 007	4 002 440	99,84	160,10	60%
Luvuvhu and Letaba	5 120 260	4 240 943	204,81	169,64	-17%
Middle Vaal	756 214	857 432	30,25	34,30	13%
Mvoti to Umzimkulu	19 192 381	20 252 236	767,70	810,09	6%
Mzimvubu to Keiskamma	37 524 061	40 943 501	1 500,96	1 637,74	9%
Olifants	8 209 876	8 781 256	328,40	351,25	7%
Olifants/Doorn	132 646	133 803	5,31	5,35	1%
Thukela	10 459 309	11 547 937	418,37	461,92	10%
Upper Orange	2 795 096	3 330 762	111,80	133,23	19%
Upper Vaal	4 548 055	6 164 977	181,92	246,60	36%
Usutu to Mhlathuze	17 141 191	24 149 604	685,65	965,98	41%
Total	127 455 625	147 498 527	5 098	5 900	16%

Source: *Stats SA, GHS 2005 and 2006*

4.9 Water supply and use in the South African economy

The 2000 EEA for Water Input-output tables (refer to Table 16, which is a combined SU-table) contain 46 key data points that describe water transactions in South Africa for the reference year 2000.

Table 17 below represent the water supply and Table 18 represent the water use in the South African economy for the year 2000.

Natural source of water supply and use (environment)

South Africa receives approximately 611 600 million m^3 of annual rainfall per year. The bulk of the falling precipitation, about 506 072 million m^3 (83%) is directly evaporated or used by the natural vegetation (evapotranspiration) and never reached the rivers. The rest of the falling precipitation, about 105 528 million m^3 (17%) is available for Gross Annual Runoff (atmosphere and sea). From the Gross Annual Runoff, about 68 274 million m^3 is used by the various sectors in South Africa. The rest of the water flows remain in the natural environment to augment surface water, groundwater and ecological reserve.

In 2000 water use in South Africa was driven by the agricultural sector, about 94% (64 065 million m^3), mostly for dryland crops (45 000 million m^3 or 66%) and forestry (10 828 million m^3 or 16%), while irrigation consumed only 12% of water (7 920 million m^3) and livestock and game only 313 million m^3. Leaving the rest of the economy with 6% of the total water use by sectors in South Africa.

Institutional source of water supply and use (water distribution sectors)

In 2000, DWAF managed a total yield[6] of 12 799 million m^3. South Africa is highly dependant on surface water supplying 77% (9 812 million m^3) of total water yield managed by DWAF, followed by treated effluent processed and supplied to DWAF by groundwater and municipal authorities, each contributing 9% (1 088 million m^3) and 10% (1 223 million m^3) respectively. Return flows from irrigation of agriculture dryland crops contributed another 5% (676 million m^3) share of available yield.

IB and WB receive all their water from DWAF. Most of the yield (62% or 7 920 million m^3) is supplied as bulk raw water by DWAF to agriculture dryland crops through IB and to other production activities (32% or 4 094 million m^3) through the WB. DWAF also supplied 116 million m^3 to municipalities, 313 million m^3 to livestock and game and 170 million m^3 was exported through transfers to neighbouring countries. Part of

[6] Water that can be reliably withdrawn from a water source at a relatively constant rate is referred to as yield.

the yield (2% or 186 million m^3) was returned to the atmosphere as surplus water, this is also referred to as the water balance.

Most of the water (74% or 3 042 million m^3) received by WB is redistributed to municipal authorities; the remaining water is distributed to mining (388 million m^3), hydroelectric power (297 million m^3) and manufacturing (367 million m^3).

Economic source of water supply and use (production and domestic)

In 2000, the municipal authorities distributed a total of 3 158 million m^3 of water, of which (62% or 1 959 million m^3) was distributed to domestic water users (rural and urban), and the remaining (38% or 1 199 million m^3) was distributed to manufacturing as well as trade and services. In turn, municipal authorities received effluent to the total of 1 223 million m^3 from mining, hydroelectric power, manufacturing, trade and services and domestic water users. The effluent was then treated, and as mentioned above, distributed back to DWAF.

Table 16: Water flow accounts: Input-output tables, 2000

		Environment						Distribution				
		Atmosphere and sea	Natural MAR	Surface water yield	Groundwater	Soil water	Ecological reserve	DWAF (total yield)	Irrigation Boards	Water Boards	Municipalities	ROW and other WMA
Environment	Atmosphere and sea		49 040		1 088	55 400						
	Natural MAR (including storage)	29 683		19 357								
	Surface water (including reserve)						9 545	9 812				
	Groundwater							1 088				
	Soil water											
	Ecological reserve	9 545										
Distribution	DWAF (available total yield)	186							7 920	4 094	116	170
	Irrigation boards											
	Water boards										3 042	
	Municipalities							1 223				
	ROW and other WMA	170										

Table 16: Water flow accounts: Input-output tables, 2000 (continued)

		Environment						Distribution				
		Atmosphere and sea	Natural MAR	Surface water yield	Groundwater	Soil water	Ecological reserve	DWAF (total yield)	Irrigation Boards	Water Boards	Municipalities	ROW and other WMA
Production	Agriculture	62 957		428				676				
	Dryland and irrigation	52 244						676				
	Livestock and game	313										
	Plantation forestry	10 400		428								
	Mining	326									62	
	Electricity	234									63	
	Other bulk (industrial)	238									129	
	Other commercial and industrial	784									415	
	Total domestic	1 405									554	
	Domestic – urban	1 144									554	
	Domestic – rural	261										
Theoretical ecological reserve							9 545					
Water balance							186					
Total use (U)		105 528	49 040	19 785	1 088	55 400	9 545	12 799	7 920	4 094	4 381	170
Total supply 1 (S1)		105 528	49 040	19 785	1 088	55 400	9 545	12 799	7 920	4 094	4 381	170
Consumption 1 (U – S1)												
Total supply 2 (S2) excluding evapotranspiration		105 528	49 040	19 785	1 088	55 400	9 545	12 799	7 920	4 094	4 381	170
Consumption 2 (U – S2) – economic consumption												

Table 16: Water flow accounts: Input-output tables, 2000 (continued)

		Production											
		Agriculture											
		Dryland and irrigation	Livestock and game	Plantation forestry	Total	Mining	Electricity	Other bulk: industrial	Other commercial and industrial	Domestic – urban	Domestic – rural	Domestic – total	Total
Environment	Atmosphere and sea												105 528
	Natural MAR (including storage)												49 040
	Surface water (including reserve)			428	428								19 785
	Groundwater												1 088
	Soil water	45 000		10 400	55 400								55 400
	Ecological reserve												9 545
Distribution	DWAF (available total yield)		313		313								12 799
	Irrigation boards	7 920			7 920								7 920
	Water boards					388	297	367					4 094
	Municipalities								1 199	1 698	261	1 959	4 381
	ROW and other WMA												170

Table 16: Water flow accounts: Input-output tables, 2000 (concluded)

		Production											
		Agriculture											
		Dryland and irrigation	Livestock and game	Plantation forestry	Total	Mining	Electricity	Other bulk: industrial	Other commercial and industrial	Domestic – urban	Domestic – rural	Domestic – total	Total
Production	Agriculture												64 061
	Dryland and irrigation												52 920
	Livestock and game												313
	Plantation forestry												10 828
	Mining												388
	Electricity												297
	Other bulk (industrial)												367
	Other commercial and industrial												1 199
	Total domestic												1 959
	Domestic – urban												1 698
	Domestic – rural												261
Theoretical ecological reserve													9 545
Water balance													186
Total use (U)		52 920	313	10 828	64 061	388	297	367	1 199	1 698	261	1 959	338 021
Total supply 1 (S1)		52 920	313	10 828	64 061	388	297	367	1 199	1 698	261	1 959	338 021
Consumption 1 (U – S1)													
Total supply 2 (S2) excluding evapotranspiration		46 440	61	10 400	56 900	97	82	162	664	910	46	956	328 610
Consumption 2 (U – S2) – economic consumption		6 480	252	428	7 161	291	215	205	535	788	215	1 003	9 411

Source: *Stats SA, Updated Water Accounts for South Africa: 2000 (D0405)*

Table 17: Water supply table: South Africa, 2000

				Environment						Distribution				
			Supply table	Atmosphere and sea	Natural MAR	Surface water yield	Groundwater	Soil water	Ecological reserve	DWAF (total yield)	ROW and other WMA	Irrigation Boards	Water Boards	Municipalities
To the environment	S1	D.1	Total water returned	105 528	49 040	9 545			9 545	186				
			To water sources	*105 528*	*49 040*	*9 545*			*9 545*					
			Atmosphere and sea (evaporation – losses)		29 683				9 545					
			Evapotranspiration											
			MAR (including storage)	49 040										
			Groundwater	1 088										
			Surface water (including reserve)		19 357									
			Soil water	55 400										
			Ecological reserve			9 545								
		D.2	*To other sources*							186				
			Balance (to atmosphere or lower reserve)							186				

Table 17: Water supply table: South Africa, 2000 (continued)

			Environment						Distribution				
		Supply table	Atmosphere and sea	Natural MAR	Surface water yield	Groundwater	Soil water	Ecological reserve	DWAF (total yield)	ROW and other WMA	Irrigation Boards	Water Boards	Municipalities
To economic activities	S2	Supply of water to other economic units of which:			10 240	1 088	55 400		12 613		7 920	4 094	4 381
		Desalinated											
		Reused											
		Waste water to sewage											
		To distribution (bulk yield available)			*9 812*	*1 088*			*12 300*			*3 042*	*1 223*
		DWAF (available total yield)			9 812	1 088							1 223
		Irrigation boards							7 920				
		Water boards							4 094				
		Municipalities							116			3 042	
		ROW and other WMA							*170*				
		To direct use by			*428*		*55 400*		*313*		*7 920*	*1 052*	*3 158*
		Agriculture – irrigation									7 920		
		Agriculture – dryland crops (excluding forestry)					45 000						
		Agriculture – livestock and game							313				
		Agriculture – plantation forestry			428		10 400						
		Mining										388	
		Hydroelectric power										297	
		Other bulk: industrial										367	
		Other commercial and industrial											1 199
		Domestic – urban											1 698
		Domestic – rural											261

Table 17: Water supply table: South Africa, 2000 (continued)

				Environment						Distribution				
			Supply table	Atmosphere and sea	Natural MAR	Surface water yield	Groundwater	Soil water	Ecological reserve	DWAF (total yield)	ROW and other WMA	Irrigation Boards	Water Boards	Municipalities
To economic activities	S2	C.1	Hydroelectric power											
		C.2	Mine water											
		C.3	Urban runoff											
		C.4	Losses in distribution (leakages, etc.)											
Total supply of water (S1+S2)				105 528	49 040	19 785	1 088	55 400	9 545	12 799		7 920	4 094	4 381

Table 17: Water supply table: South Africa, 2000 (continued)

				Production									
				Agriculture									
			Supply table	Dryland and irrigation	Livestock and game	Forestry	Mining	Electricity	Other bulk: industrial	Other Commercial industrial institutional municipal	Domestic – urban	Domestic – rural	Total
To the environment	S1	D1	Total water returned	52 244	313	10 828	326	234	238	784	1 144	261	240 216
			To water sources	*52 244*	*313*	*10 828*	*326*	*234*	*238*	*784*	*1 144*	*261*	*240 030*
			Atmosphere and sea (evaporation – losses)	7 244	313		326	234	238	784	1 144	261	49 772
			Evapotranspiration	45 000		10 400							
			MAR (including storage)										49 040
			Groundwater										1 088
			Surface water (including reserve)			428							19 786
			Soil water										55 400
			Ecological reserve										9 545
			To other sources										186
			Balance (to atmosphere or lower reserve)										186

Table 17: Water supply table: South Africa, 2000 (continued)

			Production								
			Agriculture								
		Supply table	Dryland and irrigation	Livestock and game	Forestry	Mining	Electricity	Other bulk: industrial	Other Commercial industrial institutional municipal	Domestic – urban	Domestic – rural	Total
To economic activities	S2	Supply of water to other economic units of which:	676			62	63	129	415	554		97 635
		Desalinated										
		Reused										
		Waste water to sewage				62	63	129	415	554		1 223
		To distribution (bulk yield available)	*676*									28 141
		DWAF (available total yield)	676									12 799
		Irrigation Boards										
		Water Boards										
		Municipalities										
		ROW and other WMA										
		To direct use by										68 271
		Agriculture – irrigation										
		Agriculture – dryland crops (excluding forestry)										45 000
		Agriculture – livestock and game										
		Agriculture – plantation forestry										10 828
		Mining										
		Hydroelectric power										
		Other bulk: industrial										
		Other commercial and industrial										
		Domestic – urban										
		Domestic – rural										

Table 17: Water supply table: South Africa, 2000 (concluded)

				Production										
				Agriculture										
			Supply and use	Dryland and irrigation	Livestock and game	Forestry	Mining	Electricity	Other bulk: industrial	Other Commercial industrial institutional municipal	Domestic – urban	Domestic – rural	Total
To economic activities	S2	C.1	Hydroelectric power					215					215
		C.2	Mine water				291						291
		C.3	Urban runoff								787		787
		C.4	Losses in distribution (leakages, etc.)	764	61		35	19	33	248	356	45	1 561
Total supply of water (S1+S2)				52 920	313	10 828	388	297	367	1 199	1 698	261	337 851

Source: *Stats SA, Updated Water Accounts for South Africa: 2000 (D0405)*

Table 18: Water use table: South Africa, 2000

			Use table	Environment: Atmosphere and sea	Natural MAR	Surface water yield	Groundwater	Soil water	Ecological reserve	Distribution: DWAF (total yield)	ROW and other WMA	Irrigation Boards	Water Boards	Municipalities
			Total abstraction	39 398	49 040	19 785	1 088	55 400	9 545	10 900				
			Abstraction for own use											
		b.1	Hydroelectric power											
			Mine water											
			Urban runoff											
			Other											
		b.2	*Abstraction for distribution*											
From the environment	U1		*From water resources*	*39 398*	*49 040*	*19 785*	*1 088*	*55 400*	*9 545*	*10 900*				
			Atmosphere and sea (evaporation – losses)		49 040		1 088	55 400						
			MAR (including storage)	29 683		19 785								
		a.1	Groundwater							1 088				
			Surface water (including reserve)						9 545	9 812				
			Soil water											
			Ecological reserve	9 545										
			Transfers in (ROW)	170										
			From other sources											
		a.2	Direct rain harvesting											
			Abstraction from sea											

Table 18: Water use table: South Africa, 2000 (continued)

			Environment						Distribution				
		Use table	Atmosphere and sea	Natural MAR	Surface water yield	Groundwater	Soil water	Ecological reserve	DWAF (total yield)	ROW and other WMA	Irrigation Boards	Water Boards	Municipalities
From economic activities	U2	Use of water supplied by other industries	66 130						1 899	170	7 920	4 094	4 381
		Supplied by distribution sectors	*186*						*1 223*	*170*	*7 920*	*4 094*	*3 158*
		DWAF	186							170	7 920	4 094	116
		Irrigation boards											
		Water boards											3 042
		Municipalities							1 223				
		Supplied by other sectors	*65 944*						*676*				*1 223*
		Evapotranspiration	55 400										
		Losses – evaporation	10 544										
		Return flows							676				
		Effluent											1 223
		Balance (surplus/deficit over current use)											
Total water use (U1+U2)			105 528	49 040	19 785	1 088	55 400	9 545	12 799	170	7 920	4 094	4 381

Table 18: Water use table: South Africa, 2000 (continued)

			Production										
			Agriculture										
		Use table	Dryland and irrigation	Livestock and game	Forestry	Mining	Electricity	Bulk: industrial	Other Commercial, industrial, institutional, municipal	Domestic – urban	Domestic – rural	Total
From the environment	U1	Total abstraction	45 000		10 828							240 984
		Abstraction for own use										
	b.1	Hydroelectric power										
		Mine water										
		Urban runoff										
		Other										
	b.2	*Abstraction for distribution*										
	a.1	*From water resources*	*45 000*		*10 828*							*240 984*
		Atmosphere and sea (evaporation – losses)										105 528
		MAR (including storage)										49 468
		Groundwater										1 088
		Surface water (including reserve)			428							19 785
		Soil water	45 000		10 400							55 400
		Ecological reserve										9 545
		Transfers in (ROW)										170
	a.2	*From other sources*										
		Direct rain harvesting										
		Abstraction from sea										

Table 18: Water use table: South Africa, 2000 (concluded)

		Production									
		Agriculture									
	Use table	Dryland and irrigation	Livestock and game	Forestry	Mining	Electricity	Bulk: industrial	Other Commercial, industrial, institutional, municipal	Domestic – urban	Domestic – rural	Total
From economic activities	Use of water supplied by other industries	7 920	313		388	297	367	1 199	1 698	261	97 037
	Supplied by distribution sectors	*7 920*	*313*		*388*	*297*	*367*	*1 199*	*1 698*	*261*	*29 194*
	DWAF		313								12 799
	Irrigation Boards	7 920									7 920
	Water Boards				388	297	367				4 094
	Municipalities							1 199	1 698	261	4 381
U2											
	Supplied by other sectors										67 843
	Evapotranspiration										
	Losses – evaporation										10 544
	Return flows										676
	Effluent										1 223
	Balance (surplus/deficit over current use)										
Total water use (U1+U2)		52 920	313	10 828	388	297	367	1 199	1 698	261	338 021

Source: *Stats SA, Updated Water Accounts for South Africa: 2000 (D0405)*

5. Conclusion and recommendations

5.1 Recommended future approach to Environmental Economic Accounts for Water

It is recommended that Stats SA update the EEA for Water, every five years based on the DWAF NWRS publication cycle.

This process should be accompanied by the development of an internal sources and methods document which also guides continuous improvements to the EEA for Water.

5.2 Recommended future approach to other Environmental Economic Accounts

Following from the SEEAW and the recommendations of the EEA for Water case study above, it is further proposed that Stats SA follow a similar approach to that proposed for the EEA for Water, for the other key accounts.

These accounts include, but are not limited to, the following themes:

- Minerals
- Energy
- Fisheries
- Forestry
- Land Accounts

The approach should have four phases:

1. A development phase – this phase develops the appropriate structure and specifications for the particular EEA. This is done in close consultation with the relevant line department and/or statutory bodies and following the guidelines of the SEEA. The development of minerals, energy and forestry accounts for South Africa are well advanced.
2. A commissioning phase – this phase tests the feasibility of regular reporting of the particular account, firstly through data mining the relevant Stats SA databases, and secondly by incorporating new or additional questions in surveys and questionnaires.
3. The establishment of Memorandums of Understanding (MOU) and subsequent service level agreements with relevant line ministries and statutory bodies to access data in their custody.
4. An implementation phase – this phase institutionalises the regular publication of EEA and priority indicators.

5.2 Data gaps

Improvement of questionnaires

The key improvement that could be made to questionnaires is the addition of a very limited number of questions on either physical supply-and-use-data or price data. Of the supply and demand questions identified for improvement, at least 55 questions require supplementary data to enhance its usefulness. Furthermore, additional new data may be gathered from questionnaires through the addition of new questions. Seven sets of questions have been identified to gather additional supply data. For example:

Mining LSS:

- Information on the opening and closing stocks of reserves
- Information on the extraction of water through mine dewatering.

Ocean Fishing LSS:

- Information on fishing effort. Effort is an important variable in the estimation of fish stocks.

For the demand data, 188 preliminary alterations and new questions are proposed.

These are primarily comprised as follows:

- In the Energy domain, a large number of existing questions deal with expenses on fuel, combined with other expenses. These could be separated. In addition, if price data could be gathered on fuel use, air emissions estimates can be made for each sector.
- In the Water and Energy domains, a large number of existing questions combine expense information for water and electricity, and these could be separated. In addition, if price data could be gathered on electricity and water use, accurate estimates of actual water and electricity use by sector could be made.
- Some questions in the Community Survey (CS) and the Income and Expenditure Survey (IES) deal with harvesting of natural products by households. If this question could be split, it would contribute a wealth of information to the Land domain.

All the census and survey questionnaires evaluated contained valuable and important EEA related questions. Those containing potentially the most EEA relevant data were the Agricultural Census and the GHS. Eight of the questionnaires contained more than 14 potentially relevant questions.

Additional data sources

Although additional data sources exist, these are not necessarily centralized. For the EEA for Water, valuable additional data may be gathered from the small number of WB in the country. Additional data sources are also required for the SIC sectors not covered by the 27 questionnaires upon which this study was based.

Unfortunately, it is not possible for Stats SA to introduce all the suggested changes to the existing surveys, given the resource constraints and differing priorities it needs to satisfy. The development of the data sources is therefore a longer term goal that will be phased in gradually.

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Glossary

Account

An account is a tool which records, for a given aspect of economic life, (a) the uses and resources or (b) the changes in assets and the changes in liabilities and/or (c) the stock of assets and liabilities existing at a certain time; the transactions accounts include a balancing item which is used to equate the two sides of the accounts (e.g. resources and uses) and which is a meaningful measure of economic performance in itself.

Department of Water Affairs and Forestry (DWAF)

DWAF is the line department responsible for monitoring and evaluating the supply and use of water in South Africa.

Ecosystem services

Ecosystem services cover the provision of ecosystem inputs, the assimilative capacity of the environment and the provision of biodiversity.

Environmental Economic Accounts (EEA)

EEA brings together economic and environmental information in a common framework to measure the contribution of the environment to the economy, and the impact of the economy on the environment.

Effluent

Effluent is liquid waste product (whether treated or untreated) discharged from an industrial process or human activity that is discharged into the environment.

Environmental indicator

An environmental indicator is a parameter, or a value derived from parameters, that points to, provides information about and/or describes the state of the environment, and has a significance extending beyond that directly associated with any given parametric value. The term may encompass indicators of environmental pressures, conditions and responses.

Environmental services

Environmental services refer to qualitative functions of natural non-produced assets of land, water and air (including related ecosystem) and their biota.
There are three basic types of environmental services:
(a) Disposal services which reflect the functions of the natural environment as an absorptive sink for residuals;
(b) Productive services which reflect the economic functions of providing natural resource inputs and space for production and consumption; and
(c) Consumer or consumption services which provide for physiological as well as recreational and related needs of human beings.

Monetary accounts

Provide a basket of measures that describe the economic and welfare impacts of water supply and use.

National accounts

National accounts are a coherent, consistent and integrated set of macro economic accounts, balance sheets and tables based on a set of internationally agreed concepts, definitions, classifications and accounting rules.

National accounts provide a comprehensive accounting framework within which economic data can be compiled and presented in a format that is designed for purposes of economic analysis, decision-taking and policy-making.

Natural Resource Accounting

Natural Resource Accounting is an accounting system that deals with stocks and stock changes of natural assets, comprising biota (produced or wild), subsoil assets (proved reserves), water and land with their aquatic and terrestrial ecosystems. It is frequently used in the sense of physical accounting as distinguished from monetary (environmental) accounting.

Natural resources	Natural assets (raw materials) occurring in nature that can be used for economic production or consumption. The naturally occurring assets that provide use benefits through the provision of raw materials and energy used in economic activity (or that may provide such benefits in future) and that are subject primarily to quantitative depletion through human use are subdivided into four categories: mineral and energy resources, soil resources, water resources and biological resources.
Opportunity cost	In the System, the cost of using, or using up, some existing asset or good in one particular process of production is measured by the amount of benefits that could have been secured by using the asset or good in alternative ways. Opportunity cost is calculated with reference to the opportunities foregone at the time the asset or resource is used, as distinct from the costs incurred at some time in the past to acquire the asset.
Physical accounting	Natural resource and environmental accounting of stocks and changes in stocks in physical (non-monetary) units, for example, weight, area or number. Qualitative measures, expressed in terms of quality classes, types of uses or ecosystem characteristics, may supplement quantitative measures. The combined changes in asset quality and quantity are called volume changes.
Satellite accounts	Satellite accounts provide a framework linked to the central accounts and which enables attention to be focused on a certain field or aspect of economic and social life in the context of national accounts: common examples are satellite accounts for the environment, tourism or unpaid household work.
System of Integrated Environmental and Economic Accounting (SEEA)	Satellite system of the System of National Accounts (SNA) proposed by the United Nations for the incorporation of environment concerns (environmental costs, benefits and assets) into national accounts.

System of Environmental Economic Accounting for Water (SEEAW)	Conceptual framework for organising the hydrological and economic information in a coherent and consistent manner. SEEAW is and elaboration of the SEEA.
System of National Accounts	The revised (1993) system adopted worldwide for conventional economic (national) accounting (Commission of the European Communities and others, 1993).
Water pollution	Water pollution refers to the presence in water of harmful and objectionable material – obtained from sewers, industrial wastes and rainwater run-off – in sufficient concentrations to make it unfit for use.
Water quality	Water quality refers to the physical, chemical, biological and organoleptic (taste-related) properties of water.
Water Quality Accounts	Accounts that describe the quality and changes in quality of the water bodies (watercourses) by classes of quality.
Water Resource Accounts Monitoring	Monitoring refers to the continuous or frequent standardised measurement and observation of the environment (air, water, land/soil, biota), often used for warning and control.
Water resources (SEEA)	The water found in fresh and brackish surface water and groundwater bodies within the national territory. In the case of surface water, the volume in artificial reservoirs and watercourses is included in addition to that in natural water bodies. The water of the oceans and open seas is excluded on the grounds that the volumes involved are so enormous as to make any stock measure meaningless and that extraction for human use has no measurable impact on them.
Water use	Water use refers to use of water by agriculture, industry, energy production and households, including in—stream uses such as fishing, recreation, transportation and waste disposal.

Annexure 1: Identifying data from Statistics South Africa databases

1.1 Data requirements for Environmental Economic Accounts

Developing EEA requires two types of data:

- Physical data on the stocks and flows of natural resources
- Monetary data on the production, prices and costs of natural resources.

Physical data are in most instances collected by the Department of Minerals and Energy (DME), DWAF and the Department of Environmental Affairs and Tourism (DEAT) who are responsible for the particular natural resource. These are generally not completely suited for EEA, as they are collected for specific use of the line departments. In particular, the categorisation of sectors is often inconsistent with the 1993 SNA framework and the SIC. This makes comparison to economic data difficult.

Stats SA is the custodian of economic data for South Africa. To date this monetary data have been used to a limited extent in EEA. Ideally, the data must be available in time series format. This allows the analysis of trends in growth and sustainability.

The data must also be of good quality. Stats SA defines data quality according to the SASQAF. The prerequisites of data quality (including the legal and institutional environment) include the following attributes: relevance, accuracy, timeliness, accessibility, interpretability, coherence, methodological soundness and integrity.

1.2 Statistics South Africa data

Stats SA regularly conducts surveys and censuses to collect a variety of information from the full spectrum of economic role players.

Stats SA has investigated the use of its existing internal data with the purpose of identifying all possible available data sources for EEA within Stats SA, and, where possible; to make improvements on the identified data sources[7]. That report identified and analysed key surveys and censuses.

[7] *Stats SA, 2008. Internal data audit for natural resources within Stats SA. Stats SA Internal Report*

The key Stats SA survey and census questionnaires used as data sources were:

1. CS
2. Census 2001 A
3. Census 2001 B
4. Census 2001 C
5. GHS
6. Census of Commercial Agriculture (1102–E)
7. Census of Agricultural Services (1140–E)
8. Census of Ocean (Marine) Fishing (1301–E)
9. Census of Commercial Forestry (1201–E)
10. Annual Financial Statistics Survey (AFS) (0021–E)
11. Quarterly Financial Statistics Survey (QFS) (0044–E)
12. Financial Census of Municipalities (9114–E)
13. Non-Financial Census of Municipalities (9115–E)
14. Survey of Actual and Expected Capital Expenditure of Public Corporations (9101004–E)
15. Survey of Actual and Expected Capital Expenditure of the National; Government, Provincial Government and the Extra-Budgetary funds (9101/001–E)
16. Survey of Actual and Expected Capital Expenditure of Universities and Technikons (9107/004–E)
17. Accommodation: LSS (8001–E)
18. Construction: LSS 502 (5001–E)
19. Construction: LSS 503, 504 (5001–E)
20. Construction: LSS 501, 505 (5001–E)
21. Personal Services: LSS (9001–E)
22. Mining: LSS (2001–E)
23. Survey of Electricity Distributed (4141–E)
24. Income and Expenditure Survey (IES) (01/11/01/E)
25. Production Price Index (PPI) – Export (P0142-1)
26. PPI – Import (P0142-1)
27. PPI – Local (P0142-1)

Following from the economic theory discussed in Section 1.2 above, the 27 census and survey questionnaires listed above were analysed for the following types of physical and monetary data:

- Stock of assets
- Consumption
- Environmental quality
- Market price
- Costs
- Investment

The Survey of Actual and Expected Capital Expenditure of Universities and Technikons and the three PPI questionnaires contained no relevant information. The QFS contained identical information to the AFS. The three Census 2001 questionnaires contained identical data to the CS. The remaining 19 questionnaires were then analysed for:

- Their current content of relevant supply and demand information
- The potential of improving the relevance of this information through the use of supplementary data
- Proposed additions to these questionnaires to gather improved environmental statistics in future.

Analysis of the census and survey questionnaires indicates that the existing Stats SA data archives contain a vast amount of environmental statistics which may potentially be used to improve environmental accounting.

The preliminary analysis of these questions are summarised in a separate report. There are 149 questions relating to supply of natural resources and 230 questions relating to the demand for natural resources. More than half of this is in the Water domain. The Energy and Land domains also contain a large number of potentially useful questions.

The Census of Agriculture contained significant amounts of information on water use especially, by the sector with the highest water use in South Africa. The usefulness of this questionnaire to EEA could be enhanced considerably by effecting slight changes to existing questions and limited additions.

The various LSS questionnaires contain valuable questions on resource use and production in the various sectors.

The questionnaires focusing on households (CS, GHS, Population Censuses and IES) contain a large number of questions on resource use by households. In addition, Section 3 of the GHS contains interesting information relating to leisure travelling, which may inform Land accounts.

The Survey of Electricity Distributed questionnaire could be useful in collecting physical data and monetary data for both electricity produced and consumed, as well as emissions produced, especially if small enhancements are made.

The Non-financial Census of Municipalities is a very valuable source of water and energy distribution data.

Annexure 2: Environmental Economic Accounts

2.1 Theoretical background

The 1993 SNA is a conceptual national accounting framework that provides international statistical standards for the measurement of the market economy. It is published jointly by the UN, the Commission of the European Communities (CEC), the International Monetary Fund (IMF), the Organisation for Economic Co-operation and Development (OECD), and the World Bank. It consists of an integrated set of macroeconomic accounts, balance sheets and tables which are based on internationally agreed concepts, definitions, classifications and accounting rules. Together, these principles provide a comprehensive accounting framework within which economic data can be compiled and presented in a format that is designed for purposes of economic analysis, decision-taking and policy-making[8].

Theoretically, the 1993 SNA is based on four accounts: the Production Account, the Income Consumption Account, the Capital Account, and the Rest of the World Account. These accounts provide supply-side data and information (Gross Domestic Product and imports (M)), and demand-side data and information on consumption (C), gross investment (GI) and export (X), so that the following relationship holds:

$$GDP + M = C + GI + X$$

This relationship can be converted to the relation (demonstrated by Aniyar and Mäler[9]):

$$NDP = C + NI + (X - M)$$

[8] UN Internet Site: http://unstats.un.org/unsd/sna1993/introduction.asp
[9] Aniyar S and Mäler K-G, 2008. Wealth and well-being. Beijer Institute and Stockholm Resilience Centre

The (C) can be interpreted as a measure of well-being. The net investment (NI) can be interpreted as the contribution, in the current period, to future well-being. The final term, the trading balance (X-M), is an increase in our net claims on our trading partners, which increases capital stock and future well-being. Therefore, net domestic product (NDP) is commonly used as a national welfare measure.

However, (C), as accounted for in the 1993 SNA, is not a complete measure for human well-being. Firstly, the list of items included in consumption excludes a number of important services such as quality of the environment, health status, longevity and leisure. These are, in other words, services not bought and sold in markets. They may include biodiversity services, various services from forests or subsistence agriculture. Secondly, market prices do not necessarily correspond to their impact on human well-being. The administered prices of energy and water in South Africa are commonly known to be much lower than its expected market value. Thirdly, social well-being depends not only on consumption, but on the distribution of wealth between households[10].

EEA are satellite accounts to the 1993 SNA that seek to address these deficiencies. The UN and its counterparts have been developing the SEEA in order to provide standards for environmental economical accounting.

2.2 The System of Integrated Environmental and Economic Accounting

SEEA provides a common framework for economic and environmental information, permitting a consistent analysis of the contribution of the environment to the economy and the effect of the economy on the environment. It is focused on the needs of policy-makers and provides indicators and descriptive statistics to monitor the relationships between the economy and the environment. It also serves as a tool for strategic planning and policy analysis to identify more sustainable development paths[11].

[10] Aniyar S and Mäler K-G, 2008. Wealth and well-being. Beijer Institute and Stockholm Resilience Centre
[11] UN SEEA-2003 Internet Site: unstats.un.org/unsd/envAccounting/seea.htm

2.3 Aspects of the System of Integrated Environmental and Economic Accounting

The SEEA identifies three categories of assets: natural resources; land and surface water; and ecosystems. SEEA used the following classification codes for the assets categories:

- Natural resources: EA.1
- Land and surface water: EA.2
- Ecosystems: EA.3.

The three asset categories are discussed below.

Natural resources

Natural resource assets are those elements of the environment that provide use benefits through the provision of raw materials and energy used in economic activities, and that are subject to quantitative depletion through human use. They are subdivided into four categories: mineral and energy resources; soil resources; water resources; and biological resources.

Mineral and energy (or subsoil) resources

Mineral and energy resources include subsoil deposits of fossil fuels, metallic minerals and non-metallic minerals. They are the only natural resources where the only living species they directly interact with is mankind, and such interaction takes place entirely in the market place.

Soil resources

Soil resources include soil found on agricultural land as well as that found elsewhere within the territory. In practice, it is agricultural soil that is of great importance in most countries from a natural resource perspective and it is likely that most countries would focus their soil accounts here.

Water resources

Water resources are defined as the water in fresh and brackish surface water and groundwater bodies within the national territory. Surface water is different from many other natural resources in that it can be extracted from the environment and brought into the economic system for use in a variety of ways. Uses of water include agricultural, industrial, household, recreational and environmental activities.

Biological resources

Biological resources include timber resources, crop and plant resources, aquatic resources, and animal resources other than aquatic that bring use benefits today or that may do so in the future.

Land and surface water

Land and surface water assets are subdivided into five categories: land underlying buildings and structures; agricultural land and associated surface water; wooden land and associated surface water; major water bodies; and other land. They are defined as the areas within the national territory that provide direct or indirect use benefits through the provision of space for economic and non-economic human activities.

Forest, wooden land and forest products

It is informative to look at the total value of forested land, paying attention to the timber, the land on which it grows and other forms of ecosystems supported by the forests.

Aquatic resources

An important issue for aquatic resources is the issuing of fishing licences and quotas. These are an important economic instrument in the preservation of sustainable levels of fish stocks. Fish exist both in cultivated and non-cultivated forms. By convention, only aquaculture (fish farming) is treated as non-cultivated, including those where freedom of movement in the open sea is inhibited by human controls (fish ranching).

Ecosystems

Ecosystems can be defined as groups of organisms and the physical environment they inhabit. They are recognised as assets in the SEEA for their provision of indirect use benefits for humans in the form of a variety of services, including the cleaning of air, water and soil, protection against solar radiation, regulation of geochemical flows and others.

Both land and ecosystems are assets which are unlike any other natural resource in that it may change in quality due to human intervention but effectively cannot be either created or destroyed by man. Neither can land be imported or exported. Data on land use and land cover relate to the nature of the use being made of land, changes in this use and changes in the quality of land which may affect its suitability for various purposes.

The key SEEA accounts for which guidelines are provided (Chapter 8 of the SEEA) are:

- Mineral and energy accounts
- Water resource accounts
- Forests, wooded land and forest products accounts
- Aquatic resource (fisheries) accounts
- Land and ecosystem accounts

These accounts are also relevant for South Africa.

2.4 The Millennium Ecosystems Assessment Framework[12]

The MA proposes an alternative but complementary categorisation for EEA. This provides and opportunity to improve the SEEA categorisation.

The MA was published in 2005 by the UN and assesses the consequences of ecosystem change for human well-being. From 2001 to 2005, the MA involved the work of more than 1 360 experts worldwide.

Their findings provide a state-of-the-art scientific appraisal of the condition of and trends in the world's ecosystems and the services they provide, as well as the scientific basis for action to conserve and use them sustainably. In the final analysis the MA concludes that human actions are depleting Earth's natural capital, putting such strain on the environment that the ability of the planet's ecosystems to sustain future generations can no longer be taken for granted. Furthermore, at local and national scale, relatively limited information exists about the status of many ecosystem services and even less information is available about the economic value of non-marketed services. The costs of the depletion of these services are rarely tracked in national economic accounts.

The MA considers ecosystems to be assets that yield a flow of services of benefit to people, much like other capital stocks. The MA proposes a framework for analysis of ecosystem services, which includes four major categories of which each contains a number of subcategories. These include:

a. Provisioning services (covering the production of foods, fuels, fibres, etc.)

b. Cultural services (covering non-consumptive uses of the environment for recreation, amenity, spiritual renewal, etc.)

c. Regulating services (covering the absorption of pollutants, storm buffering, erosion control, and the like).

The MA refers to an additional set of ecosystem services, namely supporting services. These cover the basic ecosystem functions and processes that underpin all other services. They are therefore embedded in those services, and are not evaluated separately. These services are further defined in Table 19 below.

[12] MA Internet Site: http://www.millenniumassessment.org

Table 19: The definition of the Millennium Ecosystem Assessment ecosystem services[13]

Category of ecosystem services	Types of services in the category	Description	Sufficiency of SEEA
Supporting	Soil formation	Sediment retention and the accumulation of organic matter underpin other services.	Not applicable
	Photosynthesis	Photosynthesis is a metabolic pathway that converts light energy into chemical energy.	Not applicable
	Primary production	Rate of biomass produced by an ecosystem.	Not applicable
	Nutrient cycling	The process of the storage, recycling, processing and acquisition of nutrients, which underpins all other ecosystem services.	Not applicable
	Water cycling	Affects climate, chemistry and biology and is fundamental to the delivery of all ecosystem services.	Not applicable
Regulating	Air quality regulation	Ecosystems both contribute and extract chemicals from the atmosphere that influence many aspects of air quality.	Emissions Account

[13] With an assessment of the extent to which the SEEA framework addresses these services. The MA framework provides and opportunity for improving the SEEA categorisation

Category of ecosystem services	Types of services in the category	Description	Sufficiency of SEEA
	Climate regulation	Ecosystems influence climate both locally and globally. At a local scale, changes in land cover can affect both temperature and precipitation. At a global scale, ecosystems play an important role in the carbon cycle by either sequestering or emitting greenhouse gases.	Emissions Account
	Water regulation	The timing and magnitude of runoff and flooding can be strongly influenced by changes in land cover, including particular alterations that change the water storage potential of the system such as the conversion of wetlands or the replacement of forests with croplands or croplands with urban areas.	Water Account
	Erosion regulation	Vegetative cover plays an important role in soil retention and the prevention of landslides.	Insufficient
	Water purification and waste treatment	Ecosystems can be a source of impurities in fresh water but can also help to filter out and decompose organic wastes introduced into inland waters and coastal and marine ecosystems.	Water Quality Account
	Disease regulation	Changes in ecosystems can directly change the abundance of human pathogens such as cholera, and can alter the abundance of disease vectors such as mosquitoes.	Land Account
	Pest regulation/Biological control	Ecosystem changes affect the prevalence of crop and livestock pests and diseases.	Insufficient

Category of ecosystem services	Types of services in the category	Description	Sufficiency of SEEA
	Pollination	Ecosystems that support pollinators are often important to the success of economies and genetic diversity. This refers to animal-assisted pollination, done by bees, rather than wind pollination.	Insufficient
	Detoxification	Biological processes are involved in the sequestration or detoxification of various chemical wastes introduced into the environment.	Insufficient
	Natural hazard regulation	Such as storm protection, the presence of coastal ecosystems such as mangroves and coral reefs can dramatically reduce the damage caused by hurricanes or large waves.	Insufficient
Provisioning	Food	Provision of food from crops, livestock, marine and fresh-water capture fisheries, aquaculture or wild plant and animal food products.	Not relevant, captured in 1993 SNA
	Fresh water	Ecosystems provide storage and retention of water for domestic, industrial, and agricultural use.	Water Account
	Wood and fibre	Direct benefits from wood for timber and pulp, biomass energy (fuelwood and charcoal consumption) and from the production of agricultural fibres such as cotton, silk and hemp.	Forestry Account

Category of ecosystem services	Types of services in the category	Description	Sufficiency of SEEA
	Biochemical and pharmaceutical products	Ecosystems provide natural products that have been used for biochemicals and pharmaceuticals and other natural products (such as cosmetics, personal care, bioremediation, biomonitoring and ecological restoration.	Insufficient
	Genetic resources	The exploration of biodiversity for new products and industries, such as medicine, genes for plant pathogen resistance or ornamentals. Conserving genetic diversity maintains the potential to yield larger future benefits and ensures options for adapting to changing environments.	Insufficient
Cultural	Cultural diversity	The diversity of ecosystems is one factor influencing the diversity of cultures and the identity of specific cultures.	Not relevant
	Spiritual and religious values	Many religions attach spiritual and religious values to ecosystems or their components.	Not relevant
	Knowledge systems (traditional and formal)	Ecosystems influence the types of knowledge systems developed by different cultures.	Not relevant
	Educational values	Ecosystems and their components and processes provide the basis for both formal and informal education in many societies.	Not relevant

Category of ecosystem services	Types of services in the category	Description	Sufficiency of SEEA
	Inspiration	Ecosystems provide a rich source of inspiration for such activities as art, folklore, national symbols, architecture and advertising.	Not relevant
	Aesthetic values	Many people find beauty or aesthetic value in various aspects of ecosystems, as reflected in the support for parks, scenic drives, and the selection of housing locations.	Not relevant
	Social relations	Ecosystems influence the types of social relations that are established in particular cultures. Fishing societies, for example, differ in many respects in their social relations from nomadic herding or agricultural societies.	Not relevant
	Sense of place	Many people value the 'sense of place' that is associated with recognised features of their environment, including aspects of the ecosystem.	Not relevant
	Cultural heritage values	Many societies place high value on the maintenance of either historically important landscapes ('cultural landscapes') or culturally significant species that serve to remind us of our historic roots.	Not relevant
	Recreation and ecotourism	People often choose the location for spending their leisure time based in part on the characteristics of the natural or cultivated landscapes in a particular area.	Tourism and Water Account

2.5 Relevant Environmental Economic Accounts for South Africa

Minerals

South Africa's most prominent minerals are gold, platinum and coal. They contribute more than other minerals to South Africa's GDP; therefore, environmental economic accounts for minerals play a major role in GDP. Stats SA has previously developed both mineral accounts and a mineral accounts discussion document. DME has been the key source of data.

Energy

The South African economy can be considered as energy intensive, because it is largely based on primary extraction and the processing of coal and uranium. Stats SA is currently working on an energy accounts discussion document[14]. Of importance for the future will be the development of an emissions account for South Africa, based on Climate Change statistics. DME has been the key source of data.

Water

Water is arguably the most important resource that we have for all socio-economic sectors and all economic development activities. In South Africa there is a large dependence of the people on the environment (soil, water and forest) and it is commonly known that South Africa, in terms of the UN definition[15], is water stressed, bordering on water scarce, with a water availability of only 1 100 m^3/person/annum. In a water-scarce country, the provision of water should always be considered in terms of the socio-economic benefits. A water account and discussion document has been published by Stats SA. DWAF has a large hydrological database on water supply and use.

[14] Stats SA discussion document – Energy Accounts 1995-2001

[15] Water availability of less than 1 700 m^3/person/annum constitutes water stress, with values below 1 000 m^3/person/annum classified as water scarce.

Forestry

Forest accounts provide data and information on plantation forestry, natural forests and woodlands. South African firms and households have a very large reliance on these resources. Plantation forestry accounts are constructed annually by DWAF, but no natural forest or woodlands accounts are done.

Fisheries

South Africa has a significant fishing sector. The purpose of fisheries accounts are to monitor and ensure sustainable harvesting of fish stocks. Although evidence of collapse in the stock of commercial fishing species in South Africa exists[16], there are currently no fisheries accounts. DEAT through its Directorate: Marine and Coastal Management (MCM) is the responsible line department.

Land and ecosystems

South Africa has a wealth of natural land and ecosystem assets spread across its seven biomes, some of which are significant as biodiversity hotspots while others have significance value as international heritage sites. DEAT, through its agents South African National Biodiversity Institute (SANBI), South African National Parks (SANParks) and others, is responsible for the monitoring and protection of biodiversity and ecosystems. Through these agencies, much data exist, but a Land and Ecosystem Account has not yet been constructed.

These accounts are arguably the least well developed of the SEEA accounts. The MA framework defined above provides a basis for improvement of this set of accounts.

Annexure 3: Methodological notes

The primary purpose of Stats SA data collection activities, a variety of censuses and surveys, has always been to provide data for conventional national statistical reporting – South Africa's national accounts are drawn up according to the UN standard known as the 1993 SNA. During this process, Stats SA collects incidental data which provide valuable environmental statistics.

[16] DEAT Internet Site: http://www.deat.gov.za/NewsMedia/MedStat/2008Mar5/05032008.pdf

3.1 System for Integrated Environmental and Economic Accounting and Environmental Economic Accounts

Since the 1993 SNA does not explicitly include the development of environmentally oriented statistics, the UNSD has developed the SEEA to provide a conceptual basis for implementing a 1993 SNA (satellite). These are referred to as EEA. The SEEA measures contribution of the environment to the economy and the impact of the economy on the environment. Environment statistics are still in an early stage of development in many countries like South Africa, and data are often sparse. In support of this, Stats SA has been developing discussion documents for land, energy and water accounts and appointing consultants to assist in the development of EEA. The data mining project referred to earlier is also one of the tools that are being used to develop the accounts. Stats SA is currently in a planning process to determine the levels of priority to be assigned to environmental statistics and environmental accounting.

3.2 System of Environmental Economic Accounting for Water

The SEEAW was developed to provide a conceptual framework for organising the hydrological and economic information in a coherent and consistent manner. It was adopted by the United Nations Statistical Commission (UNSC) as an international standard in March 2007. The SEEAW is an elaboration of the SEEA.

3.3 Background

Stats SA has developed two Discussion Documents on water resource accounting, namely the *Water Accounts for Nineteen Water Management Areas, 2000* (*Report No. 04-05-01*), published in 2004, and the *Updated Water Accounts for South Africa: 2000* (*D0405*) published in 2006. Both discussion documents provide background reading material to these accounts.

3.4 Data sources

The data sources include various census and survey data, as listed in Annexure 1 of this discussion document.

3.5 Water Management Area delineation

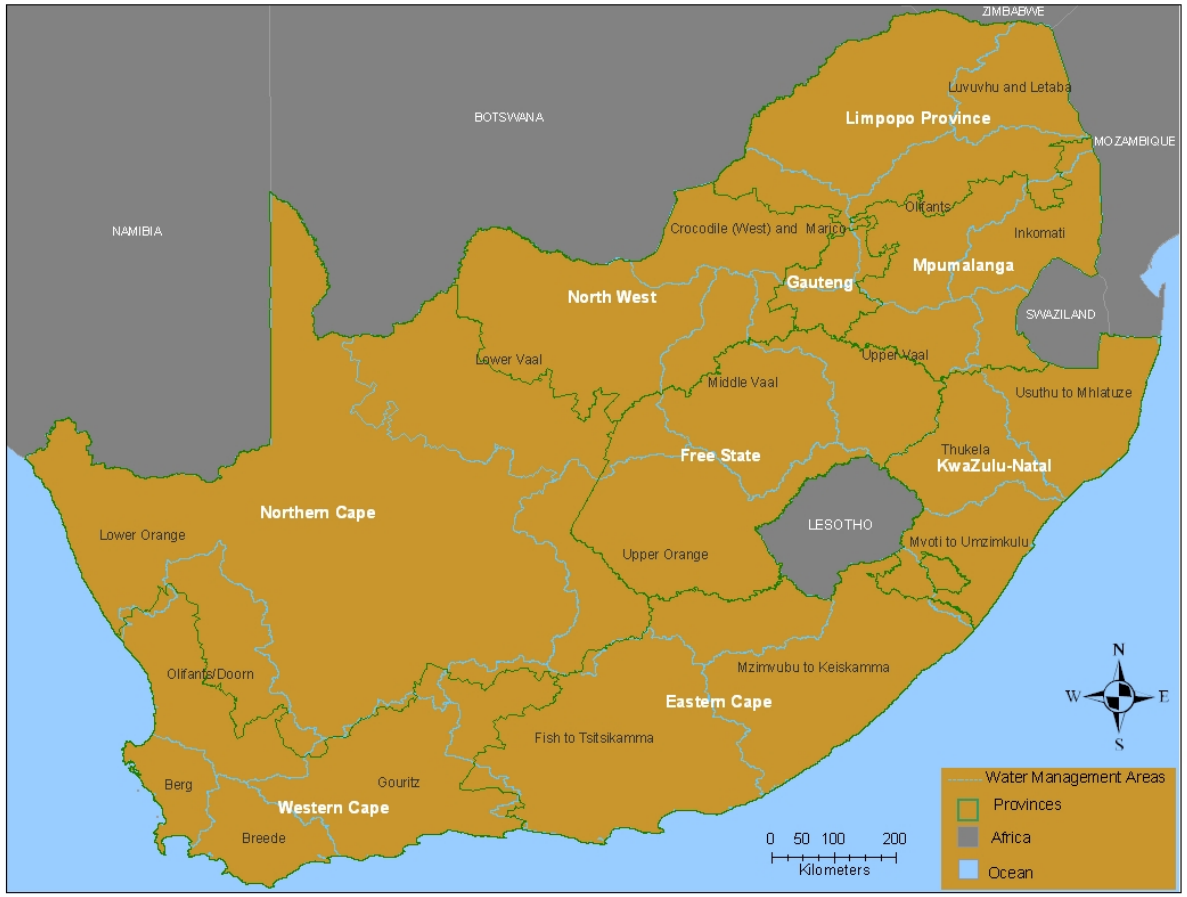
Source data are reported at either provincial or municipal level. Conversion of these data to a WMA specific delineation was done on a 'per area' basis (see Figure 1).

3.6 Monetary data

Monetary data were, as far as possible, sourced from the raw data available. In the case of the Mining, Business, Personal services and Accommodation sectors, data were also sourced from the Stats SA SU-tables.

Annexure 4: Water Management Areas

Figure 3: Map of South Africa showing the boundaries of Water Management Areas and provinces



Source: Department of Water Affairs and Forestry