

## Chapter 14

# Environmental outlook

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## Chapter 14

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### 14.1 INTRODUCTION

What has been presented in this report thus far has been the existing state of the South African environment. In presenting the existing state, key environmental issues and concerns have emerged which require some form of response, either to prevent or reduce the negative environmental impacts or to supplement and support the areas where improvements have been noted. Before these responses can be defined, however, it is necessary to try and determine how these issues are likely to change in the future without intervention so that the options for action (presented in the next part of this report) are as focussed and goal-directed as they can be.

The 2006 SAEO presented a series of scenarios for the future state of the South African environment. Developing scenarios is a powerful way of determining the likely future state for any context where interventions may be required, and to pin-point those interventions that are going to be the most effective (and the most efficient). Such scenarios tend to be presented as extremes (viz. high-road, low-road), whereas in reality the future seldom manifests in such extreme ways and is more often than not some combination of the various scenarios. In this report an attempt is made to define the state



of the environment in 2030 but presenting the scenarios in a more realistic way than as the extremes that were presented in the previous SAEO.

The basis of the approach to defining the environment in 2030 is grounded in the DPSIR philosophy itself. It is presented here that the DPSIR framework which underpins the entire state of environment report also provides a good foundation from which to determine what is likely to happen in the future. If an understanding exists as to how drivers result in pressures which in turn result in a given state of the environment, then it stands to reason that assessing how the drivers and pressures are likely to change, will provide a realistic and accurate outlook on the environment in 2030.

Finally, but importantly, the changes in drivers and pressures will not occur unpredictably but will unfold, to some extent at least, in response to government policy. As such the NDP features prominently in this Outlook chapter in highlighting at least the desired changes in the drivers, which when viewed within the context of trends and forecasts in the drivers and pressures, should provide for a reasonable presentation of the Outlook for the environment in 2030.

## 14.2 IMPACT MAPPING

### 14.2.1 Overview

Impact mapping is an approach to mapping (in a relationship rather than spatial sense) how environmental impacts manifest. On the assumption that the environment has reached some state of balance, impacts are defined as changes to that existing state. Such changes are mostly perceived to be negative, but of course there are changes that may manifest as benefits too. At the same time, there is always a suite of changes that occur as a result of one change because the environment is a system.

For example, a change in the ambient concentration of sulphur dioxide will constitute an impact (it is a change in atmospheric quality), but that change will potentially result in other changes such as increased human respiratory disease, reduced visibility, acidification of rain and soil, increased corrosion and so forth (such impacts are presented in more detail in Chapter 10: Air Quality). Each of those changes will also bring about further changes, such as the acidification of the soil resulting in a change in land productivity or potential, changes in vegetation cover and in land potential, and so the process continues. The point is quite simply that environmental impacts seldom, if ever, manifest in isolation but result rather in a series of changes throughout the environmental system. This chain reaction renders environmental assessment extremely complicated and challenging especially when the impacts result in changes in multiple specialist domains.

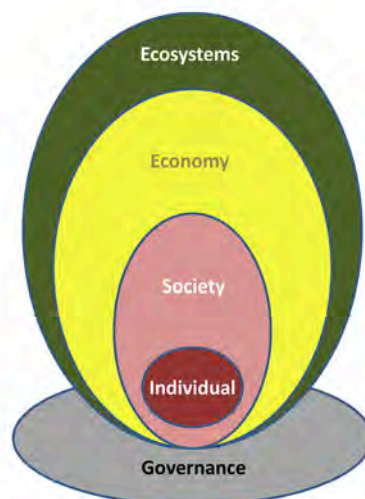
Impact mapping serves to do no more than illustrate these various chains of reactions by presenting variables that make up a given environment and the cause-effect relationships between these variables. Impact mapping is not easy to do; the more detail that is included in the impact map, the better the representation of the system, but at the same time, the greater the level of detail, the more difficult it is to present the map in a way that can be assimilated. Another important

challenge with impact mapping is where to start the map and where to finish it. This start-finish challenge introduces a discussion on sustainable development.

### 14.2.2 Sustainable development

Part I of this report discussed the concept of sustainable development. Where the debate lies with sustainable development is how it gets defined beyond the classic Bruntland definition of “*development that meets the needs of the current generation without compromising on the ability of future generations to meet their needs.*” Perhaps the challenge is less about a proper definition and more about expressing the principle in a way that is conceptually accessible and how it can be assessed and characterized. The old ‘three-ring circus’ model that shows society, economy and environment conveniently intersecting to give rise to sustainable development has become largely discredited for *inter alia* implying that the three components must each somehow compromise something. Chapter 2: Sustainability in South Africa discusses this at some length.

The so-called ‘nested’ model of sustainable development is an improvement on the three-circle model but actually does not illustrate the principle of sustainable development. The nested model emphasizes the dependence of society on economy and economy on the natural environment. The model is a better reflection of the reality of that interdependence as opposed to the idea that the environment, the economy and society must somehow give up something for sustainable development to occur. In recognizing the interdependency it becomes possible to argue that the real manifestation of sustainable development or sustainability (which is a preferable term) is the state of welfare (health, happiness, prosperity, and general well-being) enjoyed by the individual as shown in Figure 14.1.



**Figure 14. 1: The relationships between the environment, economy, society and the individual as the foundation for understanding the concept of sustainability**

Source: Adapted from DEA (2010)

As expressed in Chapter 2 of this report, the idea that individual human welfare (expressed as quality of life in the NDP) is the overarching objective of sustainability is strongly premised on the principle that if society collapses, the welfare of the individual will be reduced, that if the economy collapses that society will be significantly weakened, and that if the environment collapses then the economy will be massively damaged. For individual welfare to be maximized, environment, economy and society must be in the best possible state *without* compromising each other. The role of governance in all of this is to ensure that there is equity and so that one party is not allowed to draw unfairly from the environment for personal gain where other players are then left worse off as a result.

### 14.2.3 The DPSIR framework

The DPSIR framework has been described extensively in this report and it is not the intention to repeat that description here. Some of the key DPSIR tenets are critical to the development of the impact map and so these are described in the section that follows in the context of the sustainability model described above.

#### 14.2.3.1 Drivers

Within the sustainability framework described above, the fundamental driver is the needs and wants of individuals. These needs and wants are expressed in many different ways but the needs and wants are serviced (or met) by society, the economy and the natural environment. As such the fundamental driver, which is people, manifests as a range of activities (also considered to be drivers) that are geared towards responding to the demand for products and services that comes from people.

#### 14.2.3.2 Pressures

Pressures equate to the ISO14001 principle of environmental aspects, which are defined as *“the interaction of activities, products and services with the environment”*. As such, pressures are easily defined if they are thought of as ways in which the drivers interact with the receiving environment. Pressures can then take three principal forms namely:

- Resources such as water, energy, land, minerals and so forth;
- Waste and pollution – Solid, liquid (effluent), gaseous wastes, noise, light, emitted energy and so forth; and,
- Products – Liquid fuels, goods, jobs, spending.

#### 14.2.3.3 State

The state is simply defined as the state of the environment that exists today as a result of the drivers and pressures. Defining the state of the environment can be difficult for several reasons of which the most important are:

- The complexity of the receiving environment; and,
- The availability (or lack thereof) of quantitative information that can be used to unambiguously characterize a given component of the environment.

As a result of these difficulties, indicators must play an essential (and often unappreciated role) in defining the existing state of the environment. As implied by the name, indicators will never provide an absolute statement on the state of the

environment, they will simply serve to provide an indication of certain components. If the indicators are well selected and supported by available information they can provide a clear statement on where the environment is improving and deteriorating and the nature and the urgency of the required response.

### 14.2.4 An impact map for the current state of environment in South Africa

The relationships and interactions that occur between the individual and the society, economy and environment in which those individuals occur are shown schematically in Figure 14.2. Individuals have needs and wants, which are provided to varying degrees by society, the economy and the environment. The economy responds to these needs and wants by using resources (which include land) to provide goods and services to the individuals. In providing these goods and services, the economy also produces waste and pollution, which goes back into the environment, but also provides jobs for society.

Society also requires resources that are drawn from the environment and also produce waste and pollution, which goes back into the environment. Society responds to the needs and wants of the individual by providing certain satisfiers such as identity, sense of belonging, relationships and so forth. Finally, the environment responds to the individual needs and wants by providing services (such as a living environment) and satisfiers (such as scenic beauty). It stands to reason that the degree to which the environment can respond to the needs and wants is a function of the quality of that environment, which in turn is a function of how the environment is used (and abused) by economy and society. The key findings of the state of environment assessment are shown in Figures 14.3 and 14.4, with the areas of concern being shown in the former and areas of improvement in the latter. Note that the key findings are all derived from Part II of this SAEO.

The depictions in Figures 14.2, 14.3 and 14.4 are obviously highly schematic and simplified and represent processes that are a great deal more complicated. That complexity is better illustrated in Figure 14.5 in which an impact map is presented that serves to summarize some of the key relationships between the variables that make up the natural environment, society and the economy. The impact map serves to present the underpinning of the existing state of the environment in South Africa. The impact map forms the key mechanism for ascertaining what the state of environment will be in 2030 as a function of how the many variables shown in the impact map are likely to change in that time.

The way in which this has been done is to predict the behaviour of the drivers over the next several years, what those changes will mean for the pressures, and the state of the environment that will result in response to those changing pressures. The behaviour of the drivers will be affected to varying degrees by government policy and so before presenting how the drivers are forecast to change, it is necessary to first consider what government is planning to do. Government’s collective plans over the next 15 years are probably best encapsulated in the NDP, which is briefly summarized in the section that follows.



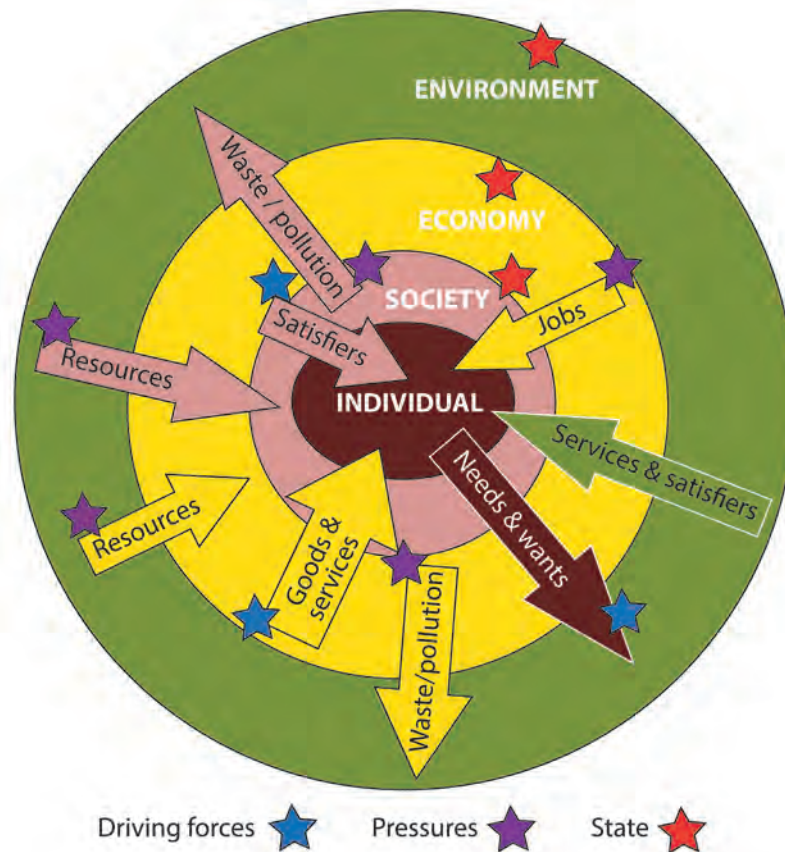


Figure 14. 2: The interactions and relationships between individuals, society, economy and the environment in which those individuals occur

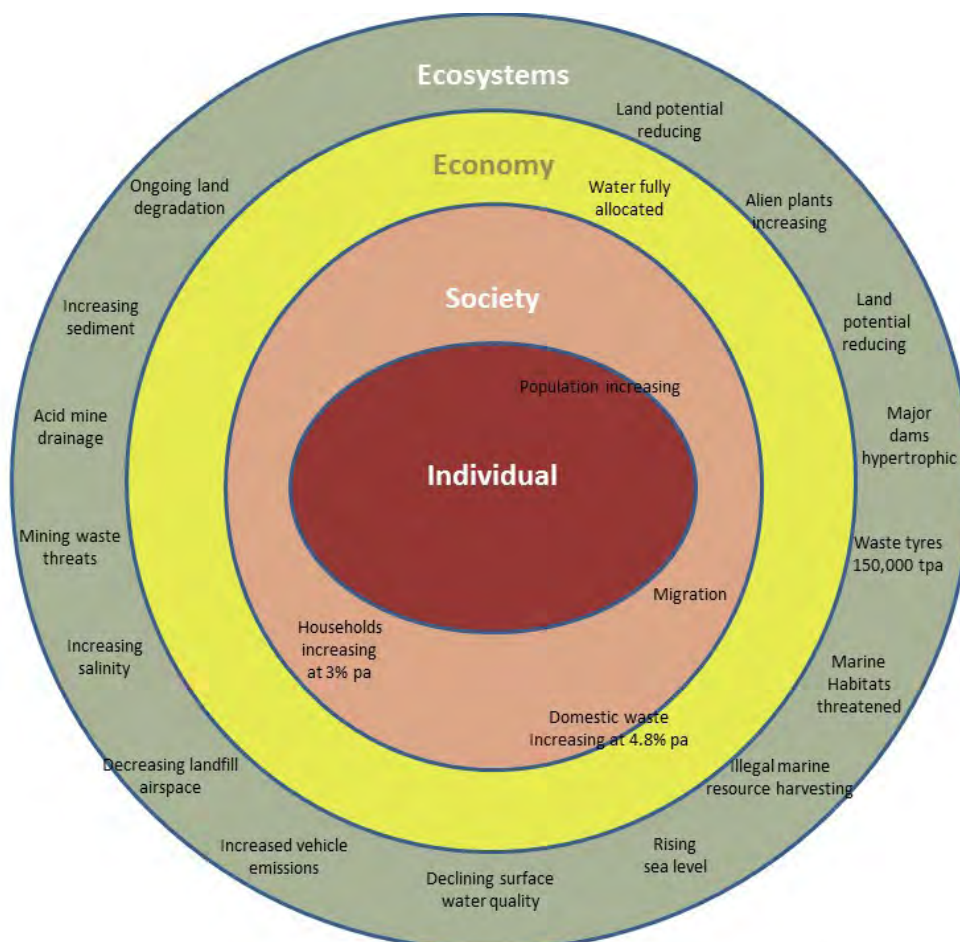


Figure 14. 3: The major areas of concern in respect of the current state of the environment



## 14.3 NATIONAL DEVELOPMENT PLAN

### 14.3.1 Overview

In assessing the key challenges facing the future environment of South Africa, it is important to consider what government is seeking to do; accordingly attention has now turned to the NDP. This Plan, commissioned in 2010, is based on achieving a range of goals by the target year of 2030. The NDP sets out nine primary challenges (NPC 2013), which are listed below:

- Too few people work;
- The quality of school education for many black people is poor;
- Infrastructure is poorly located, inadequate and under-maintained;
- Spatial divides hobble inclusive development;
- The economy is unsustainably resource intensive;
- The public health system cannot meet demand or sustain quality;
- Public services are uneven and often of poor quality;
- Corruption levels are high; and,
- South Africa remains a divided society.

### 14.3.2 The environment

In direct recognition of the challenges facing the environment, the NDP suggests certain actions that the country needs to take, in order to best provide for the South African environment, and those living within it. These actions are listed here below:

- Protect the natural environment in all respects, leaving subsequent generations with an endowment of at least equal value;
- Enhance the resilience of people and the economy to climate change;
- Extract mineral wealth to generate the resources to raise living standards, skills and infrastructure in a sustainable manner; and,
- Reduce greenhouse gas emissions and improve energy efficiency.

Four main measures are proposed in the NDP that need to be instituted in order to protect the natural resources of the country. Of particular interest is Item 4 below, which suggests the use of environmental indicators to monitor the impacts on, and the performance of, the natural environment. This report has given particular attention to the use of indicators, and the value this can provide in assessing the environment. These four main measures are:

- An environmental management framework (note that a number of EMFs have been developed for various parts of the country);
- Developments that have serious environmental or social effects need to be offset by support for improvements in related areas;
- A target for the amount of land and oceans under protection (presently about 7.9 million hectares of land, 848 km of coastline and 4,172 km<sup>2</sup> of ocean are protected); and,
- A set of indicators for natural resources, accompanied by publication of annual reports on the health of identified resources to inform policy.

### 14.3.3 Enabling milestones

In addition to the above the NDP is structured to achieve the following enabling milestones:

- Increase employment from 13 million in 2010 to 24 million by 2030;
- Raise per capita income from R50,000 in 2010 to R120,000 by 2030;
- Increase the share of national income of the bottom 40 per cent from six per cent to ten per cent;
- Establish a competitive base of infrastructure, human resources and regulatory frameworks;
- Ensure that skilled, technical, professional and managerial posts better reflect the country's racial, gender and disability makeup;
- Broaden ownership of assets to historically disadvantaged groups;
- Increase the quality of education so that all children have at least two years of preschool education and all children in grade three can read and write;
- Provide affordable access to quality health care while promoting health and wellbeing;
- Establish effective, safe and affordable public transport;
- Produce sufficient energy to support industry at competitive prices, ensuring access for poor households, while reducing carbon emissions per unit of power by about one-third;
- Ensure that all South Africans have access to clean running water in their homes;
- Make high-speed broadband internet universally available at competitive prices;
- Realize a food trade surplus, with one-third produced by small-scale farmers or households;
- Ensure household food and nutrition security;
- Entrench a social security system covering all working people, with social protection for the poor and other groups in need, such as children and people with disabilities;
- Realize a developmental, capable and ethical state that treats citizens with dignity;
- Ensure that all people live safely, with an independent and fair criminal justice system;
- Broaden social cohesion and unity while redressing the inequities of the past; and,
- Play a leading role in continental development, economic integration and human rights.

These enabling milestones serve to define what government will be striving to achieve in terms of human development and improved quality of life. In order to project the future state of the environment it is assumed here that even if these enabling milestones are not met completely that there will be significant effort towards meeting them. As such it stands to reason that the pursuit of the enabling milestones will be a key driver of activities (especially by government) in the next 15 years with a view to having realized these milestones by 2030.

In the section that follows the likely behaviour of the drivers (population dynamics and resultant economic development) are assessed and forecast. Thereafter the changes in pressures as a function of the change in drivers are presented,

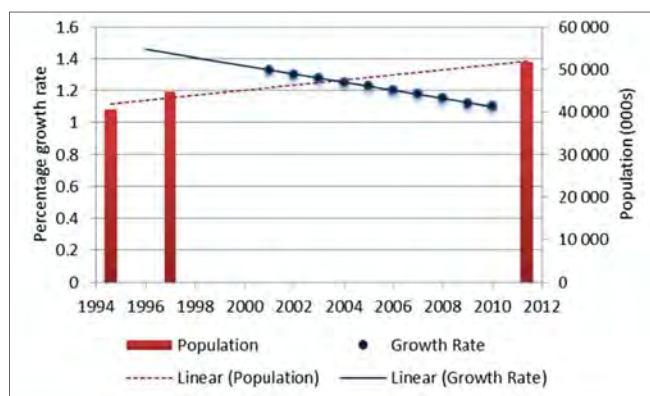


culminating in an assessment of the state of the environment in 2030. That assessment of the future state of environment in combination with the current state of environment is then used to determine the Options for Action, which is presented as Part IV of this report.

## 14.4 DRIVER TRENDS

### 14.4.1 Population dynamics

South Africa's population continues to grow but at a reducing rate (Figure 14.6). Declining population growth rates is a global occurrence where only two countries in the world continue to see rising growth rates. To look only at population *growth*, however, ignores some important underlying drivers, which also result in pressure on the environment. These additional population dynamics include increasing life expectancy, rapid urbanization, a reduction in household density (more houses for fewer people) and significant changes in the spending ability of the population (greater demand for goods which obviously translates into a greater demand for resources).



**Figure 14. 6: The actual population for South Africa, together with the growth rate in the equivalent period**

People are also living longer (life expectancy has increased considerably over the last decade) which places additional burden not just on resources directly but in terms of additional medical care with associated increases in the resource demands and wastes produced by such medical care. These changing population dynamics must be seen within the context of existing backlogs in service provision and massive income inequality where it is a stated objective of the NDP to increase the per capita income from R50,000 in 2010 to R120,000 by 2030, while increasing the share of national income of the bottom 40 per cent of the population from six to ten per cent. What this means is that even if the population were to stabilize immediately (or even decline) that the resource demands of society would continue to increase significantly simply in response to addressing service backlogs and the increased spending power of the population.

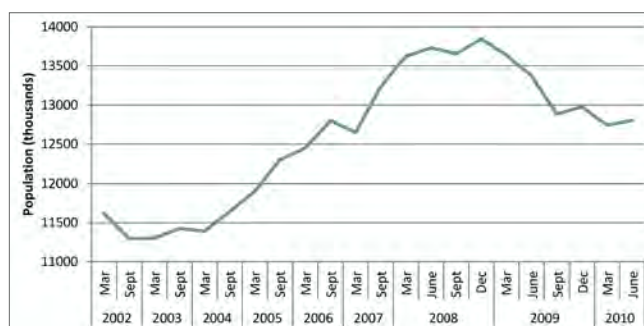
### 14.4.2 Individual welfare (quality of life)

In a similar vein, the desire to improve the quality of life of South Africans will also see continued growth in the demand for resources regardless of whether the population stabilizes or not. The overarching objective of the NDP is to increase the quality of life of South Africans. Although quality of life

objectives are expressed principally in terms of income equality in the NDP, quality of life improvements are also seen more broadly as material improvements in human welfare (wellbeing) which translates inter alia, into reductions in disease burden, improved food security and nutrition, improved accommodation and living environments, improved education and others.

Development Indicators published by the Department of Planning, Monitoring and Evaluation and released during the last months of 2010 highlight that in many areas there are positive trends in quality of life, most notably access to basic services improvements. In other areas, however, while there are improvements, the improvements are not considered adequate. Perhaps the best example of this latter area is the infant mortality rate, which despite notable improvements will simply not meet the MDGs. In other areas, quality of life simply continues to deteriorate.

Very importantly, the indicators also highlight the significant effect of the economic crisis of 2008 in limiting growth and employment, poverty reduction, and public finances. Employment is shown in Figure 14.7 where a clear reduction in employment is evident from the last quarter of 2008. That employment trend must also be seen within the context of an ever-increasing population implying that the number of work seekers is growing rapidly. It is also noted in the report that it will likely take some time before these indicators return to pre-crisis performance levels. Monthly income levels are shown in Figure 14.8 for the ten wealth groups in South Africa. The monthly income of the poorest ten per cent of the population has increased from R742 in 1995 to R1,386 in 2009 in real terms. Monthly income amongst the richest ten per cent has nearly doubled in the same period from R13,416 to R26,602 (also in real terms).



**Figure 14. 7: Employment in South Africa between 2002 and 2010**

Two indicators from the report provide important measures of the state of human health namely severe malnutrition in children under five years (which more than halved between 2001 and 2009) (Figure 14.9) and the TB cure rate (which increased by some 15 per cent between 2001 and 2009). Added to that is the fact that the crime rate continues to decline albeit at an uncomfortably slow rate.



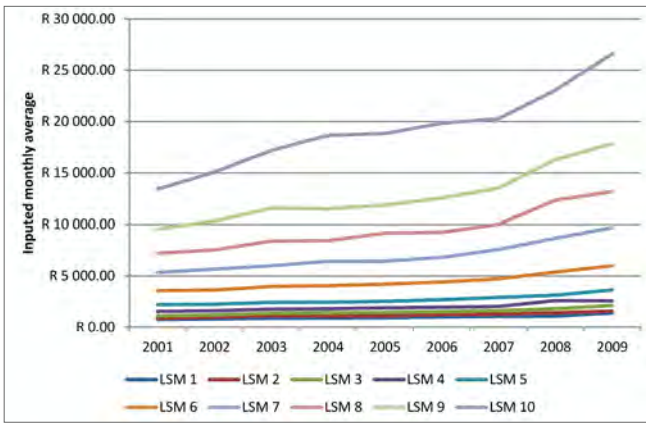


Figure 14. 8: Living standards measurements (LSM) for the ten wealth groups in South Africa

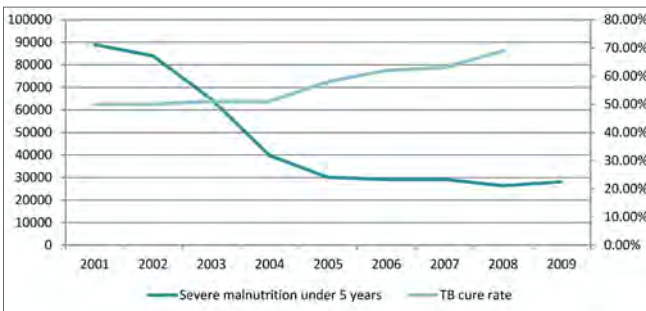


Figure 14. 9: The reduction in severely malnourished children under the age of five years as well as the improved TB cure rate between 2001 and 2009 in South Africa

### 14.4.3 Economic sectors

The contribution to GDP of the various economic sectors is summarized in Figure 14.10. It can be seen from the graph that all exhibit relatively low growth with a noticeable decline in manufacturing following the global financial crisis of 2008. Despite the decline, manufacturing exhibits the largest growth over the ten-year period. The question that must now be addressed is how these sectors will perform over the next 15 years and more importantly, what activities can be expected within each of these sectors. Please note that in the section that follows, the StatsSA economic sectors have not been used specifically as the groupings need to be disaggregated for the purpose of defining activities that will have specific impacts on the environment and those that will not.

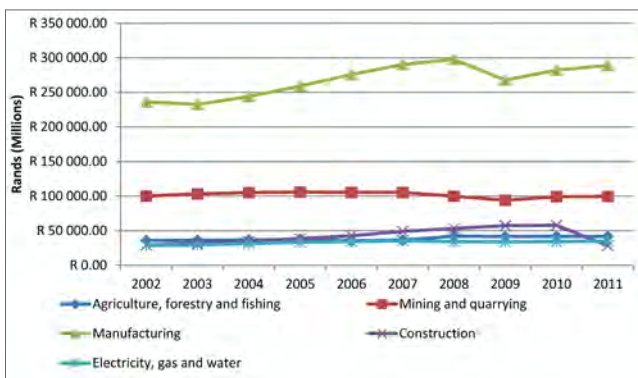


Figure 14. 10: The quarterly value added by industry and gross domestic product at constant 2005 prices

### 14.4.3.1 Energy

**Electricity** - While estimates regarding the future demand for electricity vary, there will be a continued increase in demand for electricity with an associated significant increase in generation capacity. The REIPPPP will target the procurement of 3.725 MW of power to be generated from renewable energy by 2015 and it is likely that there will be a sustained renewable energy growth in energy supply. The renewable energy component of South Africa's supply must be seen within the context of the requirement to provide base-load. Eskom is planning to bring a large scale nuclear power station (Nuclear 1) online at some point in future to provide for base-load but it seems unlikely that this will materialize in the next fifteen years. As such a third new coal-fired power station, in addition to Kusile and Medupi, may well prove necessary over the next 15 years for providing base-load. Water availability is a key limiting factor for further development of coal-fired stations especially if Flue Gas Desulphurization is compelled for the same.



**Liquid fuels** - The country cannot produce an adequate supply of liquid fuels and must already import to make up the shortfall. It could be that imports continue but a new refinery is possible, which would come on stream between 2020 and 2030. PetroSA have mooted a large-scale refinery at Coega (Mthombo) but that proposal has not progressed significantly for various reasons including a reduced growth in demand as a result of the global financial crisis. Sasol had been planning a Coal-to-Liquids (CtL) refinery in the Waterberg area, but it seems unlikely that the refinery will be built in the next 15 years (if at all) given the capital cost of such a plant. South Africa has the option of continuing to import liquid fuels to meet the growing demand and it is assumed that the newly constructed multi-products pipeline will be adequate to ensure that sufficient liquid fuels can be transported to Gauteng at least for the next 15 years. Transnet's pending capital investment programme in rail infrastructure and rolling stock could see fuel being transported by rail as well.

**Shale gas** - Shale gas holds significant promise in value terms but there are high levels of uncertainty and controversy surrounding the proposals to 'frack'. As such it is not expected that shale gas will become a significant energy source at least within the next ten years. Given the pressure to prevent fracking the energy source may not materialize at all, although this seems highly unlikely given the potential scale of the resource.

### 14.4.3.2 Mining

There are various perspectives on the future of mining in South Africa with multiple applications for mining rights currently with the DMR and many more in the offing. Water availability is a key constraint for mining to the extent that water rights will likely become more significant to mining in future than mining rights, if that has not already happened. Significant coal reserves exist in the Waterberg (dubbed the last large scale reserve) but it is unclear how this reserve will be exploited in the next 15 years other than some mining geared towards export coal. If Mafutha is built, the Waterberg will see the largest open cast coal mine in South Africa to supply the CtL and, as discussed earlier, another large-scale coal-fired power station may well be established in the area with associated mining activities.

Mining waste stockpiles in the form of waste rock and tailings dams will remain a significant potential threat to the environment and need proactive action. *“With slimes dams in the goldfields of the Witwatersrand Basin covering an area of about 400 km<sup>2</sup> and containing some 430,000 tons of U<sub>3</sub>O<sub>8</sub> and 6 billion tons of iron pyrite tailings, they constitute an environmental problem of extraordinary spatial dimensions”* (quoted from Federation for a Sustainable Environment). Environmental problems already exist as a result of these waste stockpiles and it is likely that this situation will only continue to worsen over the next 15 years.



The mining industry faces multiple challenges especially in respect of labour unrest and reduced investor confidence. Investors are seeing mining in Africa as an investment destination but the same does not hold true for South Africa. An important concern is the closure of marginal mines as a result of these various pressures and the extent or not of rehabilitation requirements. The Grootvlei mine in Springs is one of several examples of an abandoned mine that has not been properly rehabilitated. There are many junior mining companies but in general they struggle to raise the finance needed to transition into operations. Despite the many problems that face the South Africa mining industry, it must be recognized that with even a small deterioration in the exchange rate, mining (in particular platinum and gold) goes from being marginal to profitable in relatively short order. Any thoughts that mining will decline in South Africa should be seen against this exchange rate background.

It seems unlikely that the DMR will constrain mining in any material way. There is already evidence to suggest that mines have been approved even where the environmental assessments have shown significant potential impacts. DMR appears to be approaching their environmental obligations in a manner of approving mines and then trying to bolster the rehabilitation requirements. There are circumstances, for example, where the DMR has extended the rehabilitation requirements even after having issued less onerous authorization conditions in respect of rehabilitation (e.g. changing conditions from partial backfilling to full backfilling). Finally, but importantly, the labour unrest across many South African mines will likely see a move towards higher levels of mechanization with reduced labour uptake.

### 14.4.3.3 Construction

The major infrastructure investments planned for South Africa will see big opportunities for construction companies. While construction activities do have potentially significant impacts and are users of resources such as water, steel, cement and energy, construction in its own right is not viewed within the Outlook as being an environmentally significant activity. It is considered that the real environmental implications of construction lie in the nature of the projects that are constructed and the land and/or water transformation associated with such projects.

### 14.4.3.4 Agriculture

In respect of agriculture, the key environmental consideration is the area (footprint) under (intensive) agriculture. The NDP seeks to increase agriculture output (providing food security), and also seeks to grow the number of small farmers as part of that process. Neither requirement will necessarily result in a net increase in the agricultural footprint as there are competing land use requirements, particularly from mining, that will see agriculture land being changed from agriculture to another land use. As such agricultural efficiency must be improved significantly if the food security objective of the NDP is to be met. At the same time and according to the 2008 agricultural statistics, the total number of farm employees has dropped from 1.6 million in 1971 to 628,000 in 2005. Given the population increase over that time, agriculture's contribution to employment dropped from 8.3 per cent to 1.3 per cent in relative terms.

Farmers will have to double their use of water by 2050 if they are to meet growing food demands using current farming practices and this will require enhanced water supply and a significant increase in water use efficiency. The quantum of the additional water needed is made clear when it is considered that year 2000 data showed irrigation extracting 63 per cent of the country's available surface water (Water Accounts for South Africa 2000). With more than 98 per cent of the available water resources allocated, there is little room for increased extraction, particularly as other sectors compete for the little that is available. It takes up to 1,000 litres of water to produce one kilogram of maize in South Africa (Dabrowski *et al.* 2009). This is the Virtual Water Value of maize, and the amount of water South Africa 'exports' with every tonne of maize. A water-scarce country such as South Africa needs to look at importing its water-intensive products (e.g. oranges



and sugarcane), and focus on growing crops that use water efficiently (WWF undated).

The Census of Commercial Agriculture (2008) reflects a 31 per cent decline in the number of farmers since 1993, resulting in the industry being left with fewer than 40,000 farms. The maize, wheat and dairy sectors have been the hardest hit. Although the number of units has dropped during this time, gross farm income (GFI) has increased by more than 300 per cent. With expenses growing by a relatively low 285 per cent, net farm income (NFI) grew by a staggering 410 per cent over this period. Because of this growth, the net farm income per farm unit has increased significantly to five times more than what it was in 1993. This was mainly due to economies of scale that were realized as the units became fewer but bigger. A shift from beef to game farming is also evident.

The agricultural sector is also re-evaluating pesticide and herbicide use in recognition of the fact that often less than 0.1 per cent of crop-sprayed pesticide reaches the target pest with the remainder entering the environment (Pimental & Levitan, 1986). Z22, a commercial farming company based in Limpopo and a world leader in tomato production, has introduced the concept of 'Natuurboerdery' (nature farming) to their operations. Since 2002 the Z22 farming enterprise has implemented a programme for the gradual conversion of all its farming activities from a predominantly conventional chemical- to a more ecologically-balanced nature farming approach. They aim to achieve long-term improvement and stabilization of the soil and optimum sustainable yields through the use of compost and manures, compost tea, Effective Micro-organisms (EM), bioproducts, minimum tillage, cover crops and crop rotation.

There are agricultural sectors that will not only intensify but also expand over the outlook, compared to the previous decade. These industries are soybeans, canola, chicken, eggs, beef, pork, sheep meat and dairy. In 2013, South Africa will reach its highest area under production of field crops since 2004 by expanding production by almost 300,000 hectares. This expansion must be seen against a backdrop of the current rate of coal mining in Mpumalanga, where it has been calculated that approximately 12 per cent of South Africa's total high potential arable land will be transformed by mining. A further 13.6 per cent is currently being prospected for mining in Mpumalanga. Current and new mining could soon have devastating effects on agricultural production as well as long term food security implications for the entire country. If the current mining areas are overlaid with the latest field crop boundaries, a total of 326,022 hectares will be lost to mining and a further 439,577 hectares are at risk if the prospecting area is also transferred, totalling 765,599 hectares of cultivated land potentially transferred if all the mining activities take place (BFAP Baseline 2012).

The demand for potatoes and wheat-based products is projected to grow by 18 per cent and 20 per cent respectively while the consumption of maize meal is projected to remain stagnant. The increase in the demand for beef over the next decade is expected to match that of the past decade, averaging an annual growth rate of three per cent. Some 2.4 million tonnes of chicken meat will be consumed by 2021. Chicken meat production is anticipated to grow by 29 per cent

from 1.4 million tonnes to 1.8 million tonnes over the next decade, implying that South Africa will remain a net importer of chicken meat (BFAP Baseline 2012).

#### 14.4.3.5 Forestry

In the last decade or so there has been a net reduction in the total area under plantation from 1.5 million hectares to 1.3 million hectares. This reduced footprint has resulted to some extent from foresters going out of business but has also been a function of recovery of wetland and riverine areas under the forestry stewardship programme. It seems improbable that there will be a net increase in footprint as the process of 'freeing up' biodiversity priority areas will continue. Government is planning an additional 100,000 hectares but this is not likely to be more than about 40,000 hectares as a result of limited water and distance to market (Scotcher, pers. comm.).



Source: [www.saforestrymag.co.za](http://www.saforestrymag.co.za)

#### 14.4.3.6 Manufacturing

The country's manufacturing competitiveness has declined steadily over the last several decades but manufacturing provides an important opportunity for significant job creation with a generally lower direct burden on the environment. Currently, though the view ahead is not encouraging with the packaging industry expected to contract (China/India imports), import of low-cost finished goods is likely to increase with a resulting drop in this sector within South Africa (unless government puts restrictions on these imports) and uncertainty in demand (domestically and internationally) due to the global financial crisis (e.g. reduced demand from the Eurozone for automotive products). The generally poor performance of the mining sector has resulted in reduced demand for mining related products (Manufacturing Circle 2012).

With government implementing an infrastructure investment expenditure drive, certain manufacturing sectors may grow (e.g. transport related products) and from the Industrial Policy Action Plan – three sectors that are well placed for up-scaling:

- Green industries;
- Agro-processing; and,
- Metal fabrication, capital and transport equipment.

Should the mining sector continue to grow, the manufacturing sector will likely follow suit. In addition there is a view that South Africa needs to 're-industrialize', and to build up the

manufacturing base of the country to return to the days where manufacturing made up 30 per cent of GDP as opposed to the current 15 per cent (Creamer, pers. comm.).

## 14.5 TRENDS IN PRESSURES

### 14.5.1 Resources

#### 14.5.1.1 Water

In terms of current supply options more than 98 per cent of the country's water resources have been allocated. There will only be a significant additional source with the completion of the second phase of the Lesotho Highlands Water Project which is currently projected to start delivering water in 2020 and, given the current delays in schedule, it may well be later than that. The lack of water means that the country must move from a situation of allocating water to everyone that asks for it to one where the economic and social return in respect of that water use must be considered. Water pricing must reflect the scarcity of water and not only the cost of providing the water (Chapter 8: Inland Water).

Against a background of extreme water scarcity there is continued deterioration of water quality, which has the effect of further reducing options for water use. For example, there is a high salinity load entering the Vaal system. The salinity can be controlled to less than 600 mg per litre by discharging fresh water from the Vaal Dam but only if the system has the excess water for that dilution. As previously described, agriculture will need significant additional water if the food security objective of the NDP is to be met and the combination of deteriorating water quality and reduced availability strongly counter against that objective ever seeing the light of day.

Dams continue to be mooted but there is almost no way of managing water quality within those dams without managing activities in the catchment. Dams also lose significant quantities of water to evaporation and with the hotter and drier climate forecast for the country, the evaporation problem is likely to be exacerbated. In addition the cost of inter-basin transfer is increasing and these costs would be particularly acute if water must be moved up the escarpment. The net effect is that there is likely to be growing pressure on the ecological reserve and that the effects of a drought, for example, will seriously aggravate that pressure.

#### 14.5.1.2 Electricity

The electricity outlook for the next 15 years is to remain largely reliant on coal-based power for base-load but recognizing the addition of over three gigawatts of green energy over the next three years or so. Nearly 10 gigawatts will come on line over the next five years all of which will be coal-based power (Medupi and Kusile power stations). Economic projections indicate that the availability of this additional generation capacity will not significantly ease the strain on the supply system.

#### 14.5.1.3 Land

There will be continued demand for land over the next 15 years, which obviously means change in land use and transformation of the land potential. As has been described

earlier, it is not just the loss of untransformed land that is a concern but also the loss of agriculture land to mining and human settlements. Mining also poses a threat to biodiversity priority areas such as the PGM mine proposed downstream of Nyslvlei, the platinum mine that is operating between the Madikwe and Pilansberg Game Reserves and the Vele mine near Mapungubwe. Other non-mining land requirements are also important such as the proposed De Beers Pass Route, dams and other large-scale infrastructure.

In urban areas, land is at a premium, especially for low-cost housing, and this has the effect of placing pressure on the urban fringe and associated biodiversity priority areas (Chapter 5: Human Settlements). Added to this complexity is the objective of the NDP to establish housing in areas that are close to places of work. While that objective has important socio-economic benefits, it must also be recognized that limited land availability together with typically poor living environments in close proximity to industrial/manufacturing areas complicate achieving that objective and potentially undermine the benefits.



### 14.5.2 Waste and pollution

#### 14.5.2.1 Waste water

Waste water is likely to be characterized over the next 15 years by much the same problems as those that exist currently namely high salinity, acidity, high nutrient loads and high sediment loads. The challenge will be one of trying to protect the resource value of the water but it seems unlikely that there will be material improvements in any of these issues and further deterioration is likely. The threat to water of existing and future mine waste cannot be understated and that introduces the spectre of radioactivity and metals as additional water quality challenges (Chapter 13: Waste Management).

#### 14.5.2.2 Atmospheric emissions

**Greenhouse gases** - There will be significant increases in greenhouse gases as the Medupi and Kusile power stations are commissioned and there are no prospects of material reductions in greenhouse gases for at least the next ten years and probably longer. Even Eskom's plans to reduce greenhouse gases are only in a relative sense per unit of power generated across the fleet, and this will not translate into a reduction in absolute emissions. Another important potential source of greenhouse gas would be a large-scale liquid fuels refinery, especially if this was based on CtL, which would result in a



significant further increase in greenhouse gas emissions. A third coal-based power station would also simply add to the overall load.

**Particulate matter** - Particulate matter emissions are set to reduce as the emission standards contained in the NEM:AQA are implemented in 2015 and the new plant standards in 2020. The continued electrification of residential areas will also see reduced emissions associated with domestic fuel use. An increase in manufacturing may see increases in emissions but again these will be controlled by the emission standards. The generally drier climate that is forecast will likely result in more burning with associated additional particulate matter emissions together with greater quantities of airborne dust. Finally, there is no direct control of particulate matter emissions from mining so increased mining will likely see an increase in dust emissions from blasting, vehicle movement and general mining activities.

**Sulphur dioxide** - In a similar vein, sulphur dioxide emissions should reduce as the emission limits are implemented, however the high water demand of FGD may severely limit options for controlling sulphur dioxide emissions from power stations. Continued electrification should result in reductions in sulphur dioxide emissions from domestic fuel use and again emissions from additional manufacturing activities would be controlled by the emission standards. Discard coal heaps and underground fires in abandoned mines remain important sources of sulphur dioxide emissions and it is not clear how the emission sources will be controlled. The additional rehabilitation efforts of the DMR may result in better control of such fugitive emissions from existing mines and those that will close over the next 15 years but it is difficult to see that these sources will be controlled to the degree needed.

**Nitrogen oxides** - Nitrogen oxide emissions will also be reduced by the implementation of the emissions standards and continued electrification of residential areas that limits the use of domestic fuel. There may well be some challenges for the power stations and CtL activities to meet the new plant standards for nitrous oxide but there should still be important reductions as a function of the 2015 standards. Emissions will, however, continue to increase from the ever-expanding vehicle fleet and there are no major public transport schemes on the horizon (at the scale of Gautrain). At least ten years would be required to bring a major public transport scheme to fruition. Toll fees and rising fuel prices are likely to reduce the appeal for owning and operating a motor vehicle and as such it is anticipated that there will be no material change in nitrous oxide emissions over the next 15 years.

#### 14.5.2.3 Waste

Mining waste likely presents the most significant waste threat to the environment over the next 15 years (and longer). The facilities in which this waste is stored are likely to deteriorate over time with an ever-increasing risk of AMD and radioactivity being released into the environment. It is likely that some form of hazardous waste destruction will be established in South Africa but it is not clear as to the form that this will take. It is also considered that there will be a steady improvement in the formalization of municipal solid waste collection and disposal (Chapter 13: Waste Management).

## 14.6 SCENARIOS

### 14.6.1 Overview

In this section the various trends that have been described in the previous section are collated in the impact maps to highlight the possible outcomes that can be expected by 2030. The impact maps have been developed around the various drivers identified with the DPSIR framework.

### 14.6.2 Mining and electricity generation

Mining and electricity generation have been grouped together because of the significant mining activities that are associated with electricity generation in the country (Figure 14.11). Some 53 per cent of South Africa's average of 224 million tonnes of marketable coal per annum is used for electricity generation, with 25 per cent being exported internationally and much of the remainder being used by Sasol (Secunda). Installed capacity which is currently some 40.5 GW, will be increased by 9.6 GW as the Medupi and Kusile power stations come online (coal-based power) with a further three GW becoming available from renewable sources (see [www.eskom.co.za](http://www.eskom.co.za) for more details).

Coal mining will increase significantly to provide the coal needed for the two new power stations with the Grootegeluk mine increasing production from 18.8 million tonnes (of which 14.8 million tonnes is supplied to the existing Matimba Power Station) to 14.6 million tonnes of power station grade coal, also specifically for Medupi. Kusile will be supplied by the New Largo and Zondagfontein collieries supplying some 17 million tonnes of coal (new production) to the station. Over and above the additional coal production required for the power stations, coal mining is set to continue to grow in South Africa with multiple applications for exploration and mining rights currently sitting with the DMR.

The increase in mining and the increase in electricity generation will see an increase in manufacturing and an increase in trade (with coal and other minerals not being used domestically exported). The increase in manufacturing will see additional goods being made available to both the mining sector and to consumers. As these various economic sectors grow, additional jobs will be created with associated increases in real income. The additional availability of electricity will allow bulk services to increase supply, supporting municipal services in providing greater access to electricity.

The increase in economic sector activity will see a huge growth in the demand for water. Mines require significant quantities of water as do the power stations, especially if the latter are compelled to install FGD. The new emission standards that come into force in 2015 and 2020 (Chapter 10: Air Quality) will result in significant additional water demand simply to allow existing power stations to reduce their sulphur dioxide emissions to meet these new emission standards. As an already stretched resource water will become even more stretched. If (when) Gauteng experiences a severe drought either as a result of climate change or simply the natural periodicity of rainfall, there will be increasing competition for this extremely scarce resource by economic activities and it is the environment that is least likely to receive its required share.





### 14.6.3 Population dynamic

South Africa's population will continue to grow but with a decreasing growth rate. In the meantime the quality of life improvements that have been evident in the last 15 years will likely be continued in response to strong demand for the same by the general public but also in response to government policy (Figure 14.12). This will be supported by a continued real growth in income as a result of better wages but also increased employment and better opportunities to derive a livelihood. Formal housing is likely to continue to grow with continued improvements in respect of services such as electricity provision, water and sanitation (Figure 14.13). Demand for domestic fuel will likely ease as electrification is continued and housing standards improve. Rural housing is also expected to improve in response to greater real income (being returned to rural homesteads) and greater penetration by government into the rural areas.

The general standard of living will also be improved by additional goods being available (and purchasable), with higher levels of nutrition and an assumed eradication of at least chronic malnutrition (if not malnutrition in general). There will also likely be further reductions in disease burden (a major breakthrough in HIV/AIDS treatment, more effective TB treatment and so forth) (see Section 4 of this chapter for existing trends). The reduction in the disease burden is not seen to translate into an overall improvement in general health, due to a higher risk living environment. In addition safety risks are also seen to be more severe as a result of continued climate change and the likelihood of increasingly energetic and damaging storms.

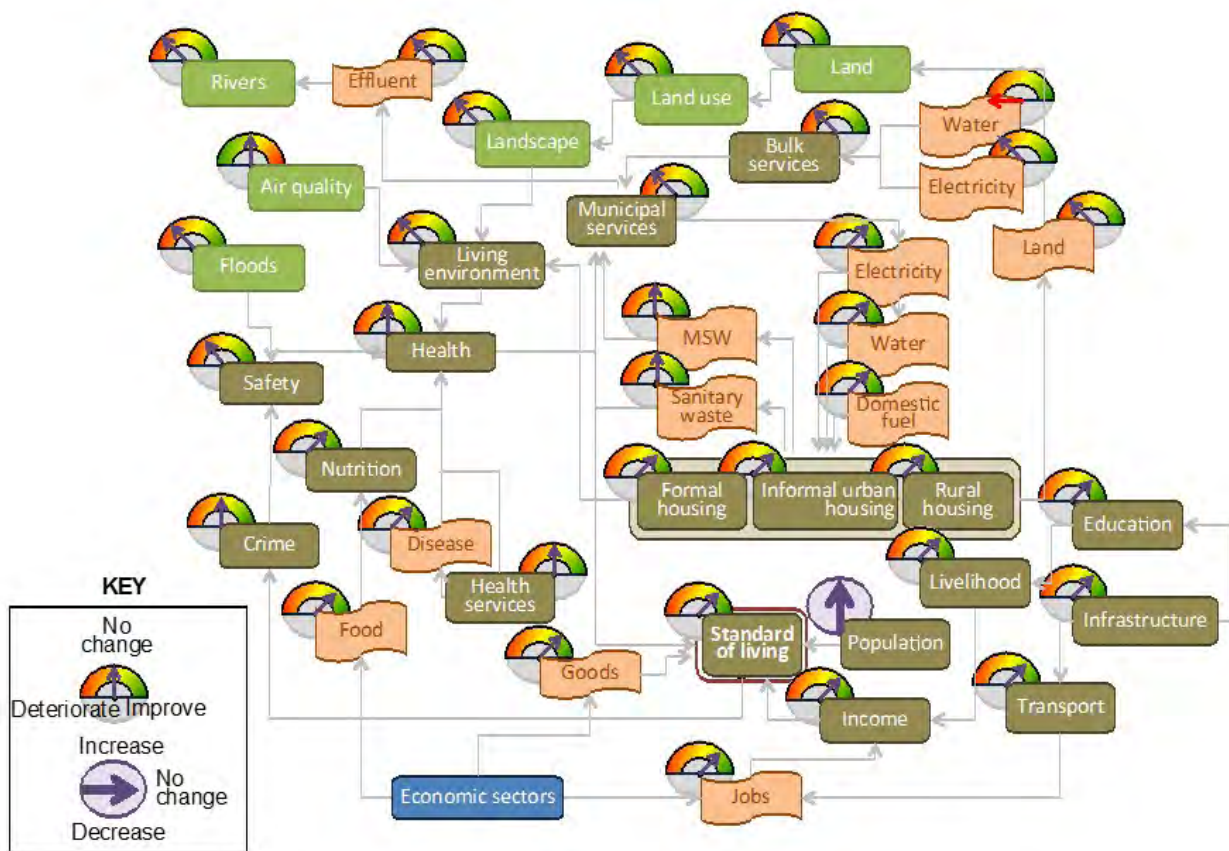
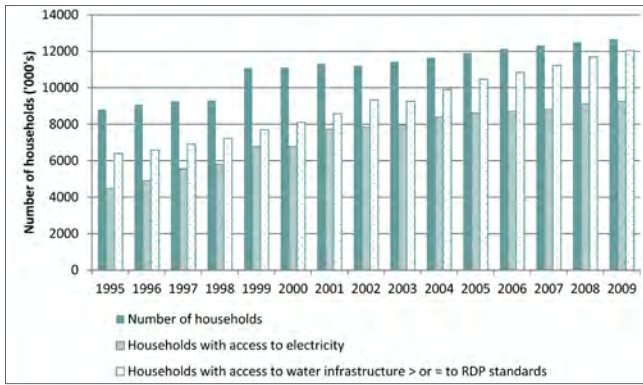


Figure 14. 12: The probable future state of the environment in South Africa in response to the predicted future state of standards of living



**Figure 14. 13: The number of formal households established in South Africa between 1995 and 2009 together with the number of households that have access to electricity and access to water infrastructure that equals or exceeds the RDP standards**

Crime is predicted to remain largely unchanged. This may be a pessimistic view but there are multiple drivers of crime and a simple improvement in quality of life is unlikely in its own right to result in a significant change in the crime rate. This unchanged crime rate will also have a negative impact on overall health, to some extent offsetting the gains that may have been made by the other quality of life satisfiers.

Bulk services supply will likely be in a worse state than they are today because of the continued decline in available water (and electricity) together with rising costs of sourcing and supplying these services. Municipal services are also seen to decline as infrastructure continues to age and becomes increasingly difficult to maintain and/or replace. Municipal solid waste is seen to stay the same as the continued increase in municipal solid waste (currently at 4.8 per cent per annum) is offset by continued improvements in its management and by more effective recycling initiatives.

#### 14.6.4 Agriculture

The probable future state of the environment as a result of agriculture is shown in Figure 14.14. Agriculture will and must increase to meet the increased demand for food and the objective of food security contained in the NDP. In order to achieve such increases it seems unlikely that there would be an increase in land used for agriculture. Although there may well be new land areas that are used for agriculture, there is an on-going loss of land currently used for agriculture (especially for mining as described in Section 4.3.2 and 6.2 of this Chapter). Atmospheric emissions from agriculture (most notably burning and dust generation during ploughing) are not expected to change given that the land area used for agriculture will not change significantly. There may be a reduction in dust generation as agriculture moves progressively into no-till farming but the rate of uptake of no-till is not clear.

The availability of food is expected to increase as agricultural practises change with higher food yield being obtained from the same land areas as a result of new technologies and hopefully changes to less water demanding crops. The general state of health of the population is also considered to increase as a result of greater food availability (and access to that food), which will contribute to an improved standard of

living. A significant change in job numbers in agriculture is not expected but real incomes are expected to increase in the next 15 years, together with increases in livelihood opportunities within the agricultural sector as a result of efforts to increase the numbers of small farm owners. Rural housing is also expected to improve and that together with the increased levels of income will also contribute to an improved standard of living. What will detract from that improved standard of living will be a significant reduction in landscape quality and crime and safety, which are not anticipated to change significantly in the next 15 years.

Water demand by agriculture is not expected to change significantly in the next 15 years as agriculture becomes better geared towards using less water. Effluent from agricultural use is also expected to improve with more efficient use of fertilizer, less erosion and less use of pesticides and herbicides. Greenhouse gas emissions from agriculture are not expected to change significantly although, if beef farming reduces in response to water scarcity then such emissions might well reduce. Climate change will see hotter and drier conditions for the country as a whole whereas Mpumalanga may see wetter (and hotter) conditions as a result of climate change.

Water availability will increase in importance for agriculture as the resource dries up and there is competing demand for the resource from other economic sectors. Reductions in rainfall together with hot conditions will see increased evaporation and reduced runoff resulting in less recharge for groundwater. Groundwater resources will also reduce as a result of competition for the resource. Rivers, wetlands and vegetation will be affected negatively as a result of generally less water, which will reduce the quality of habitat and reduce species diversity and populations.

Although there is unlikely to be a significant increase in the land required for agriculture, competing demand for land, mainly from mining, will result in significant land degradation. Significant deterioration of soil, vegetation, land potential and landscapes can be expected as land is increasingly lost from agriculture and transferred to mining or other land uses. This deterioration will also see reduced habitat quality and reduced species diversity and populations.





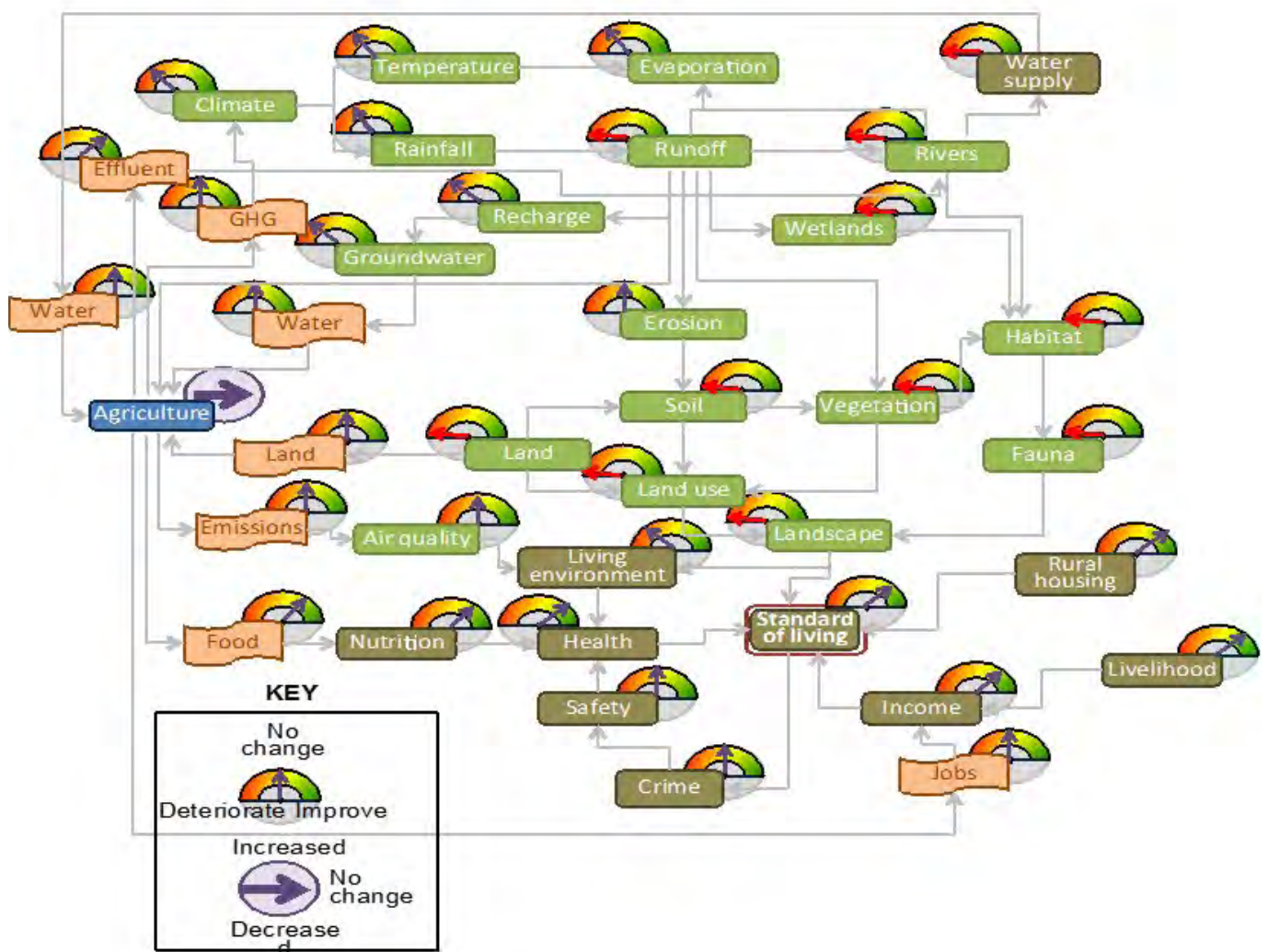


Figure 14. 14: The probable future state of the environment in South Africa in response to the predicted future state of agriculture

### 14.6.5 Forestry

The impact map for forestry is shown in Figure 14.15. As described previously the footprint area for forestry is not expected to increase significantly over the next 15 years and therefore water demand is not expected to increase significantly for this sector. Furthermore, the land required for forestry is also not expected to increase although it must be noted that government plans to increase afforested areas, particularly the Eastern Cape (a known biodiversity hotspot). However, this insignificant change in footprint must be seen within the context of a generally hotter and drier climate that will likely reduce runoff. The reduced runoff will mean competition for the water available to river systems resulting in reduced water in rivers, lakes/dams and estuaries even with no increase in forestry.

The continued uptake of forestry stewardship programmes will likely see the ‘freeing’ up of sensitive environments that are currently under trees. These areas include wetlands and riverine habitats. As such it is likely that there will be additional habitat created with an associated increase in fauna in those habitats and an improved landscape (viz. forestry plantations interspersed with areas of natural vegetation). Finally, it seems unlikely that significant additional employment will be provided by the forestry industry in the forecast period.



Source: [www.saforestrymag.co.za](http://www.saforestrymag.co.za)





quality of life. As such the continued deterioration of land will ultimately severely undermine many of the quality of life improvements that may manifest in the corresponding period.

#### 14.7.4 Greenhouse gas emissions

The prognosis for greenhouse gas emissions from South Africa is that these are simply going to increase significantly in the next five years or so as Kusile and Medupi are commissioned with the possibility of a third large-scale coal-fired power plant within the next 15 years. At the same time continued growth in traffic volumes will also contribute to greenhouse gas loading as will a new refinery, particularly if such a refinery is based on coal-to-liquid technology. South Africa will thus continue to be a globally significant producer of greenhouse gases especially if viewed per capita.

#### 14.7.5 Resources

Resource use is also considered a tipping point because there appear to be no plans to reign in the continued use of resources. Although the DSM has been used extensively (and relatively effectively) by Eskom in limiting demand for electricity, the same cannot be said for water or mineral resources. There appears to be no consideration for preserving resources for use by future generations. If the country is to seriously drive sustainability, it will be necessary to start the process of limiting non-renewable resource use, and not simply allowing such resources to be used without a detailed assessment of how the country will benefit from the allocation of those resources.

### 14.8 CONCLUSION

The key challenges facing the South Africa environment have been presented in Part III: Outlook. If the environment is considered in terms of sustainability then it can be seen that important inroads have been made in improving the quality of life enjoyed by South Africans. These improvements include income levels, quality of housing and access to water supply and sanitation and a generally reduced disease burden. These improvements need to be maintained and expanded to ensure that all South Africans enjoy a good quality of life in future.

Against the backdrop of these quality of life improvements, is the continued deterioration of the biophysical environment with multiple concerns evident. These concerns include deteriorating water quality, reductions in river health, the almost complete allocation of the country's water resource, and continued loss of habitat with associated reductions in biodiversity. Most of the trends suggest a continued deterioration into the future, which if unchecked will ultimately undermine the improvements in quality of life that have been gained as living environments deteriorate and resources reduce in quality and availability.

The outlook has been structured to consider the likely changes in the key drivers over the next 15 years or so. Using impact maps, these anticipated changes in drivers have been translated into the likely consequences for the environment and sustainability in general. While there are many positives (for example the forestry stewardship interventions and the impacts of the atmospheric emissions standards in maintaining and improving air quality), there

are several critical tipping points that emerge, which, unless very effectively managed, will see a serious reduction in environmental quality with resultant reductions in the quality of life enjoyed by South Africans. The four tipping points are considered to be water, land, greenhouse gas emissions and resource use, of which water and land transformation are the most critical. The outlook for the South African environment is directly a function of how these two critical resources are managed over the next 15 years.

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