Climate change induced drought, land degradation and increasing food prices are resulting in food insecurity for millions of poor South Africans and increasing malnutrition among children and may lead to increased internal and external migration. Although South Africa has policies that have embraced sustainable development, the natural environment is continually threatened. There is fierce competition for resources due to a declining economy and competing health threats such as the HIV, AIDS and tuberculosis epidemics.

Water is a threatened resource in South Africa. Poor people who are often subsistence farmers or urban slum dwellers are particularly vulnerable to drought and extremes of weather. Although access to potable water and appropriate sanitation has improved substantially, climate change can threaten these gains resulting in water- and food-borne disease.

Greenhouse gases can lead to global warming and locally to pollution-related respiratory disease. South Africa has a much larger carbon footprint relative to other African countries and needs to lead in addressing climate change.

Action needs to be taken at an individual, community and national level to increase awareness of the importance of environmental sustainability to health and well-being and to establish intersectoral collaboration necessary to address the health impacts of climate change.

The Millennium Development Goals have highlighted the importance of ensuring environmental sustainability to mitigate and prevent climate change and to prevent any further deterioration of the health of the people of the world.

Progress to achieving these goals, however, has been limited and climate change may threaten gains in environmental protection and in health improvement. Climate change induced drought, land degradation and increasing food prices are resulting in food insecurity for millions of poor South Africans and increasing malnutrition among children and may lead to increased internal and external migration.

Although South Africa has policies that have embraced sustainable development, the natural environment is continually threatened. There is fierce competition for resources due to a declining economy and competing health threats such as the HIV, AIDS and tuberculosis epidemics.

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Action needs to be taken at an individual, community and national level to increase awareness of the importance of environmental sustainability to health and well-being and to establish intersectoral collaboration necessary to address the health impacts of climate change.
Introduction

A total of 189 rich and poor nations signed the United Nations Millennium Declaration of September 2000 and pledged to work together in a global bid to make the world a better place. The Declaration set a number of goals for collective action to “free a major portion of humanity from the shackles of extreme poverty, hunger, illiteracy, and disease”. The specific objectives included Goal 7, which aimed to “integrate the principles of sustainable development into country policies and programmes and reverse the loss of environmental resources” and highlighted the importance of ensuring environmental sustainability to improve human health and well-being.

The Millennium Development Goals (MDGs) Report 2009 highlighted progress made towards the goals, many of which have a target date of 2015. In relation to environmental sustainability, not only has progress been slow but climate change threatens to reverse any gains in protecting the environment and progress towards achieving and sustaining the MDGs. In March 2009 the International Scientific Congress on Climate Change: Global Risks, Challenges and Decisions, reported that “the worst-case scenario trajectories (or even worse) are being realised, with a significant risk of abrupt or irreversible climatic shifts”. Climate change is already exerting a discernible influence on the global burden of disease and particularly on the health of the most impoverished in society.  

Millennium Development Goal 7 includes three specific targets:

- to reduce biodiversity loss achieving, by 2010, significant reduction in the rate of deforestation and loss of fisheries and more efficient use of water;
- to halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation; and
- by 2020, to have achieved a significant improvement in the lives of at least 100 million slum dwellers.

South Africa is a middle-income country with an economy which has demonstrated impressive growth in the post-apartheid period. Since 1999 South Africa has also witnessed substantial progress in the area of environmental management with exemplary laws and strategies established to protect biodiversity, air quality and other aspects of the ecosystem. The 2002 World Summit on Sustainable Development was hosted in Johannesburg. Key outcomes of the summit were to secure a leadership role for South Africa in the arena of international environmental negotiations as well as the publication of the Johannesburg Plan of Implementation, focusing on sustainable development within the country.

Despite such notable progress, concerns remain because economic growth has not been translated into increasing prosperity, health and well-being for all South Africans. In reality, existing socio-economic inequalities have widened, with the increasing gap between the rich and the poor being attributed to “the embracing of economic neoliberalism under the policy of Growth Employment and Redistribution (GEAR) and then the Accelerated Growth Initiative South Africa, by the previous government”. As a consequence, the Gini coefficient rose from 0.56 (less inequality) in 1995 to 0.73 (more inequality) in 2005. According to Statistics South Africa (StatsSA), in 2001 “the 10% of the population in the lowest income decile shared R1.1 billion, whereas the 10% of the population in the highest income decile shared R381 billion”. In addition, the South African economy has been affected by the recent global financial crisis resulting in a sharp decline, the extent of which was not anticipated, and leading to less optimistic projections for the future. The proportion of people living in poverty remains unchanged from 1994 levels, but the poor have become poorer and the gap between the rich and the poor has widened.

Furthermore, the epidemics of HIV and AIDS and tuberculosis (TB) have also taken a huge toll on the South African economy. It has been estimated that at 2009 levels, 47% of the national health budget will be required to meet the first and second-line treatment costs of all eligible patients with HIV and AIDS by 2014. This is set against a background of 24% unemployment and poor people having limited access to economic opportunities and basic services.

The condition of the natural environment is also reported to be deteriorating in association with the pressures on it – a disappointing but inevitable consequence of economic growth.

The state of the environment in South Africa

Protecting the nation’s biodiversity

A 2006 report on the state of the environment in South Africa has provided detailed evidence of the environmental priorities facing the country (Table 1). South Africa enjoys one of the highest levels of biodiversity in the world. Due to this rich diversity of plants, animals and ecosystems, the country has three globally recognised biodiversity hotspots: the Cape Floristic Region, the Succulent Karoo, and the Maputaland–Pondoland–Albany hotspot. A healthy ecosystem is economically important because of its association with tourism and with people’s livelihoods. Human pressure within the ecosystem is resulting in declining biodiversity, with many South African species of flora and fauna threatened. Over-exploitation of
natural resources, such as forests and grasslands, is putting rural livelihoods and the capacity of the country to feed its population at risk (Figure 1).

The aquatic ecosystem is also reported to be in poor condition. Up to 50% of wetlands in South Africa have been destroyed or damaged, undermining natural systems for flood control and water storage, water quality and the preservation of biodiversity. River pollution is increasing, particularly in highly urbanised areas. Although coastal and marine ecosystems are generally in better shape, some zones on the West Coast are severely threatened with many fish species reported to be over-exploited and their ecosystems to be in a state of decline.

**Access to safe water and sanitation**

South Africa is a semi-arid country and water is consequently one of its most precious resources. As a result of inadequate controls over pollution and former land-use practices that have led to degradation of water resources and declining health of river ecosystems, the country is experiencing declining water availability and quality. Although the 2004 National Water Resources Strategy was intended to reverse this decline by achieving an appropriate balance between ecological sustainability and demands of socio-economic growth, addressing the effects of unsuitable agricultural and land management practices on water quality and the consequent adverse effects on health remains a challenge. However, the Free Basic Water Policy of 2001, which stipulates that households should receive up to 6 000 litres of free water per month, has accelerated progress towards the MDG target of providing safe drinking water. In South Africa access to an improved water source in urban areas was reported at 99% in 2008, whilst in rural areas those with access increased from 66-78% from 1990 to 2008. The picture in relation to adequate sanitation is less satisfactory, with approximately 17 million South Africans still lacking access to improved sanitation. Access to improved sanitation in urban areas has increased from 80-84% between 1990 and 2008, whilst in the rural population access has improved from 69-77% during the same period. Improving sanitation is still identified as a priority as, without considerable additional effort nationally, the MDG target might not be met.
The state of urban slums

South Africa is becoming increasingly urbanised with 58% or more of its population living in urban or peri-urban areas. Slum households have increased in absolute terms and, whilst many slum dwellers have been provided with water, electricity and sanitation, other basic services remain inadequate. Waste management services are often deficient and the residents face disproportionately higher health risks due to environmental factors such as indoor air pollution and living close to hazardous industrial areas or waste-sites and on flood plains. The climate-related risks of flooding and the threat of rising sea-levels further threaten coastal settlements. Informal settlements are often situated on vulnerable land most prone to flooding and sea level rise. Air pollution is on the rise in South Africa. The major contributors to air pollution are emissions from vehicular exhausts, power plants, international airports and poorly regulated industrial operations. PM10 concentrations are elevated across the country and exceed safe limits for human health.

Ozone concentrations have also been found to exceed health limits at many measuring sites. Residents of slums, exposed to both indoor air pollution as well as outdoor air pollution, may be at greatest risk of developing pollution-related cardio-respiratory disease. Figure 2 highlights the reality that, as populations become increasingly urbanised, their carbon emissions increase as well as the corresponding levels of chronic diseases and injuries. The figure encapsulates the experience of high income countries, where urbanisation has been gradual and has evolved over many decades. The trajectories for future urban health penalties in South Africa may look very different because the rapidity of urbanisation, reinforced by the impact of climate change including water shortages and extreme weather events together with economic uncertainties, may result in a more severe and prolonged burden of urban health penalties.

Climate change threatens to reinforce the existing challenges to sustainable development and to undermine the considerable efforts being made to protect the ecosystem and to maintain the pace of socio-economic growth.

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a PM10 – Solid or liquid particles found in the air with a diameter of 10 micrometers or less. Major concerns for human health from exposure to PM10 include asthma, lung cancer, cardiovascular disease and premature mortality.
## Table 1: The state of South Africa’s environment - a summary

<table>
<thead>
<tr>
<th>Environmental Component</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Freshwater resources</strong></td>
<td></td>
</tr>
<tr>
<td>Use of available water resources</td>
<td>[ ] INCREASING, with almost all exploitable sources tapped and freshwater flows decreasing</td>
</tr>
<tr>
<td>Water quality</td>
<td>[ ] VARIABLE, with overall DETERIORATION</td>
</tr>
<tr>
<td>Health of river ecosystem</td>
<td>[ ] DECLINING, with effluent pollution continuing to grow</td>
</tr>
<tr>
<td><strong>Invasive alien species</strong></td>
<td></td>
</tr>
<tr>
<td>Rate of spread of alien invasive plants</td>
<td>[ ] INCREASING (faster than the Working for Water programme can clear)</td>
</tr>
<tr>
<td><strong>Land degradation</strong></td>
<td></td>
</tr>
<tr>
<td>Extent of land degradation</td>
<td>[ ] UNCERTAIN, whether this has increased since 1999, due to lack of data</td>
</tr>
<tr>
<td><strong>Land use</strong></td>
<td></td>
</tr>
<tr>
<td>Availability of arable land</td>
<td>[ ] DECLINED, in the 1990s due to the expansion of settlements and other activities</td>
</tr>
<tr>
<td>Land restitution</td>
<td>[ ] INCREASING, but the majority of these successful land claims are in the urban areas</td>
</tr>
<tr>
<td><strong>Marine biodiversity and fish stocks</strong></td>
<td></td>
</tr>
<tr>
<td>Threats to marine biodiversity</td>
<td>[ ] All threats, including extractive use, pollution and mining, are expected to INCREASE in the next ten years</td>
</tr>
<tr>
<td>Populations of abalone and linefish</td>
<td>[ ] Continue to DECLINE dramatically</td>
</tr>
<tr>
<td>Numbers of species listed as endangered or vulnerable</td>
<td>[ ] INCREASING, for example bird species affected by longline fishing</td>
</tr>
<tr>
<td>Sardine fishery</td>
<td>[ ✓ ] RECOVERING, after a near collapse in the late 1960s, and currently healthy</td>
</tr>
<tr>
<td><strong>Ozone depletion</strong></td>
<td></td>
</tr>
<tr>
<td>Use of ozone-depleting substances</td>
<td>[ ✓ ] DECREASED, significantly since 1990</td>
</tr>
<tr>
<td><strong>Persistent organic pollutants</strong></td>
<td></td>
</tr>
<tr>
<td>Concentration of persistent organic pollutants</td>
<td>[ ] UNKNOWN, and needing to be quantified</td>
</tr>
<tr>
<td><strong>Poverty and human development</strong></td>
<td></td>
</tr>
<tr>
<td>Human Poverty Index</td>
<td>[ ] INCREASED from 16.4% in 1995 to 31.7% in 2002, reflecting an increase of 1.7 million people living on less than US$ 1 per day</td>
</tr>
<tr>
<td>Human Development Index</td>
<td>[ ] DECREASED, after 1995, although there has been increased investment in education</td>
</tr>
<tr>
<td><strong>Renewable energy</strong></td>
<td></td>
</tr>
<tr>
<td>Use of renewable energy</td>
<td>[ ] INCREASING, slowly mainly through solar water heating, experimental wind farms, some landfill gas projects, and the testing of wave energy</td>
</tr>
<tr>
<td><strong>Urbanisation and housing</strong></td>
<td></td>
</tr>
<tr>
<td>Urban sprawl</td>
<td>[ ] INCREASING, with 58% of the population living in urban areas, up from 53% in 1996</td>
</tr>
<tr>
<td>Informal settlements</td>
<td>[ ] EXPANDING, rapidly around urban centres and peri-urban areas</td>
</tr>
<tr>
<td>Housing backlogs</td>
<td>[ ] INCREASING, from 1.5 million units in 1994 to 3 million units in 2000</td>
</tr>
<tr>
<td>Slum households</td>
<td>[ ] INCREASED, in absolute terms, by 361 000 between 1996 and 2001, with the proportion of slum households in urban areas DECLINING from 32% to 28% over the same period</td>
</tr>
<tr>
<td><strong>Use of natural resources</strong></td>
<td></td>
</tr>
<tr>
<td>Natural resources that support livelihoods</td>
<td>[ ] RAPIDLY DECLINING, due to over-exploitation particularly in forests, grasslands, the KwaZulu-Natal coastal belt, and Cape Floristic Region</td>
</tr>
<tr>
<td>Levels of abalone poaching</td>
<td>[ ] INCREASING dramatically since 2000, threatening the sustainability of the fishery</td>
</tr>
<tr>
<td><strong>Overall state of the environment international indicators</strong></td>
<td></td>
</tr>
<tr>
<td>Ecological footprint per person</td>
<td>[ ] Higher than the global average, and increased by 2% between 1991 and 2001</td>
</tr>
<tr>
<td>Environmental Sustainability Index</td>
<td>[ ] DECLINING to an overall rank of 93 out of 146 countries in 2005</td>
</tr>
</tbody>
</table>

**Source:** Department of Environmental Affairs and Tourism, 2006.
The health impacts of climate change in South Africa

Burden of climate change related mortality and morbidity

Africa is recognised as being one of the continents most vulnerable to climate change and variability. There are many pathways whereby climate change affects human health, as illustrated in Figure 3. Additional local modulating influences may include mass population migrations, food and water insecurity resulting in conflict and the breakdown of health and social support systems.

A World Health Organization (WHO) estimate in 2000 of the global burden of disease attributable to climate change demonstrated that the African region had the greatest disease burden per million population (Figure 4). A German Advisory Council on Global Change analysis confirms these findings (Figure 5). The WHO analysis included only those health impacts that were underpinned by the strongest evidence – food- and water-borne disease, vector-borne disease, fatal injuries resulting from climate disasters and the risk of malnutrition – and is therefore likely to be an underestimate of the true burden of climate change on health. The disease burden estimate for the African region was 3 071 disability adjusted life years (DALYs) per million, a figure which represented the sum of years of life lost due to premature death and years of life lived with disability.

Figure 3: Pathways by which climate change affects health


Figure 4: Estimated health impacts of climate change by WHO region


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Figure 4: Estimated health impacts of climate change by WHO region

South Africa’s systematic and forward thinking strategies to adapt to and mitigate the impacts of climate change may ensure that the necessary plans and infrastructures are in place to reduce the burden of adverse health impacts on its population. The well-performing nature of its overall economy may also place the country at a significant advantage, in terms of strengthening its resilience to climate-induced health impacts. Such a possibility depends on addressing socio-economic inequalities and reduction of poverty, with these becoming the overarching goals of national economic policies and strategies. Nevertheless, the country is likely to face an additional burden of ill-health as climate change progresses, as a consequence of the population’s vulnerability arising from the many existing health challenges.

South Africa today has a significant number of people living with HIV and AIDS and also has an extensive epidemic of TB. High prevalence of HIV among young and pregnant women has significantly impacted on maternal mortality as well as infant mortality. In addition to the unprecedented levels of HIV prevalence, there is a high burden of morbidity and mortality resulting from violence and injury, chronic diseases, mental illnesses and maternal, neonatal and child mortality. These have resulted in a reduction of life expectancy since 1994 of almost 20 years, with average life expectancy at birth in 2009 standing at 50 years for men and 54 years for women.

Inequalities shaped by poverty, ill health and exclusion heighten the vulnerability of certain population groups – the rural and the urban poor – and places them at greatest risk of paying the price of climate chaos and undermining their recovery from the successive and increasingly intense and frequent climatic events likely to occur in the future. The vulnerability of the marginalised urban poor is increased by the environmental conditions in which they live. For example, people living in informal settlements on flood plains not only risk having their homes destroyed by floods but may lack the necessary capability to recover from such loss if they suffer from a high prevalence of debilitating chronic illness such as HIV and AIDS. Compromised immune systems further heighten the vulnerability of such people to air pollution induced respiratory illness and water-borne diseases.

Climate change induced drought, land degradation and increasing food prices are resulting in food insecurity for millions of poor South Africans and increasing malnutrition among children. Inadequate access to water and sanitation may increase the risk of diarrhoeal and other infectious diseases. Vulnerability to vector-borne disease such as malaria and to the consequences of air pollution may also increase in the future.

“A concrete illustration of the inter-relationship between human vulnerability, health and environmental change is the situation in the Umkhanyakude District in North Eastern KwaZulu-Natal. This is the poorest district in KwaZulu-Natal, with a scattered rural population, the highest HIV prevalence in the country and an unemployment rate of 54%. More than half of the households lack adequate access to water and sanitation, which contributes to frequent outbreaks of cholera and the district has the highest malaria incidence in South Africa – which may in future be increased by climate change. These factors have contributed to very high levels of human vulnerability, further exacerbated by the rapid increase in tuberculosis associated with HIV infections and poor living conditions. The health and economic stresses have placed further strain on social institutions, reducing even more the ability of people to cope with environmental changes and shocks.”

Impact of climate change on the other MDGs

A recently published review of South Africa’s progress towards the MDGs showed that some progress has been made towards several intersectoral goals but progress was insufficient or even reversed for many of the goals. Climate change may further negate progress towards achieving the health goals and is also likely to reverse the progress made towards enhancing environmental sustainability in the country (Table 2).
Table 2: Progress towards achieving the MDGs in South Africa and potential impacts of climate change

<table>
<thead>
<tr>
<th>MDG</th>
<th>Progress in South Africa</th>
<th>Potential impacts of climate change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal 1 Eradicate extreme poverty</td>
<td>Reversal of progress</td>
<td>Further damage to progress likely due to climate change impacts on livelihoods, food security and environmental resources available to the urban and rural poor.</td>
</tr>
<tr>
<td>Goal 2 Achieve universal primary education</td>
<td>Insufficient progress</td>
<td>Frequent natural disasters may disrupt regular education. More children (especially girls) may be taken out of school to earn an income or care for ill family members. Food insecurity and hunger may reduce school attendance and the ability of children to learn and complete primary education. Displacement and migration may disrupt education.</td>
</tr>
<tr>
<td>Goal 3 Promote gender equality and empower women</td>
<td>On track</td>
<td>Progress may be reversed if women and girls are compelled by natural disasters to help generate income and support their families. Deaths and illnesses due to extreme weather events have been shown to disproportionately affect more women than men.</td>
</tr>
<tr>
<td>Goal 4 Reduce child mortality</td>
<td>Reversal of progress</td>
<td>Morbidity and mortality are likely to increase due to climate change related population migration or displacement, food insecurity and increased risks of water-borne and vector-borne disease.</td>
</tr>
<tr>
<td>Goal 5 Improve maternal health</td>
<td>No progress</td>
<td>Morbidity and mortality are likely to increase due to climate change related population migration or displacement, food insecurity and increased risks of water-borne and vector-borne disease.</td>
</tr>
<tr>
<td>Goal 6 Combat HIV and AIDS, malaria and other disease</td>
<td>Insufficient progress</td>
<td>Increased vulnerability to infection due to increased water contamination, air pollution, increased malnutrition and changing patterns of vector-borne disease.</td>
</tr>
</tbody>
</table>

Contribution of South Africa to greenhouse gas emissions

This chapter has, thus far, examined the implications of environmental degradation and climate change on the health of South Africa’s population. But what of South Africa’s contribution to climate change?

Greenhouse gas emissions have been steadily rising in South Africa from 324 million metric tonne (Mt) of carbon dioxide to 444 Mt in a 14 year period from 1992 to 2006 (Figure 6). This 24% increase has amounted to a per capita emission level of 10.0 Mt. This increase, which is a reflection of the economic growth experienced, needs to be set in the context of the lower per capita emissions of adjoining countries such as Botswana (2.4 Mt), Zimbabwe (0.8 Mt) and Namibia (1.3 Mt) and the substantially higher levels recorded in the United States, which has a per capita emission of 20 Mt. Furthermore, national per capita emission estimates mask the socio-economic inequalities that continue within South Africa. The extent of poverty has not changed substantially between 1996 and 2001 and inequality has worsened. Per capita carbon dioxide emissions, which serve as a measure of affluence, are therefore also likely to vary widely between population groups.

It is evident that although the economy of South Africa is still developing, it remains heavily reliant on coal-driven energy sources and the energy intense nature of its economy has resulted in a high carbon emission level per unit of gross national product. Per capita emission levels are equivalent to that experienced by developed nations such as the United Kingdom. The growth of road transportation and coal-fired power plants have substantially affected South Africa’s increasing contribution to greenhouse gas emissions and climate change.
for South Africa to demonstrate leadership by reducing its carbon emissions and supporting others to strengthen their resilience to climate change.

Recommendations

With increasing greenhouse gas emissions, high income inequalities and inadequate progress towards environmental sustainability and other MDGs, South Africa needs to substantially increase its efforts to achieve MDG 7 to harmonise economic growth with sustainability and to improve the health and well-being of all South Africans.

Leadership

South Africa has actively supported a number of advocacy and awareness-raising efforts aimed at promoting the achievement of the MDGs by developing countries, with particular emphasis on the continent of Africa. South Africa played a leading role in championing the New Partnership for Africa’s Development (NEPAD), which is Africa’s primary socio-economic development programme through which the MDGs are addressed.

Climate change is a global issue requiring global co-operation, leading to local responses. South Africa can progress further in its efforts to achieve sustainable development and can address climate change through strategies for adaptation to reduce impacts and mitigation to reduce the pressure on the environment. In order to address climate change in South Africa we need to recognise that it could exert an effect on livelihoods, economic productivity, social stability and health.

Education and awareness

Public education and awareness are key adaptive strategies needed to address climate change. There is a growing recognition that better environmental management can reduce the impact of climate change. It is a matter central to solving many problems, including poverty reduction and economic development. Improving people’s living environment can result in more secure livelihoods, reduced vulnerability and better health. Community-based neighbourhood support/watch schemes are important participatory structures to improve involvement and awareness at a local level.

A key metric in adapting to climate change is health, specifically environmental health. Public health has been under-valued in development and environmental management decisions. We need relevant, evidence-based and accepted tools to increase awareness and justify investments for social development, including public health improvement.

Monitoring and surveillance

Early alert systems are needed to identify impending weather extremes including recognition of flooding, heat waves and droughts. Improved surveillance and monitoring of risk indicators and health outcomes that include not only the traditional public health indicators (such as mortality and morbidity) but also indicators from other relevant disciplines are needed. Infectious disease outbreaks may require enhanced infectious disease control programmes, including vaccines, vector control, case detection and treatment.

Research

There is plenty to be worried about, but also a chance arises for research to play a key role in achieving a global solution, revitalised health promotion and true sustainability. Research can enhance health protection at two levels. Recognition of health risks can potentiate primary prevention initiatives. In addition, health risks already exist and others are unavoidable. We must develop and evaluate adaptive (secondary prevention) strategies, using innovative breakthroughs to address climate change to address these challenges. Research agendas must utilise an extended time horizon in the order of decades, long enough to provide continuity and meaningful progress for data collection, policy development, implementation and analysis; but short enough to allow rapid system evolution and information updating.

Intersectoral collaboration

Addressing climate change will require intersectoral collaboration and capacity building to account for the complexity, scale and dynamics of this global problem.

The task for policymakers is to:
- integrate health assessment into impact assessments carried out by non-health sectors;
- understand the intrinsic uncertainties in this topic including unavoidable uncertainties about projected future risks;
- identify vulnerable communities and sub-populations;
- develop and evaluate adaptive strategies and interventions to reduce both present and likely future risks to health from climate change;
- co-ordinate the development of policy and programmes at local, national and international levels; and
- recognise the need for government regulatory involvement as the basis of societal response to this and other global environmental problems.

For these changes to be sustainable, it is critical for individual citizens and consumers to be involved, but also for govern-
ment to create a supportive environment for effective local action. There is a need for large-scale global environmental change and policy change. A cultural transformation – a new ‘industrial revolution’ – is required. Global climate and environmental changes arise from systemic market failures, and governments need to remedy these.

“Climate change of the order and time frames predicted by climate scientists poses fundamental questions of human security, survival and the stability of nation states, which necessitate judgements about political and strategic risks as well as economic cost”.26

South Africa nevertheless retains the potential to exercise leadership in the global effort to protect human health and well-being.

In weighing the fate of the earth and, with it, our own fate, we stand before a mystery and in tampering with the earth we tamper with a mystery. We are in deep ignorance. Our ignorance should dispose us to wonder, our wonder should make us humble, our humility should inspire us to reverence and caution, and our reverence and caution should lead us to act without delay to withdraw the threat we now pose to the earth and to ourselves.27
References


