CLIMATE CHANGE ADAPTATION
ECONOMICS

Adaptation Scenarios Factsheet Series, Factsheet 6 of 7

THE LONG-TERM ADAPTATION SCENARIOS FLAGSHIP RESEARCH PROGRAMME (LTAS) FOR SOUTH AFRICA

The LTAS (April 2012 – June 2014) aims to respond to the South African National Climate Change Response White Paper (2011) by undertaking climate change adaptation research and scenario planning for South Africa and the Southern African sub-region.

The **Adaptation Scenarios Factsheet Series** has been developed to communicate key messages emerging from LTAS Phase 2 (June 2013 – June 2014) to policy- and decision-makers, researchers, practitioners and civil society. The Factsheet Series complements the LTAS Phase 2 technical reports. For further details on this factsheet, see the LTAS Phase 2 full technical report entitled *The Economics of Adaptation to Future Climates in South Africa: An Integrated Biophysical and Economic Analysis.*

1. Introduction

The consequences of climate change are generally felt through a series of impacts that cover all aspects of society and economic development. Globally, the cost between 2010 and 2050 of adapting to an approximately 2° C warmer world is estimated to be in the range of $ 75 billion to $ 100 billion a year. A limited number of studies have attempted to quantify the economic consequences of climate change in South Africa. Many of these focus on the impact on the agricultural sector, while others provide preliminary estimates of the economic cost of unmitigated climate change to biodiversity, agricultural systems, infrastructure and human health. However, these fall short of capturing the macro-economic impacts of climate change, and may omit the agricultural impact on other activities, income and spending as well as other key sectors like roads. A risk-based assessment of the potential macro-economic impacts of future climate change on the South African economy is thus required.

2. Potential economic impacts under future climates

The analysis of potential economic impacts focuses on three key impact channels identified by LTAS, namely water availability for irrigation, municipal and industrial uses; yield impacts on dry-land agriculture; and transport, particularly roads. The scenarios analyse the cumulative impact, as the sectors cannot be analysed in isolation because cumulative impacts are not the same as the sum of the individual sector impacts. This is due to the integrated nature of the economy and the economic model. However, broadly speaking, the economic impacts arise from more rapid depreciation of transport networks and changes in the productivity of dry-land agriculture. Importantly, the water resource management system appears to be quite robust across a wide array of possible climate futures. The biophysical impacts of climate change on the relevant sectors are presented in Boxes 1–3.

The implications of climate change for the overall rate of economic growth are overwhelmingly likely to be negative. The potential growth implications are not likely to be a large percentage of the national Gross Domestic Product (GDP) within the next 10 – 20 years (-3.8% to 0.3%), however, they are still significant for the average annual growth rate, and will have a significant impact on South Africa's ability to maintain economic growth in the future under conditions of climate change. This is because these reductions are consistent and they accumulate through time. Consequently, in terms of net present value of losses, the total value of GDP expected losses induced by climate change over the next 35 years ranges from R 217 billion to R 651 billion, with a median loss of R 259 billon (almost 10% of GDP in 2012). This is a noteworthy amount.

Despite these anticipated effects on economic growth rates, the impacts of climate change tend to be fairly limited when aggregated at the national level. However, at finer spatial scales, there are cases where the regional impacts, particularly on agriculture, become significant and highly variable across climate futures. Results show that: i) there is high variability on the impact to agriculture, especially in areas with high poverty rates and a dependence on dry-land agriculture, such as KwaZulu-Natal where poverty could be exacerbated by climate change; ii) the impacts of climate change on agriculturally important areas, such as the Vaal region which is a major domestic producer of cereals and oilseeds, are likely to be significant in economic terms with additional implications on national agricultural production and food security; and iii) for certain areas, such as the Berg Water Management Area which is an important producer of winter cereals, deciduous fruits and vegetables, more than 99% of future climate results show deteriorating agricultural value. The impacts of climate change on employment growth and inequality are summarised in Box 4.

The project is part of the International Climate Initiative (ICI), which is supported by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety.

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BOX 1: BIOPHYSICAL IMPACTS OF CLIMATE CHANGE ON THE WATER SECTOR

The results in the water sector suggest that climate change will have a limited impact on water supply at a national level, but could be quite significant at regional level, particularly under drier futures. The limited impact in terms of national water supply can be attributed to the current high level of development and integration of the major water supply infrastructure and supply system. However, at a regional level, all models predict a reduction in streamflow in the Western Cape, including the Berg River catchment, with the potential for reduced ability to supply the future water demands for Cape Town. The greatest negative impact on future water supply is in the Gouritz Water Management Area where urban and bulk water supply are dependent on smaller and less integrated local resources, and the climate models predict likely future drying. The results for the agricultural sector show a general increase in irrigation demands (around 5%) based on existing crop types and management practices due to increased evaporative demand. These impacts vary across the country, with increases in some areas, notably the east coast and KwaZulu-Natal, potentially being offset by increases in precipitation.

BOX 2: BIOPHYSICAL IMPACTS OF CLIMATE CHANGE ON THE DRY-LAND CROP YIELDS

The potential impact on dry-land crop yields (represented by the nine major rain-fed crop types in South Africa i.e. maize, sorghum, wheat, sunflowers, groundnuts, soybean, lucerne, sugarcane and cotton) are mixed, with some crops even showing a potential increase in yields due to regional variations in precipitation. Most, however, show a general reduction in potential yields. Of most concern is the likely reduction in the total average annual yields from maize and wheat, two staple food crops in South Africa, of around 3.5% and 4.3% respectively by 2050. There is, however, a very wide range of potential impacts from a worst-case of 25% reduction in the total average annual maize yield to a possible increase of 10% under some very wet scenarios. All future climate scenarios show some level of reduction in wheat yields from the Western Cape catchments, the primary wheat growing areas of the country, due to a consistent reduction in future average annual precipitation in this region.

BOX 3: BIOPHYSICAL IMPACTS OF CLIMATE CHANGE ON THE ROADS

The study of potential impacts on roads infrastructure shows significant advantages in implementing adaption options to the repair and rehabilitation of the existing roads network, particularly in the second half of the century with the cost for no adaptation over taking the costs for adaption at around 2040. Given that the average design life of a major road is 30 years, however, it is important that adaption measures are implemented sooner rather than later in order to realise these potential benefits. At a provincial level, the Eastern Cape shows the highest impact of additional costs from climate change as it has the greatest number of roads, although many of these are gravel roads. The second most impacted province is Gauteng, which although having a smaller total road inventory, has a very high proportion of more expensive primary and paved roads.

BOX 4: CLIMATE CHANGE IMPACTS ON GROWTH, JOB CREATION AND INEQUALITY

Although climate change will have a relative small percentage effect on GDP, the economic implications will have a significant impact on the ability to maintain economic growth into the future. Regarding employment growth, this is extremely sensitive to labour market policies and institutions. Consequently, the potential impacts of climate change, at least at the national scale, are overshadowed by these other potential uncertainties. It is clear, however that a more flexible labour market is likely to provide resilience under future climate and other uncertainties, as it allows for the movement of labour and other resources (land, water and capital) between regions and between sectors that are more or less impacted by climate change. The economic impacts from climate change could increase unemployment and inequality at sub-national and sector-based levels. This is particularly relevant to agriculture, with unskilled labour most likely unable to transition from agriculture to other sectors of the economy. This could increase the potential for migration, particularly from rural to urban areas.

3. Adaptation responses under future climates

A window of opportunity exists to prepare to confront the challenges posed by climate change on the national economy. In two or three decades' time, the challenges are likely to be much more profound, especially in the absence of global mitigation policy, with very real consequences for the national economy as well as significant regional variability and potential inequality impacts.

Based on the results of the biophysical and economic model of the potential impacts of climate change under the different climate change scenarios, a number of underlying principles and associated adaptation response actions can be drawn and suggested for further consideration. These principles are listed below.

- Development is the best form of adaptation, but it must be 'clever development' that takes on a new form so that it is sustainable and incorporates future uncertainty, such as incorporating sensitive green urban design, 1:100 year flood lines and coastal set-back lines.

  Response action: Guidelines for appropriate climate resilience and sustainable development should be developed to assist national departments, local municipalities and developers with adaptation.

- Adaptation must work on all components of the risk equation i.e. hazard, vulnerability and adaptive capacity.

  Response action: South Africa should continue to address mitigation in the long-term, but it is critical that current vulnerabilities are addressed including, for example, people living in flood-prone areas.

- Flexible and adaptive systems that allow for the movement of resources (water, labour, land and capital) to more efficient sectors can provide resilience and potentially mitigate the future impacts of climate change.

  Response action: Mechanisms that allow for endogenous adaptation within the economy need to be identified and strengthened. Alternatively, blockages to these adaptation responses need to be removed.

- Investment in adaptation now will pay benefits in the future. For example, upgrading roads is initially costly, but after about 2040, the adaptation costs will be less than the additional impact costs if current design standards are used.

  Response action: Consideration of adaptation options should not be delayed as it will take time to realise the benefits.

- Adaptation will require us to rethink/redefine our current design standards.

  Response action: Current design standards in terms of, for example, appropriate pavement design and concrete mixes, should be revised along with design flood methodologies taking into account more recent climate information as well as assessing the increased risk under future climate change scenarios.

- There will be potential winners as well as losers due to future climate change, particularly related to increased availability of water in certain areas.

  Response action: Opportunities for benefiting from climate change, for example, in areas with potential warmer climates and increased precipitation, should be identified and potential climate change impacts should be taken into consideration in terms of prioritising future development opportunities.

4. Research recommendations

General recommendations in support of alternative development and adaptation scenarios include further research and analysis on:

- The potential for South Africa's integrated national water supply infrastructure to provide resilience to future climate change.
- Potential impacts on the agriculture sector and the impacts that this might have on the local, national and regional (SADC) economies.
- Current and proposed dam locations within South Africa to identify priority dams for consideration of additional hydro-power capacity particularly under a wetter future.
- Potential impacts of extreme events, particularly floods and the associated costs, in terms of specific infrastructure (dams and bridges) at risk.
- Critical sections of the transport infrastructure (including roads, rail and bridges) threatened by future climate change and improved modelling of the potential economic impacts.
- Current design standards, particularly for roads, in response to future increases in temperature and flooding impacts.
- Regional climate change impacts, particularly in areas of concern including the western and southern Cape for water resources availability as well as the eastern and northern provinces (Northwest and Limpopo) in terms of potential for increases in flooding.
- Current dam operating rules to potentially consider added flood control mechanisms particularly under a wetter future.
- Individual water supply systems to identify critical thresholds of failure and develop monitoring criteria to give early warning about the risks of these thresholds being realized.
- The agricultural sector to determine the range of potential impacts on both dry-land and irrigated agriculture and the impacts that this would have on crop types, farming practices and food security.
- The role, and key aspects, of endogenous adaptation used in the economic model to mitigate the economic impacts of climate change and consideration for the critical aspects of the South Africa economy that could limit the potential for such adaptation.
- Specific impacts at a sector level and a sub-national level, particularly in vulnerable sectors such as agriculture and the most vulnerable regions.
- Improved crop varieties and improved farming practices, including a regional assessment of future food security including the potential to become more reliant on food imports from neighbouring countries less impacted by climate change.
- The sensitivity of individual systems and a consistent approach to incorporating the risks and uncertainties of climate change into large-scale water resources planning in South Africa.
- The potential additional cost of climate change in terms of increased inter-basin transfers and the early adoption of new schemes including sea-water desalination.
- Developing and extending the LTAS Phase 2 approach to economic modelling to other areas of concern and applying it to multiple climate change impacts in South Africa.

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