

# **Cities and climate change synergies and trade-offs: A South African perspective**

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## **1. Introduction**

Increasingly there is evidence to suggest that there are likely to be synergies and trade-offs to interventions implemented in response to climate change challenges. This is especially relevant in developing countries, where there are likely to be significant advantages to capitalizing on synergies in climate change mitigation and adaptation in terms of supporting sustainable developmental growth. As such there are likely to be synergies and trade-offs among current or planned climate change interventions within the Agriculture, Forestry and Other Land Uses, and Infrastructure sectors that can be optimised, especially in transitioning towards Climate Smart Cities.

A Climate Smart City needs to approach the nexus between sustainable development, and climate change adaptation and mitigation in an integrated way by prioritising interventions with synergies. In particular interventions with synergies across mitigation, adaptation and urban-rural development need to be prioritised to allow for the creation of more efficient climate and development policies and responses. The development of opportunities in terms of renewable energy, waste beneficiation and investment in ecosystem services, for example, also need to be prioritised.

In South Africa, metropolitan cities are hubs for industrial and economic development and thus responsible for significant greenhouse gas (GHG) emissions (Thambiran et al., 2019). These cities are also faced with the challenge of meeting the needs of a growing population around the demand for water and energy, and for greater built and ecological infrastructure. This challenge is likely to be further compounded by

global climate change, and the associated risks of rising temperature and precipitation hazards, extreme weather events, and water and heat-related stresses (Thambiran et al., 2019).

South African cities need to become Climate Smart by prioritising and implementing climate change mitigation and adaptation planning towards ensuring economic development that is low carbon while building resilience. This supports the city in achieving its broader development objectives through sustainable and climate-compatible development (Thambiran et al., 2019).

Whilst these synergies and trade-offs for climate change mitigation and adaptation for Climate Smart Cities can be understood in a qualitative way, the opportunities for optimising synergies between these strategies often lack empirical evidence. In particular, little research within an African context has occurred, to date, to understand the implications of such synergies and trade-offs within the context of the developmental challenges faced by cities in Africa. Given that African cities typically prioritise adaptation, the opportunities for synergies are of particular interest.

A research programme currently underway at the CSIR, funded by the CSIR Parliamentary Grant focuses on understanding how climate change will impact on cities in South Africa. Specifically the research aims to improve our understanding how an optimal mix of adaptation and mitigation options can be selected to aid cities in prioritising technologies that will support their development as Climate Smart Cities. This research programme is currently using the eThekweni Municipality as a case study area.

## **2. Research Aims and Objectives**

It is expected that cities will be able to better climate-proof systems through awareness of potential climate change impacts, by developing an understanding of the optimal mix of adaptation and mitigation options that harvest synergies and reduce trade-offs, and identifying relevant climate change technologies. Policy-makers will be better positioned to help communities to be more actively prepared in the event of weather-related disasters and climate change impacts.

The aim of the research is thus to develop and implement a risk to resilience urban assessment framework for South African cities that will facilitate improved decision-making with respect to climate change mitigation and adaptation.

The research looks at the issues of mitigation and adaptation in an integrated way in an attempt to bridge the gap between responding to priorities to increase resilience of communities and cities to climate change while strengthening the country's contribution to the global mitigation effort.

### **3. Research methods**

The methods applied within the research project span climate modelling, anthropogenic heat modelling, GHG emissions inventories, land use change modelling, risk and vulnerability assessments, mitigation and adaptation response development and technology prioritisation. Specialised models are used to support this work, with a focus placed on parametrising and validating models for the case the study area that is the eThekweni Municipality.

The modelled outputs are used in an integrated way to develop different scenarios to support optimal decision-making. For example, scenarios are tested to quantify synergies and trade-offs include:

- changes to land-use in response to development plans
- changes in planning and development approaches due to adaptation or mitigation measures linked to potential climate change impacts
- changes to urban characteristics (due to the implementation of changes in the design of buildings or other infrastructure-based adaptation/mitigation measures)

A geo-information portal is also being piloted as a means of sharing the outcomes of the eThekweni Municipality study.

### **4. Relevance and impact to the eThekweni Municipality**

The development of appropriate bottom up methodologies to assess and quantify risks, climate change impacts and emissions draws on the existing capabilities of CSIR and also involves numerous post-graduate students registered at the

University of KwaZulu-Natal. The modelling outcomes generate outputs that provide new information for the municipality that is used in scenario analysis to understand the implications of different actions for climate change mitigation and adaptation. The outcomes of this research will thus provide the municipality with important information related to climate change interventions that can guide sustainability efforts, and support the improvement in the quality of life of those who reside in it. The online portal will further provide access to key resources and data that eThekweni Municipality could use in developing and refining climate change response plans.

## **5. Findings and Recommendations**

A number of key research outcomes have been achieved to date. These include coupling the Conformal Cubic Atmospheric Model (CCAM) to an urban canopy model called the Town Energy Balance (TEB) model to simulate the climate over eThekweni under present and projected climate change scenarios at a 1 km<sup>2</sup> resolution, a first for a South African city. These climate change projections were produced as part of the Cool Durban study undertaken and funded by the eThekweni Municipality.

Further to this, a spatially disaggregated GHG emissions inventory study for key sectors in the municipality has been completed. This part of the research helped to identify high emission zones. Research has also been completed on the current and projected climate change and land change hotspots and helps to inform appropriate climate change strategies for land use planning in the short, medium, and long term under projected maximum temperature and rainfall increases. Based on these types of outputs recommendations with implications for spatial planning and climate change responses have been developed for the municipality.

## **References:**

Thambiran, T. Naidoo, S. and Padayachi, Y. (2019). Climate smart cities in the context of the development nexus. In *Briefing Notes on Development Nexus*

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