

# **THE IMPACT OF SOLAR WATER HEATERS ON SUSTAINABLE DEVELOPMENT**

By

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Submitted in fulfilment of the requirements for the degree of  
Master in Arts for Development Studies at the Nelson Mandela  
Metropolitan University

April 20, 2014

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## **DEDICATION**

This Thesis is lovingly dedicated to:

My brother, Mbeng Denis Ashu, who has never failed to give me financial and moral support and for teaching me that even the largest task can be accomplished if it is done one step at a time;

My late mother, Monica Taku Ayuk, and Sister Florence Mbeng, whose memories remain with me forever.

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## ACKNOWLEDGEMENTS

I would like to extend my gratitude to a number of people without whom this thesis might not have been accomplished.

I would like to sincerely thank my supervisor, Mr Pavel Parks for the skilful ways in which he lovingly challenged and supported me for the writing of this thesis from start to finish. Most especially, I would like to acknowledge his confidence in me.

My heartfelt gratitude to Natalie Stear for proofreading this thesis. I would also like to thank Mrs Linda Palesa and Mr Given Mbara of the CoJ for their guidance and information provided during the data collection phase. I express my heartfelt gratitude to Patricia Sibiya, who acted as a guide and interpreter when I was in the field in Cosmo City.

I am greatly indebted to Ian Gouza and his wife, Belter Giwe, for their hospitality, understanding and encouragement in my many moments of crisis. I would sincerely thank Felix Nzante for giving me hope when I almost gave up on my studies. To my sister, Emelda Tambe and her husband; my sister-in-law, Nicoline Ashu; my brothers Walters Mbeng, Cletus Bessem and his wife, who supported me each step of the way; and my nieces and nephews. I love you all. To Mr and Mrs Yah and, Mr and Mrs Santos Ayuk, who enthusiastically supported me in my journey to find and realise my potential.

To all my friends, thank you for your relentless support throughout my study life in South Africa. Your companionship makes my life a pleasing experience. I cannot list all the names, but you are always on my mind. A very special thank you to Charles Nwanja, for his valuable and passionate support in making sure I achieve one of my life goals. You remain willing to engage with me in the struggle and ensuing discomfort of studies.

Above all, I appreciate God Almighty for His loving kindness and grace upon my life, throughout my studies and during the writing of this thesis. His word says “I can do all things through Christ who strengthens me” (Philippians 4: 13).

## DECLARATION

I, **Regina Nso Mbeng & 213443007**, hereby declare that the treatise for Students qualification to be awarded is my own work and that it has not previously been submitted for assessment or completion of any postgraduate qualification to another University or for another qualification.

Regina Nso Mbeng

A handwritten signature in black ink, appearing to be 'Regina Nso Mbeng', written over a horizontal line.

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## ABSTRACT

In this present world order of growing information, communication and technological advancement, it is primordial that climate change adaptation and mitigation efforts seeks to make people resilient to inevitable climate inconsistency through the exploitation and development of renewable energy sources. Though climate impacts are global, the population most at risk is predominantly from developing countries, particularly poor communities who have experienced multi-layered threats from floods, droughts and energy supply, just to mention a few. This explains why sustainable development is at the heart of all development trajectories in the world today, specifically the post-2015 development tenets. Climate change adaptation and mitigation requires international collaboration from all nations in order to get an effective and unified response to climate change. Building a critical mass for action and an institutional memory to sustain policies and efforts is crucial. A resilient-based approach to climate mitigation and adaptation founded on a crisis-driven reaction to communities vulnerable to climate threat will boost quality of life through the provision and safeguarding of safety nets for the poor. Solar water heaters, a renewable energy source, are here considered as a critical option to South Africa's coal-driven economy as a means of alleviating energy poverty in rural and low-income communities, to be more precise. Therefore, SWHs have become the epicentre of sustainable development policies and climate change mitigation efforts in South Africa. So far, this device has attracted the attention of local governments in the country who view it as a game changer in the field, particularly towards greenhouse gas emission and energy conservation. The contour of this thesis is to assess the impact of solar water heaters on sustainable development. Although it is generally difficult to assess the real impact of technology on people, that of SWHs was established by asking questions about livelihood before, during and after the introduction of this device.

**Keywords:** Impact, Solar water heaters, sustainable development, Cosmo City, resilience, climate change.

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## LIST OF ABBREVIATIONS

CDM	Clean Development Mechanism
CoJ	City of Johannesburg
COP 17	17th Conferences of Parties in Durban
DEA	Department of Environmental Affairs
DEAT	Department of Environmental Affairs and Tourism
DME	Department of Mines and Energy
ECA	Economics of Climate Change Adaptation
GHGs	Greenhouse Gases
IDP	Integrated Development Plan
IPCC	Intergovernmental Panel on Climate Change
JMM	Johannesburg Metropolitan Municipality
LTMS	Long-Term Mitigation Scenarios
MDGs	Millennium Development Goals
NCCRS	National Climate Change Response Strategy
NEMA	National Environmental Management Act
NGO	Non-governmental Organization
REFP	Renewable Energy Flagship Program
RSA	Republic of South Africa
SDSN	Sustainable Development Solution Network
SSA	Statistics South Africa
SWHs	Solar Water Heaters
SWP	Stiftung Wissenschaft und Politik
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
UNFCCC	United Nations Framework Convention on Climate Change
WCED	World Commission on Environment and Development
WMO	World Metrological Organisation

# CHAPTER 1

## INTRODUCTION

*"I refuse to condemn your generation and future generations to a planet that's beyond fixing" (Barack Obama, 2013).*

### 1.1. Background to the research

As a point of departure, this thesis is premised within the context of climate change mitigation and adaptation. The impact of climate change is already being experienced across every loop and corner of the globe today, particularly in Africa. In a continent challenged by poverty, the response from governments has been slow but steady. Combatting deforestation and promoting reforestation has been the mainstay of most governments in Africa (Sebitosi, 2006:8). Climate impact differs from region to region; however, that on Africa is worrisome given its dependence on predominantly agriculture to feed between 60-70% of its total population, as well as contributing an estimated 30 per cent to its GDP (UNEP in Maponya and Mpandeli, 2012: 48 and Quaye, Yawson, Ayes and Yawson, 2012: 6357). A viable and effective adaptation plan is required for most local communities on a continent that is particularly vulnerable in the face of adverse climatic impacts. National and local government departments have mainstream and integrated environmental and climate change issues as part of global measures directed towards developing appropriate mitigation and adaptation strategies. In this global world of growing information, communication and technological advancement, it is vital for adaptation strategies to be eco-friendly in order to fuel development in a sustainable way. The Johannesburg Metropolitan Municipality (JMM), herein referred to as the City of Johannesburg (CoJ), is part of this global struggle.

Against a backdrop of controversies surrounding appropriate strategies to mitigate the impact of climate change, adaptation has gained recognition within international circles as a more suitable option that might drastically enable humanity to adjust to eminent climate variability such as rising sea levels, floods, droughts, increasing temperatures and; at the same time pursue development that is more sustainable (Magrath, 2010: 898). There is no doubt that the adoption of the 1992 United Nations Framework

Convention on Climate Change (UNFCCC) and the prolific Intergovernmental Panel on Climate Change's (IPCC) Fourth Assessment Report (AR4) has resulted in policies and programmes being more concentrated on adaptation and mitigation. This focus on adaptation and mitigation, and their implementation stems from a revolution in developmental tenet. It is a shift from the traditional top-down approach of global assistance from rich to poor, to an approach focusing on sustainable development, a more people-oriented bottom-up approach (Sebitosi, 2006: 8).

The emergence of community-based resilience approaches is part of a key reaction to adapt local communities' sustainably, to the impact of climate change. This ingenuity plays a substantial role in easing the effects of climate change, particularly on local communities (Sanwal, 2008: 50-51). Though most of these initiatives are operated by non-governmental organizations (NGOs) and community organizations, their usefulness habitually depends on the presence of a local government department. Local governments or municipalities are the first and the forerunners to take action against environmental degradation. Resilience-based programmes on climate change support local communities who often are poor, marginalized, and the most vulnerable in society to adapt to climate erraticism. A resilience-based approach can remedy many of the misrepresentations that have ascended from a crisis-driven reaction to communities' hard-hit by climate inconsistency and can provide inspiration for advancing the sustainability course (Yohe, Lasco, Ahmed, Arnell, Cohen, Hope, Janetos & Perez, 2009: 834-835).

Nation states in line with recommendations of the UNFCCC and the United Nations Millennium Development Goals (MDGs) have come up with distinct national climate change response strategies (NCCRS), coined to curb various environmental stressors that impede sustainable development. Major international conferences and events on climate change have shaped and inspired most national climate change response strategies (Sebitosi, 2006: 7). As major cities around the globe brace themselves for eminent impact and risk associated with climate change, local and urban peripheral communities are not left out. At this juncture, it is imperative to bear in mind that the

terms municipality and local government as used in this research denote one and the same body. Hence, the two terms are used interchangeably throughout the research project.

In South Africa, adapting local communities to vulnerability requires projects that are community-based, less costly and sustainable (DEA, 2011: 23). According to Schipper (2007: 3) any community adaptation measure must identify the root causes of susceptibility, a key role in development. Schipper echoed that most adaptation measures are focused on impacts rather than adequately exploring the fundamental elements that cause vulnerability. Schipper underscores that local community adaptation should take into account both natural and man-made factors through a participatory method.

In all, a breadth of responses is required to assist countries and communities most affected by climate change. On one hand of the breadth, specific assistance must be provided to the relatively small communities, on the other hand, all communities in climate-affected countries must have increased access to government-provided social protection in all sectors, including low-cost housing and energy efficiency (Republic of South Africa, 2011: 5). Only in this way would the millennium development goal seven (MDG7) be realistically attain in a manner more sustainable.

## **1.2. Significance of the study**

This research project will add value to the existing body of knowledge regarding the impact of climate change on sustainable development. The study has theorised sustainable development in a precise and comprehensible manner as a vital component of Integrated Development Planning (IDP) for South Africa's Municipalities; to be implemented through participatory action to attain millennium development goal seven. This study speaks to most at risk population and further the course of climate change mitigation for local communities. Likewise, the outcomes, as well as recommendations, aims to guide policy legislation, decision-making, project design, planning, execution, monitoring and evaluation of development programmes relating to climate change and sustainable development.

### **1.3. Research objectives**

The objectives of the study are to:

- Analyse and assess the impact of solar water heaters (SWHs) on sustainable development in Cosmo City;
- Assess how SWHs have contributed in building livelihood resilience to climate change in Cosmo City;
- Examine strategies put in place by the CoJ to enhance climate change resilience within the municipality;
- Examine possible challenges associated with the effectiveness of solar water heaters on sustainable development so as to advise decision-makers about the possible ways of addressing these challenges, in order to boost development in all aspects;
- Draw inferences and provide recommendations on how to enhance the effectiveness of solar water heaters on sustainable development and suggest areas of further enquiry to researchers and policy-makers.

### **1.4. Problem statement**

In Africa, climate change aggravates prevailing threats to development, employment and poverty alleviation. Together with other environmental threats, communities with scarce natural resources would experience food insecurity and unsustainable increases in food prices (Yanda & Bronkhorst, 2011: 2). Local community adaptation are often limited to technical responses such as the building of dams, sea walls and solar water heaters to the neglect of socio-economic development to shape resilience against climate change (Tanzler, Maas. Carius, 2010 in Yanda & Bronkhorst, 2011: 3). The government policy approach to adaptation in South Africa is ill-developed as most adaptation strategies that aim to ignite economic growth are often carried out in an untenable way with negative impacts on development (Tiempo, 2008: 16).

In Cosmo City, emphasis has been placed mainly on minimizing risk, protection of residents and infrastructure and biophysical impact. The sustainable development impact has not been given the much needed attention as a means of enhancing

adaptive capacity of residents. The frequent energy crisis, increasing population pressure and rapid-changing urbanization limits formal adaptation efforts.

South Africa is the lead country on the continent to be highly dependent on fossil fuels as a primary source of energy; a situation critical with regard to the country's greenhouse gas emission ranking (fourteen out of fifty countries) in the world today. Inhabitants of informal settlements in South Africa depend on Kerosene and paraffin for "heating, cooking and lighting" mainly. An estimated 40% of local energy consumption comes from water heating (Ziuku & Meyer, 2012: 34). Thus, the need for the implementation of an energy efficient climate change adaptation project that would impact on livelihood and development in a sustainable manner is imperative.

Cosmo City, the case study area for this thesis, is a community where solar heaters have been installed as a response to climate change threats and to facilitate energy conservation within the City of Johannesburg. This study therefore seeks to examine the impact of solar water heaters (SWHs) on sustainable development.

## **1.5. Study area**

The Johannesburg Metropolitan Municipality (JMM) also referred to as the City Of Johannesburg (CoJ) came into existence through the amalgamation of the larger Johannesburg Metropolitan Council with its sub-constituents. In terms of population size and contribution to GDP, it is the leading and largest municipality in South Africa. It is the national heartland for finance, business services, and information and communication technology (City of Johannesburg, 2009). Cosmo City, the research area for this study is situated within the jurisdiction of the Johannesburg Metropolitan Municipality (JMM), herein referred to as the City of Johannesburg (CoJ).

### **1.5.1. Profile of Cosmo City**

Cosmo City is situated 30 km Northwest of Johannesburg's City Center. It is a low-income urban community that came into existence in 2004 as a green project undertaken by the CoJ in collaboration with the Gauteng Provincial Government. Cosmo City is located in an environmentally delicate area bordered by a river system, a

ridge and fairly unobstructed grassland susceptible to erosion. Inhabitants relocated from informal settlements of Zevenfontein and Riverbend, in the North of Johannesburg, constitute part of the population of the area. It was estimated that by the end of the project between 65, 000 to 70, 000 people will populate the area. Cosmo City occupies roughly 1100 hectares of land (City of Johannesburg, 2008).

### **1.6. Motivation**

The researcher is motivated by the increasing threat posed by climate change in South Africa, a country highly reliant on coal production to meet the increasing energy supply needs for both consumption and industrial use and which threatens service delivery efforts to local communities around. This has resulted to perturbation in energy supply, a key challenge to development within the CoJ. This research is well-timed; it comes as an attempt to bridge the gap between the rich and those in need amidst recurrent service delivery protests around the JMM. It has attempted to suggest thought-provoking ways that may help alleviate energy poverty; adapt communities to climate change and enhance growth and development.

### **1.7. Expected contribution**

The study does not aim to solve all the problems related to sustainable development and climate change adaptation, but it is a simple contribution to the already existing body of knowledge in the field of study. It should be underscored here that the purpose of this study is not to provide all the answers in terms of challenges to sustainable development. However, what the study seeks to do is to examine the impact of solar water heaters on sustainable development and give insight to climate change adaptation measures. Apart from dissecting current knowledge on the topic, new knowledge was generated through findings from this study.

### **1.8. Chapter outline of the study**

This treatise consists of five chapters. Chapter One deals with the introduction and background of the study. This comprises the statement of the research problem, research questions, objectives and framework of study. The second chapter features a review of relevant literature. Chapter Three outlines the research methodology, thus



addressing aspects such as the research approach, the research design, data collection and analysis, as well as validity and reliability. Chapter Four presents the findings and discussions and in Chapter Five, the researcher provides recommendations and concluding thoughts based on the study conducted.

### **1.9. Summary**

The discourse on sustainable development is deep-seated in environmental protection and climate change. International and national responses to effect change should aim at building resilience and a critical mass of knowledge on climate susceptibility in order to boost current and future development trajectories. To fully achieve the MDGs and post 2015 development agendas, there is an urgency to build an institutional memory that would sustain actions taken and drive policies in a rightful direction. The succeeding chapter focuses on the review of relevant and existing literature.

## CHAPTER 2 LITERATURE REVIEW

*“The decisions we take today on how we produce, consume and distribute energy will profoundly influence our ability to eradicate poverty and respond effectively to climate change”  
(Ban Ki-moon, 2010).*

### **2.1. Introduction**

The climate change discourse remains an ongoing debate within development agenda. Strategies intended to mitigate climatic changes through limitations of greenhouse gas (GHG) emissions are undoubtedly practically unsustainable (Agerup, Ayodele, Cordeiro, Cudjoe, Fernandez, Hidalgo, Krause, Louw, Mitra, Morris, Okonski, & Oluwatuyi, 2004: 3). The case might be that interventions strategies can either be too costly having little impact on risk reduction or most capable to reinforce poverty, thus creating a more challenging atmosphere for the poor to acclimatize to climate variability. Consequently, the implementation of policies and actions that would empower people to participate in economic endeavours that create wealth and lead to technological progress is imperative. This chapter undertakes an overview of South Africa’s effort to respond to climate change; pinpoints the causes of climate change, established the link between climate change and sustainable development; examine the Kyoto protocol, the energy situation in South Africa and assess the concept and analytical framework for sustainable development which has informed the need for climate-resilient development.

### **2.2. An overview of South Africa’s response to climate change**

The National Climate Change Response Strategy (NCCRS) of South Africa is an integrative hub for all mitigation and adaptation strategies. It provides guidance on the design of climate-friendly policies by various government departments in South Africa (Odeku & Meyer, 2009:2). Arrays of establishments play lead roles in implementing South Africa’s NCCRS. Local governments form the nexus of government organs that are dedicated to mitigate and adapt communities to climate variability in a sustainable way. The NCCRS outlines key approaches on adaptation, grounded on various

international conferences headed by specialised bodies within the United Nations (UN). Both the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) have directed, shaped and continue to inform policies, actions and strategies around climate change adaptation. These bodies have equally helped to further increase momentum on adaptation and mitigation efforts across the globe, as they continue to offer resources and sustained research on key concerns faced by people living in communities more vulnerable to climate variability. Given the magnitude of climate change on the socio-economic wellbeing of ordinary citizens, governments around the globe have been quick to act. Government interventions include the design of the national climate change response strategies that are allegedly oriented towards achieving sustainable development.

The City of Johannesburg (2003: 7) articulates the city's commitment to assimilate sustainable development in municipal planning and policy-design. The drive to sustainable development comprises two broad categories: sustainability and quality of life. The report directs intended programmes that reduce environmental pressures resulting from human consumption (11). DME (2004: 4) outlines economic, social and environmental principles for sustainable development in South Africa such as the clean development mechanism. The clean development mechanism (CDM) scrutinizes all development projects to assess whether they conform to the National Environmental Act principle of sustainable development. It reaffirms that if a project does not fulfil these criteria, the designated national authority (DNA) has the authority to reject the project until stated conditions are met at the conceptualization phase of the project. The CDM appraises and investigates the net carbon emission cutbacks of South Africa.

In South Africa, the national response to climate change is directed by values outlined in the Constitution, the Bill of Rights, the National Environmental Management Act (NEMA), the Millennium Declaration and the UNFCCC (Republic of South Africa, 2011: 5). The overall approach of the national climate change response has been described as "needs driven and customized; developmental, transformational, empowering and participatory; dynamic and evidence-based; balanced and cost effective; integrated and

aligned (12).” This approach is rooted in both adaptation and mitigation strategies capable of bringing about sustainable development as reflected in its socio-economic and environmental components.

In the context of the CoJ, the geographical sphere under which Cosmo City falls; the climate change response plan for the CoJ has as main goal to attain appropriate balance between adaptation and mitigation (City of Johannesburg, 2009: 2). This is based on the IPCC’s Fourth Assessment report which underlined that impact and risks of climate change would have a more devastating effect on developing economies, humanity, growth and social safety net structures for the poor. It is against this backdrop that the CoJ’s actions are geared towards building climate change resilience by making sure that adaptation takes place alongside mitigation. The CoJ’s response plan further indicates that in terms of vulnerability, Johannesburg has comparatively (with global standards) limited exposure to severe threats to climate change (3). It enjoys the advantage of not being situated on a coastline or weather-related natural disaster area. Hence, the CoJ’s climate change vulnerabilities originate from current issues such as urban flooding often intensified by mild temperature changes in weather conditions, poverty, poor air quality resulting from industrial pollution, vehicle discharges, domestic fuel burning for both cooking and heating in townships and informal settlements, energy and electricity outages, waste management and emissions from mining processes (24). To this end, the most vulnerable to climate change would be those from socio-economically disadvantaged communities who lack the necessary health, education, financial and physical resources to insure their lives and property (34). Heat is also identified as a potential threat (54). Though evidence of heat-related deaths remains undocumented in South Africa and in Johannesburg to be precise, it is projected that Johannesburg is more susceptible to heat waves in the spring season due to upsurge in day and night average temperatures. Consequently, people with health-related problems like tuberculosis, malaria, cholera infection, HIV and AIDS are most vulnerable and at greatest risk of health-related deaths (73). Poverty alleviation therefore constitutes the corner stone of the CoJ’s climate change adaptation plan (CoJ CCAP) and is a key priority measure assumed to reduce the vulnerability of such

communities to climate change stressors in order to achieve meaningful development to better the lives of ordinary South Africans.

### **2.3. Drivers of climate change**

Both natural and anthropogenic causes are drivers of climate irregularity; coupled with discharge from greenhouse (IPCC, 2007: 36). The IPCC fourth assessment (AR4) synthesis report depicts that GHG emissions resulting from human activities have scale-up since the pre-industrial era to an estimated 70% between 1970 and 2004. A prominent anthropogenic greenhouse gas is carbon dioxide whose annual emission rate sky rocketed to 77% of total anthropogenic GHG releases in 2004. During the period between 1970 and 2004, the main sources of GHG discharges emanate from transport, industries, solar radiation and energy supply; whereas, the agricultural sector, deforestation, domestic and commercial structures accounted only for a minimal amount of discharge. Meanwhile, energy intensive economies worldwide accounted for approximately 46% of total GHG emissions (37). These fluctuations in GHG atmospheric ejections modify the energy balance of the environment and thus drive climate change. In addition, human actions produce discharges of four main GHGs which are Carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O) and halocarbons. Unfortunately, these increases in emission have been accompanied by declining growth rate. IPCC agreed that the impact from human activities had been on global warming or cooling with an emission rate of +1.6 (approximately 53%), indicating a global high based on level of scientific understanding (39). More concretely, atmospheric concentration of CO<sub>2</sub> on a global scale within a period of ten years (1995-2005) stood at 379ppm, representing an average of 1.9ppm per year against an average low of 1.4ppm per year from 1960-2005. In all, fossil fuel is responsible for the global increases in atmospheric emission of CO<sub>2</sub>, whereas land- use change accounts for a substantial but lesser impact.

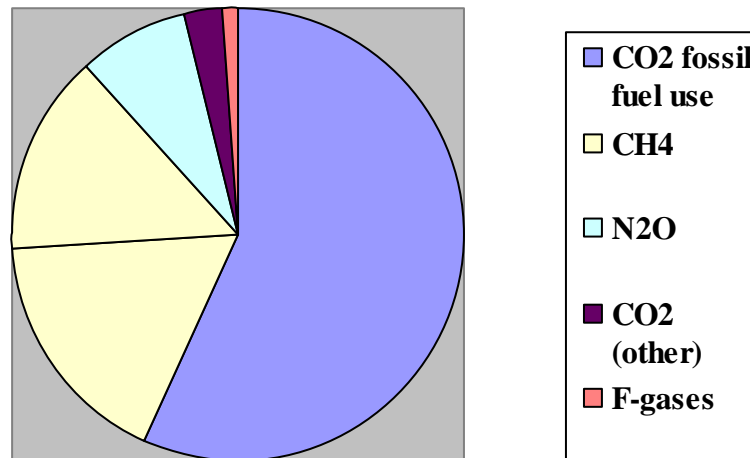


Figure 2.1: Share of different anthropogenic GHGs in total emissions in 2004 (Source: adapted from IPCC, 2007).

As interest grows, Mathew and Hammill (2009: 1124) argue that climate change scholarship has tended to place considerable attention on the increase volume of atmospheric greenhouse gases. They recognized the presence of the above mentioned greenhouse gases in the atmosphere and reaffirmed that since the industrial revolution of the 19<sup>th</sup> century, scientists have proven that global warming is evident. Concurrently, Wilbanks and Kates (2010: 722) postulated that climate change constitutes only part of several causes of global atmospheric modification with an impact on the sustainability of communities, nations and regions. These nuances interplay with other driving subtleties like demographic dynamics, global economic transformation, technological advancement and institutional transformation. Therefore, climate change mitigation and adaptation is significant not only as a concern in itself but as a bridge to sustainability.

#### 2.4 The Kyoto Protocol

The Kyoto protocol of 1997 laid the ground work for current sustainable development strategies framed around climate susceptibility (Fletcher, 2005:3). The Kyoto protocol is an international accord to the United Nations Framework Convention on Climate Change (UNFCCC). It seeks to lessen greenhouse gas emissions and implement clean development mechanism (CDM) projects. Though its ratification only came into being in 2005, this protocol remains credited for its numerous principles, many of which remain

internationally and legally binding to member states of UNFCCC. These principles include: the precautionary principle, preventative principle, the common but differentiated principle, the polluter pays principle (PPP), the principle of sustainable development and, the principle of intergenerational equity. This protocol formally committed industrialized countries to reduce their greenhouse gas emission by the set amount from between 2008 to 2012 (4). On the sideline, the Bali Action Plan established a roadmap for international collaboration on climate policy in the milieu of sustainable development and as an effective means towards guaranteeing maximum emission reductions (UNDESA, 2009: 23).

Even though the Kyoto protocol neither mandated nor put pressure on a developing country like South Africa to any emission reduction for the period 2008 to 2012, however, as a signatory to the protocol in 2002, South Africa undertook to disseminate SWHs as a solution to its coal dependent economy (Prasad, 2007: 3). Based on scientific evidence that proved human activities are increasing the concentration of greenhouse gases which contribute to global warming, rising sea level, health risks and fluctuating weather conditions; a consensus was reached on three mechanisms to curb emission in order to achieve a robust and sustainable development path way. These mechanisms are examined below:

#### **2.4.1. Emission Trading**

Article 6 of the protocol commits Annex 1(developed) countries to undertake emission-reducing projects to limit greenhouse gases to the atmosphere. In this respect, emphasis is on countries to development domestic plans on how to realize this and be responsible in meeting targets set in the protocol (Fletcher, 2005: 4). Black (2011: 5) substantiated that South Africa's emissions are the highest compared to other countries on the continent. Hence, collaboration in emission trading will offer Africa an opportunity to mitigate climate change alongside address development concerns such as energy access and food security.

#### **2.4.2. Joint Implementation:**

Fletcher (2005: 4) explains that the joint implementation policy is a project-focused intervention by which a country is acknowledged when it supports a project in different countries to promote significant emission reduction. The joint implementation enshrined within article 6 of the protocol goes a long way to complement the emission trading mechanism and hold industrialized countries responsible for reducing and meeting emission targets.

#### **2.4.3. Clean Development Mechanism:**

Another major outcome of the Kyoto protocol was the establishment of the clean development mechanism (CDM). The clean development mechanism serves as a platform for both developing and developed nations to collaborate in reducing emission. Seen as a modified or elaborate form of the joint implementation mechanism, Annex 1 countries will make financial contributions from which developing countries will source to finance projects sanctioned under the CDM. For Africa, it is imperative that the CDM either devise more supple extra requirements or nurture renewable energy sources as a way out of eminent climatic threats (World Bank, 2009: 4).

#### **2.5. The energy situation of South Africa**

On the continent, South Africa is the principal emitter of greenhouse gases (GHGs) due to its energy intensive industrial and economic sectors, making the country particularly vulnerable to climate change. Eskom, the largest national electricity supplier, generates 90 percent of its energy from coal (Earthlife Johannesburg, 2009: 6). In South Africa, climate change is a complex national concern that impacts on all sectors of the economy: agriculture, forestry, water resource management, transport, energy, and the provision of health services (DEAT, 2004 in Odeku & Meyer, 2010: 159).

South Africa is a fossil fuel-driven economy dominated by the mining and manufacturing activities. Coal remains the primary energy supply source (70%) and accounts for 92% of electricity production (Winkler, Davidson, Kenny, Prasad, Nkomo, Sparks, Howells, and Alfstad, 2006 in Chang, Lin, Ross & Chang, 2011: 3). This situation has ranked South Africa amongst the first twenty GHG producers in the world. Unsustainable as the



situation present itself, its electricity generation from coal is the least-expensive in the world. However, Lumba and Sebitosi (2010) (in Chang, Lin, Ross & Chung, 2011: 3) posits that electricity accessibility remains an issue to many South Africans. During peak periods, household electricity consumption in the country constitutes an estimated 35% with hot water production accounting for 40%. Consequently, energy efficiency constitutes a core aspect of sustainable development planning and reduction in GHG emission in the face of growing climate inconsistency and threats. Ziuku and Meyer (2012: 34) concur that residents of informal settlements in South Africa are exposed to severe health menaces due to dependence on kerosene for lighting, cooking and heating. In order to achieve sustainable development, the impending environmental consequences attributable to electricity production through fossil fuel, needs to be addressed to help South Africa attain its obligation to lessen high carbon emissions and mitigate the impact of climate change. They recommend the use of renewable energy technologies and the implementation of energy efficiency strategies in residential areas as the ultimate step in making climate change adaptation and mitigation more tenable.

With regard to the City of Johannesburg in particular, energy consumption for the municipality is outweighed by transportation (petrol, diesel and other fuels), whereas that from the residential sector is predominantly as the case cited above but with some dependence on coal and paraffin in poorer communities (City of Johannesburg, 2009: 30). Households' electricity supply within the municipality is approximately 77% from both Eskom and City Power. Certain informal settlements also do not have access to electricity, and thus make use of other fuel sources (usually paraffin, coal or biomass). In some cases, these informal settlements may be located in unsuitable areas, for example, within floodplains; hence making it difficult to electrify these areas. To be more precise, 45% of electricity supply for the CoJ is consumed by the domestic sectors alone while the remaining half by the commercial and manufacturing sector (Prasad, 2007: 7). The report asserts that City power (a franchise of the CoJ) is keen on reducing domestic power usage through the application and introduction of energy efficient measures and hot water chambers. Perturbations in electricity supply over the past years have been attributed to wet coal accumulation due to climate irregularity.

Unfortunately, no substantial renewable energy supply scheme is taking place in the CoJ. Notwithstanding the great potential of such existing in the CoJ, small scale experimental projects have been undertaken such as solar street lighting in Zandspruit and solar water heaters in Cosmo City (31). This report conclusively states and highlights the fact that climate change does have an impact on energy sources and electricity generation in South Africa (32).

### **2.5.1. The role of renewable energy**

The energy policy of South Africa is construed from key priority objectives, amongst which are to: increase access to affordable energy services, improve energy governance, stimulate economic growth, manage energy-related environmental and health impacts and secure supply through diversity (Wlokas, 2011: 36). Under these policy objectives and from the demand side, it is established that grid electrification falls short of meeting the needs of low-income household and as an adaptive measure, particularly the needs of women. Women are most exposed to the environmental and health impacts of energy consumption from both fuelwood and coal use. As such, basic energy requirements must take into account, gender, accessibility, cost and health factors. Only through consultation can technological innovations be introduced for household consumption (Prasad, 2007: 11). It is only through this means that energy needs for low-income households can help alleviate poverty, increased living standards and better the quality of life. This is a clarion call that obligates government to encourage the building of thermally efficient low-cost housing and create awareness on energy efficiency and conservation in households as an adaptation strategy (DME, 1998: 8-10).

DME (1998: 14) illuminates renewable energy as a catalyst for development through the provision of low cost energy services, especially when social and environmental costs are taken into consideration. In this regard the government commits to promote the sustainable manufacture and implementation of non-grid electrification schemes, such as production of home solar systems, solar cookers, solar pump water supply systems, hybrid electrification systems, wind power for, homes, schools and clinics (Wlokas &

Ellis, 2013: 2). Thus, to enable the transition to a low-carbon economy, the government commits to support research in low-smoke fuel products.

DME (2003: 12) reaffirms that by 2010, the renewable energy industry would have had a global growth rate of 15-20% due to its long-term sustainability potential. Renewable energy sources, for instance, will significantly contribute to the reductions in GHG emission and air pollutants compared to fossil fuel and coal-fired power plants. Hence, it is expected that solar water heating systems positively impact on energy demand-side management, social well-being and help mitigate fuel poverty, employment and health risks. The aforementioned will meaningfully contribute towards the achievement of sustainable development goals and concede the need for a supplementary power plant in South Africa so as to mitigate climate erraticism (DME, 2005: 1).

As the lead country on the continent in respect of its climate change and associated energy policies, renewable energy production accounts for less than 2% of electricity generation in South Africa (Odeku & Meyer, 2009: 7). An aggressive strategy has been embarked upon through the enhancement and production of not only an eco-friendly solar energy tapping but equally biodiesel and bioethanol energy productions from crops like sunflower, maize, wheat, sugar cane, canola and soya (8). This is expected to enhance environmental protection, create new jobs and shield the country from unstable oil prices. Odeku and Meyer recounts that a major innovation in this sector has been the renewable energy tariffs to help stimulate investment, render the country's climate and energy agenda more sustainable and to enable South Africa to attain its renewable energy output target of 2% in 2013. To meaningfully lower carbon-based energy generation and commence the drive towards sustainable energy, large scale projects continue to be instigated to significantly scale up the annual 10.000GWh target (Prasad, 2007: 3; Odeku & Meyer, 2009: 9). Odeku and Meyer went ahead to elucidate that energy efficiency and development of renewables are an essential adaptation move to cut the country's reliance on coal and energize the industrial sector projected to be extremely interrupted by climate variability. Specifically, converting to solar energy would ease the epileptic state of energy production experienced in the country in recent

years resulting to frequent load shedding. A key economic benefit accruing from efficiency actions has been the drastic drop in the cost of electricity bills from the individual to households and industrial levels. Energy efficiency programmes in South Africa are centered on load shedding during peak hours, introduction of energy-saving equipment such as compact fluorescent lamps, switching to natural gas for cooking and energy efficient buildings in an effort to save 3000MW in 2013 and 8000MW by 2015. The expectation is that these measures would contribute towards poverty reduction in both peripheral urban communities and rural settlements (10).

For development to become sustainable, attempts have been made to enhance the renewable energy programme of South Africa. The Renewable Energy Flagship Programme (REFP), the driving force behind any renewable energy technology in the country, is reliant on local productive capacity and local government application of renewable energy programmes, and it is deep-seated in the national climate change response strategy as a suitable mitigation and adaptation option (Republic of South Africa, 2011: 31). Foster, Lowe and Winkelman (2011:4-5) emphasize that renewable energy strategies support sustainability and climate resilient goals. Renewable energy practices would complement climate mitigation efforts by providing safety nets to the poor and curb the high electricity demand. Eco-roofs, for example, an element of green infrastructure have been initiated to further realize environmental and sustainability objectives such as carbon immersion, energy saving and water conservation. Accordingly, the promotion and manufacture of solar heater products for domestic supply needs to be strengthened to boost the productive capacity of local manufacturers. Ziuku and Meyer (2012: 35) contend that renewable energy technologies and energy efficiency projects are expected to help reduce the South Africa greenhouse gas discharge by 30% before 2030.

### **2.5.2. The case of solar water heaters**

The evolution of the solar water heating industry is framed within two time periods; 1979-1983 and 2005-2008. A great leap occurred in South Africa in 2008 during which 100.000m<sup>2</sup> of both glazed and unglazed solar collectors were installed. In 2009,

approximately 13,812,000 households were connected with solar collectors (Statistic South Africa, 2010 in Chang *et al.*, 2011: 4). Milton and Kaufman (2005: 14) referred to solar water heating systems as a climate protection strategy and argued that they are the most cost-effective way to curb oxides of nitrogen, carbon monoxide, sulfur dioxide, and CO<sub>2</sub> into the atmosphere. They further explained that because women are responsible for stocking fuel for heating, solar heaters would help reduce their workload. Another of such is health related through the prevention of waterborne bacteria that can cause diarrhea.

According to Prasad (2007: 3), the roll-out of SWHs in South Africa is for two reasons. Firstly, at a time when electricity supply cannot meet demand, decreasing peak load and reducing greenhouse gas emission is important. Secondly, SWHs have the potential to save electricity cost for households in low-income communities in the long run. Hence, the sector has experienced a steady growth in glazed collectors in recent times as leverage for a coal-driven energy economy. The use of Photovoltaic panels as a sustained solar heating system to generate electricity is anticipated to meaningfully contribute in alleviating poverty through job creation and improved welfare conditions of households most especially in low-income communities (4).

The National Solar Water Heater Conference (2009: 4) disclosed that South Africa trailed thirty years behind lead leaders in SWH installation notwithstanding its abundance of sunshine. Thus, to follow this footpath, it is imperative that the use of SWHs becomes mandatory in South Africa, the reason being that government would not be required to fund SWHs. This is the case with Israel who initiated mandatory solar installations resulting in 95% of households using SWHs. It cautioned that SWH schemes that rely on government subventions are not viable and so, funding will become a challenge as demand increases in the long-run (12). However, the conference recommended a government-led plan on solar water heating so as to fast-track the approval of renewable energy programmes for increased application in all spheres of the economy. The city of Johannesburg has rolled out a programme to fund

solar water heaters and recover expenses through a lease agreement with homeowners (13).

In the same vein, Eskom (2011:1) contends that the introduction of solar water heaters has significantly reduced the electricity demand in the domestic sector leading to a constant power supply and a drop in the quantity of energy loss through the transmission and distribution of electricity. Overall, solar water heating systems have enabled the extension of hot water to people who had never consumed it before. Against a backdrop of an energy-intensive economy, the application of SWHs is an opportunity for structural transformation. SWHs have the prospects of mitigating the impact of climatic changes and promoting employment, skills creation and have demonstrated enormous potential in limiting GHG emission levels (Chang *et al.*, 2011: 2; Wlokas, 2011: 28; Wlokas & Ellis, 2013: 4-5). Situated between latitude 22°S and 34°N, South Africa has one of the highest solar radiation rates in the world (4.5kWh/m<sup>2</sup> and 6.5Kwh/M<sup>2</sup>). The high level of insolation has allowed solar water heating to become the most cost-effective means of reaching the national targets of increased use of renewable energy sources. However, with the potential to stimulate electricity savings, Chang *et al.* (2011) questioned the sustainability of solar water heaters given the fact that they are more costly compared to old-fashioned systems of producing hot water such as liquefied petroleum gas (LPG), electricity or natural gas. Hence, the affordability aspect of SWHs needs to be taken into consideration for it to be tenable to the poor and the public at large. Ross (2010) (in Chang *et al.*: 2011: 6) notes that the repayment for South Africa's solar water heaters is projected to be over a period of four years whereas their lifespan is estimated to be twenty-five years. This shows the viability and growth of SWH in South Africa in the coming years.

Bearing in mind the fact that water heating accounts for an estimated 40% of household energy usage in South Africa amidst a high level of sunshine in the country, the use of domestic solar water heaters remains in its infancy (Ziuku & Meyer, 2012: 37). Ziuku and Meyer postulate that an estimated 10.000 units are being installed a year around municipalities in South Africa; a number which is insignificant, necessitating a massive

roll-out. However, Sebitosi and Pillay (2007 in Ijumba and Sebitosi (2010: 25) warned that the implementation of technology alone might not sufficiently translate into increased energy conservation if it is not matched by a uniformed use by consumers. Worthy of note is the fact that high capital cost and low electricity prices are the main hurdles to large scale roll-out (Prasad, 2007: 11).

Ijumba and Sebitosi (2010: 28) suggested a number of energy conservation measures to enable households move up the energy ladder centered on consumer behaviour change. These measures involve taking a cooler shower and reduction of thermostat setting to below 65°C. In so doing, less electricity would have been used to heat water and hence, increased energy conservation. The second measure is to improve the functioning of SWHs through the application of a geyser blanket to help improve energy savings as seen in Johannesburg, Durban and Cape Town (30). The final option is altering the time of bathing (31). Ijumba and Sebitosi (2010) revealed that because most solar energy is only available in the afternoon, using a substantial amount of hot water in the morning would significantly impact on energy saving as opposed to using hot water at peak periods in the evening. In the context of Johannesburg to be more precise, they claimed that energy conservation is at its peak in the month of January and July between 1pm and 3pm when hot water usage is at its minimum (31). This claim is based on the assumption that a considerable amount of solar power is only available in the early afternoon. Therefore, they proposed that in order to fully enjoy the benefits of solar water heaters, a large part of hot water consumption should be moved to the aforementioned periods of the day. Unfortunately, this is not possible due to other commitments such as work and school but they recommended that users should strive to use hot water within this period as quickly as they can, when they get home because the more they wait, the less energy preserved (32).

Furthermore, in low-income communities, solar water heaters have the potential to augment household capital and decrease vulnerability which gives meaning to the social dimension of sustainable development, thereby increasing their adaptive capacity (Wlokas, 2011: 29). Wlokas hypothesized that in terms of safeguarding natural capital,

SWHs act as a substitute for fossil fuel, thereby contributing to improved air quality and increased reforestation. Alongside is the strengthening of social capital through community mobilization and fostered social networks, culminating in total upliftment of human capital in the form of employment creation, poverty alleviation, education, health and narrow inequality gap (Wlokas, 2011: 30; Wlokas and Ellis, 2013:2). Wlokas hinted that the key determinants of households linked to optimal use of SWHs encompass local topography, location, technological advancements, the governance system, meteorological conditions and the population of the area (32). However, she went further to state hurdles linked with the use of solar waters from her study of SWH projects of Kuyasa in Cape Town and Zanemvula in Port Elizabeth. She chastised that though these projects were fully embraced by both communities, it was challenged by issues such as fire, theft and vandalism on the installations. The technical issues are mostly in the form of leakages and noise emanating from the SWH during repairs and installations. Cost was not identified as a problem as both projects were paid for by the municipalities. While seasonal variations affect the functioning of SWHs in Kuyasa, the later minimally affects SWHs in Zanemvula due to the absence of frost conditions. She noted the complete shift from the use of firewood as a source of energy as a result of the installation of SWHs in both communities (Wlokas, 2011: 33-36). To this end, Wlokas warned that only if specific SWH stressors are eliminated, there is a high tendency for households to slide back to using traditional fuel sources which rather exposes them to increased environmental hazards (31).

## **2.6. The link between climate change and sustainable development**

As a point of departure, Swart, Robinson and Stewart Cohen (2003: 19) argued that there is a strong bond between climate change and sustainable development in climate adaptation discourse. They argued that since the reduction of greenhouse gas emission is reliant on socio-economic growth trails, climate change mitigation and adaptation strategies should be framed within a broad context of know-how and socio-economic policy representation and not as a supplement to broad-based sectoral policies. Accordingly, they purported that climate policies can affect the broader sustainable development goals by: allocating direct budgets on adaptation and mitigation actions,



increasing climate change resilience, stimulating positive spill-over effects; stimulating technological innovation and, provision of subsidiary benefits such as reduction of air pollution, biodiversity conservation and employment creation. Likewise, broader development plans can affect climate change and its response thereof by ensuring diverse development paths; adopting specific environmental and socio-economic strategies that are climate-related, for example, pursuing renewable energy and nature conservation programmes; putting in place an institutional base to address existing socio-economic and ecological concerns and encouraging scientific innovation and transformation (22). In this present world, these linkages clearly reflect the underlying natural and socio-economic forces associated with climate change as depicted in the diagram below.

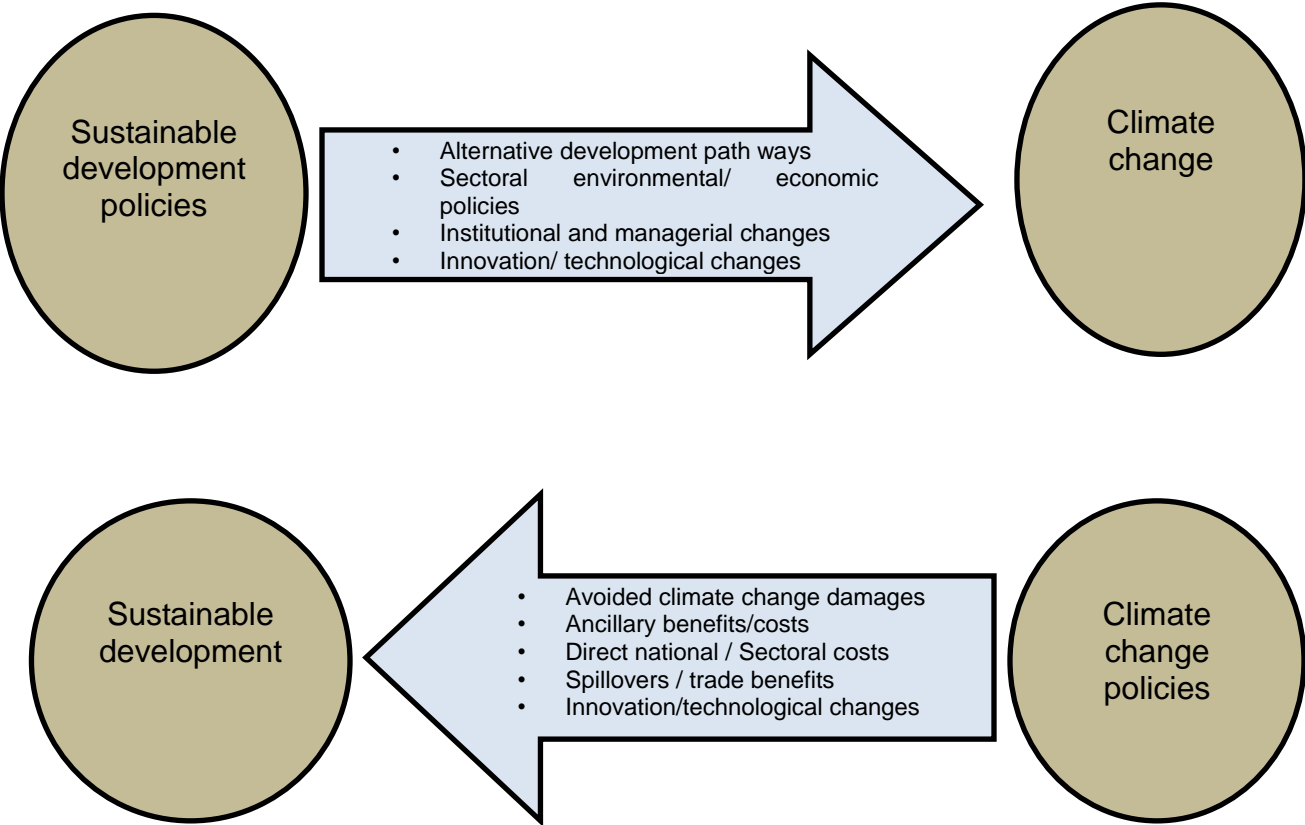


Figure 2.2: Two-way linkages between climate and sustainable development (Source: adapted from Swart et al. (2003).

Munasinghe (2003: 11) reaffirms this stance but posits that climate policies by themselves fall short of meeting current equity issues. Thus, it is vital to pursue adaptation and mitigation strategies that would narrow the disparity gap such as instituting a fair and participatory global agenda for design and execution of common policies on climate change. Whereas economic motives will be most appropriate in crafting cost-effective procedures, sustainable development is a problem-driven concept that seeks to challenge poverty in order to better the well-being and safety of the world's poor while preserving natural and environmental resources often threatened by advances in technology. Munasinghe went further to explain that though the poor and most marginalized are the least able to cope and adapt to climate risk unfortunately, seldom would you find advocates of sustainable development working at disaster-stricken areas. Such scenarios often upset development and contributes in making development untenable because people would be forced to exploit resources in an uncontrollable manner. Hence, in the face of globalization, a human dimension to climate change has been accentuated through its association with sustainable development.

Lim, Spanger-Siegried, Brton, Malone and Huq (2004: 49) corroborates that socio-economic factors can either slow down or intensify the impact of climate change and are a key determinant of communities' ability to cope with climate variation. Therefore, they pinpointed the need for stakeholders' involvement in project design, implementation, evaluation and communication of fallouts in order to mitigate threats and render development more sustainable. Stern (2006: 5, 6) warns that should it be that climate change adaptation is not sustainable, the repercussions on socio-economic prosperity and human development would be devastating. For him, modern-day greenhouse gas emissions are major obstacles to growth and because a large part of these are produced by industrialized countries, justice must prevail during international negotiations per the cost of adaptation. Hence, it is important to understand that combatting climate variability must not worsen growth and poverty reduction in developing countries.

The synergy between climate change and sustainable development is further propelled by Schipper and Pelling (2006) (in Yohe *et al.*, 2007: 835) who emphasised that climate change is a serious threat to poverty reduction efforts in emerging economies of the world partly due to their low ability to adapt to climate variations. Therefore, to render climate change adaptation as more sustainable; it requires that poverty reduction constitute an integral part of all development agendas. Likewise, adaptation measures need to be embedded in sustainable development planning alongside the mainstreaming of good governance programmes into national economic plans (AfDB, 2003 & Davidson, 2003 in Yohe *et al.*, 2007: 835).

According to Sanwal (2008: 53), a paradigm shift occurred at the Bali climate change conference of 2007. It was at this meeting that developing countries formally committed to contextualized sustainable development within mitigation strategies. It was a shift from viewing the ecological influence of CO<sub>2</sub> to questioning its relationship with energy distribution for socio-economic well-being of humanity. The forum offered a chance to identify areas and activities through which energy production can enhance environmental production and international development. Base on the model, developing countries would no longer rely on internationally approved environmental targets and emission reduction but instead on technology transfer and sharing of experiences to build capacity at national levels. Sanwal concluded that developing countries can only support the fundamental position of energy services as a public policy concern.

Mathew and Hammil (2009: 1127) identified two main goals of sustainable development embedded within climate issues: poverty alleviation and evading global ecological devastation. They warned that climatic changes would cause technological and institutional advances but would equally pose as a stumbling block in achieving sustainable development. This conflicting situation can only be solved by embracing a continuum of responses such as: the adaptation continuum which if properly implemented would lessen the susceptibility of individuals, households and communities to a wide array of climate risks. The second is to strengthen adaptive capacity for

effective response to climate threats and, the third to increase the capacity to cope with climate perils. This can be done through the absorption of climate knowledge and climate data during planning and decision-making processes. The last but not least is to comprehensively address the impact of climate change. In other words, for climate science to strike a balance between economic growth, fairness and environmental protection, sustainable development needs to become climate-sensitive. Key concerns to start off with are water and energy, the epicenter at which everything occurs. Above all, in the absence of joint efforts to incorporate climate change into sustainable development, the effects of climate erraticism will frustrate efforts towards attaining development that is viable.

The United Nations Department of Economic and Social Affairs -UNDESA (2009: 3) cautions that prospects of sustainable development are challenged by three dimensional perils of climate change. The first dimension is climate change itself and its impact on human development, prosperity and health. Climate change will retard progress towards meeting MDGs 1, 6 and 7. The second relates to the spillover effects of climate-related policies in developed economies which may negatively upset commodity prices, financial flows and growth in developing countries. The last dimension refers to the repercussion of the adaptation and mitigation strategies implemented by developing countries. Development can only be sustainable if developing countries adopt strategies in both areas. Within the broad context of sustainable development, UNDESA recounts that climate change is undeniably a challenging issue. Incentives should be made available to support projects and activities that pursue sustained pathways. Hence, a move away from a more energy-intensive economy seeking to reinforce adaptive capacity is fundamental. UNDESA reports that economic advancements are predominantly characterized by a general increase in the demand of natural and energy resources. Therefore, a re-orientation in infrastructural investment, capacity building and institutional development framed from a climate suitable angle will render current development trajectories more justifiable. The availability of energy supply in the long run is a significant component in sustainable development (9).

Glemarec (2010:3) articulates that over the past years, there has been a paradigm shift from outdated power supply channels to a more energy supply sources to a more viable eco-friendly approach; an attempt to discourage the use of fossil-fuel-driven technologies, thereby rendering the use of clean energy technologies less costly and affordable. In the same vein, a rapid transition to a low-carbon economy is what Africa and South Africa require for sustainable development (Tadesse, 2010: 7; Jotoafrika, 2011: 8). Tadesse elucidated that in the face of climate change, development can only be sustained by making people resilient and implementing suitable adaptive strategies. For example, climate change will magnify poverty except the poor are aided in adapting robust livelihoods mechanisms through projects that target issues such as: disaster risk management, empowerment of women and the marginalized in an all-inclusive and participatory adaptation programme (10).

Yanda and Bronkhorst (2011:4) posited that the association between climate change and sustainable development necessitates local community adaptation projects. Community-sensitive adaptation strategies should be at the frontline of current and future approaches to sustainable development and environmental management. Survival strategies have to be protected and not exposed to outside competition; the equitable management of natural resources and the introduction of new and alternative ways for people to make a living would make development tenable. Local knowledge has to be recognized in order to augment the sustainability of climate change adaptation plans. Foster *et al.* (2011:31) supplement this standpoint and argue that green infrastructure is a synchronized approach towards achieving sustainable development, smart growth and climate adaptation strategies in urban surroundings. The intersection of these three enhances human capacity to adapt to natural and human induced climatic stressors.

IPCC (2012:20) highlighted that challenging fundamental causes of susceptibility, social inequalities and sustained poverty is a precondition for sustainability. It reported that community resilience is low where vulnerability is high as such, adaptation strategies should be embedded into all socio-economic and environmental policies and

programmes. The most appropriate adaptation intervention therefore, would be those that offer near-term development benefits to the population. Here, the link between climate change mitigation and adaptation impact on sustainable development is emphasized. Adaptation to climate change should be comprehensive in addressing not only the risk aspect but equally environmental and human factors that cause stress associated with climate change so as to enhance and support sustainability in socio-economic development programs (37).

In South Africa, climate change mitigation requires projects that are community-based, less costly and sustainable (DEAT, 2004 in Odeku & Meyer, 2009:7). To complement this, adaptation strategies necessitate the formulation and application of low greenhouse emitting technologies, localization of production and the setting of sustainable development targets for growth from a less energy intensive economy. Pursuant to these strategies, the NCCRS, issued on the eve of COP 17 in Durban, reiterates and underscores that climate change and sustainable development are framed within two key principles of greenhouse gas mitigation measures and long-term mitigation scenarios (LTMS) for South Africa (Republic of South Africa, 2011: 40-41). Against this backdrop, the CoJ acknowledges the vulnerability of its residents to climate change and thus contends that poverty alleviation measures such as those involving the resettlement of inhabitants situated within swamplands, housing schemes, the creation of job opportunities, and improved access to education and health care facilities are poignant steps aimed at bringing about sustainable development (City of Johannesburg, 2009: 34).

However, Yohe *et al.* (2007:813) in the fourth assessment report (AR4), argue that strategies to adapt to the impact of climate change and actions to stimulate sustainable development share common characteristics, comprising information and know-how, fairness in the allocation of resources and access to physical, human and social capital. Notwithstanding these connections, limited negotiations about supporting sustainability have so far remotely incorporated adaptation to climate sways. Madzwamuse (2010: 6) remarked that South Africa's past history of social exclusion and marginalization of the

vast majority of the population remains an on-going challenge to sustainable development strategies responsive to climate adaptation. Social systems that would have formed a solid base for appropriate sustainable development strategies have been destabilized. Hence, social-economic inclusion and transformation should be key components in any sustainable development policy framework.

### **2.6.1. The concept of sustainable development**

Estes (1993:1-2) describes sustainable development as a theory that has thrived in fusing conflicting philosophical and theoretical viewpoints into a single conceptual outline. With reference to development paradigms of 1980s (structural adjustment programmes and the World Bank/IMF conditioned loan policies) that failed to end the cycle of poverty in the world's poorest and developing economies but rather plunged already impoverished countries into deeper debt, the need for a new development focus became glaring. To be more precise, the shattering effect of these development paradigms on the environment necessitated a shift to a new development agenda. This led to the appearance of sustainable development with a renewed commitment on the environment. He articulates that sustainable development was propagated as a unifying theory. A theory that would:

*“provide a new vision for national and international development; ease the unbearable pressures on the earth’s fragile ecosystems in rich and poor countries; lead to the formulation of new solutions to recurrent socio-economic needs of the world’s least developing countries; and provide greater assurance that contemporary approaches to development would not deprive future generations of the resources needed for their development.”*

Sustainable development is not time bound but is an incessant and on-going process of transformation and adaptation and specifically dwells on the relationship of the poor, particularly poor women, in the course of development. This aspect constitutes core elements that portray the unifying power of sustainable development (Arnold, 1989 & Lindner, 1989 in Estes, 1993: 3).

Over the past decades, the meaning of sustainable development have been informed by that spelt out in the landmark report of the World Commission on Environment and Development (WCED) in 1987 (also known as the Brundtland Commission) titled *Our Common Future: From One Earth to One World*, which defines sustainable development as: “development which meets the needs of the present without compromising the ability of future generations to meet their own needs” (Drexhage & Murphy, 2010: 6). The popularity of this definition attracted a lot of criticism from non-state actors, researchers and development analyst. Drexhage and Murphy (2010) lambasted the fact that its endorsement by the UN General Assembly offered the concept political silence. This definition is all-inclusive and mirrors issues link to the impact of development on the current generation but also safeguards future generation accessibility to resources that would enable them to thrive sustainably. It is worth mentioning that South Africa acknowledges the definition provided by the Brundtland Commission.

In the context of this research, the theoretical framework of sustainable development would be examined from three dimensional standpoints as assumed by Bindra and Hokoma (2009: 716) who identified three autonomous but mutually connected pillars of sustainable development as social, economic and environmental. Embedded within socio-economic explanations, sustainability is an elusive concept that not only paraded the corridors and dominated discussions of the Rio 2012 conference, but led to the adoption of sustainable development goals that would guide the post 2015 development trajectories. Its near global acceptability can be attributed to its flexible and fluid nature that allows stakeholders and nations states to adapt and domesticate the concept. It can very well be said that sustainable development is the point of convergence for meeting the MDGs and economic development from a human development perspectives amid challenging environmental threats (SDSN, 2012:1). Over and above, though current development pathways have created decent jobs, they have profoundly widened the inequality gaps inherent in most societies of the world today (2). In this respect, the world is in dire need of a development framework that is well-suited within social and environmental goals



SDSN (2012) went further to explain that the socio-economic dimension of sustainable development is built on the assumption that most developing countries are challenged with huge growth problems such as poverty, poor infrastructural development, conflict, food insecurity, inadequate health care facilities, education and population explosion; created by fiscal and development policies that have rather worsen the socio-economic condition of the world's poorest and economically disadvantaged (3). A case in point is globalization, which has led to increased social exclusion and inequality that caused those with low educational attainment to remain in low-paying jobs. The consequence of this has been a high rate of redundancy which comes with the multiplier effects of human right abuses, violence against women and children (Bindra & Hokoma, 2009: 717). On the basis of the aforementioned assumptions, SDSN (2012: 4) avers that only when the natural resource base of these fragile nations is fully harnessed and transformed to benefit the poorest of the poor can the socio-economic motives of development be considered sustainable. Accordingly they advanced key policy transformative instruments that if strategically implemented would benefit not only underprivileged members of our society but bring about development that is just and greater social justice for all. These measures include fighting corruption, education and training for the poor, women empowerment and the legislation of affirmative action. These it is hoped will close the inequality gap and open equal opportunities for all, hence render development more viable.

The inclusion of environmental protection into what comprises sustainable development has been applauded as a firm and appropriate way of safeguarding sustainable human welfare from ecological depletion and pollution (Bindra & Hokoma, 2009: 717). On the same line of thought, SDSN (2012: 6) remarked that an eco-friendly development pathway could be pursued through the application of a green economy. Sustainable development should offer alternative sources of livelihood that prevent the depletion of natural resources. SDSN further explained that the concept of environmental governance has of late equally dominated discourses on sustainable development. Consequently, national and local governments must enact policies that would align sustainable development goals with good governance principles such as transparency

and accountability to get buy-in from all key stakeholders for development to be tenable and mitigate climate threats.

The CoJ in its 2040 Growth and Development Strategy (GDS), outlines its intention in the face of increasing inequality, migration, climate change, scarce natural resources, globalization and technological advancement as a means of creating a sustainable, resilient and adaptive metropolis for all and sundry (City of Johannesburg, 2011:6-8). The expectation is to offer sustainable, smart, liveable, and resilient urban settings supported by infrastructural development aimed at transitioning to a low-carbon economy and establish a highly effective cosmopolitan government that is keen on building a broad social, interconnected and internationally viable municipality (9). This strategy is informed by South Africa's national climate change response paper (The Green Paper), and the National Framework for Sustainable Development (NFSD) connects economic growth, human and social development with energy security and sustainability, the enforcement of which lies on regional governments. However, the document regrets the fact that though the needed technology to exploit other energy sources is readily available, the regulative and legislative environment is not supportive to the course (18-21). Accordingly, in order to transform a municipality into a liveable, resilient and sustainable environment, it has to change the way energy is produced and consumed through shared responsibility from its inhabitants, government and businesses. This will enable the municipality to save energy and together manage scarce natural resources (28). Meanwhile, the key priority sustainable development strategy of the country as stated in the NFSD includes: encouraging integrated planning; ecological protection through natural resource conservation, transition into a green economy, building sustainable communities and responding effective to climate change (Republic of South Africa, 2011:15).

### **2.6.2. The Analytical Framework for sustainable development**

According to Bannister (2002: 7) the sustainable urban livelihood approach (SULA), is used as a tool to establish the relationship between energy and poverty in the lives of urban poor communities. Bannister argued that livelihood approaches which people

embrace will lead to their lives becoming more protected or more exposed, and would determine the ability of households to cope with stress and shocks resulting from the environment. Framed within the context of people's access to human, social, financial and physical capital, Bannister posited that in an urban milieu, some of these strategies comprise engaging in income-generating activities, urban agriculture and the use of firewood for heating and cooking (UNDP, 2013: 31). This framework was applied to the Moshie Zongo community in Ghana six to eight months after huge price hikes in electricity and fuel in the country.

Bindra and Hokoma (2009: 716-718) reaffirmed this position and contended that energy plays a key role in realizing sustainable livelihood coping mechanisms in developing countries in the face of increasing demand for energy. It is therefore urgent that governments strive to secure efficient energy supply sources in order to curb environmental and social impacts on the most vulnerable, particularly women, who are the hardest hit by insufficient energy sources. Knutsson (2006: 9) and ECA (2009: 64) complement this stance by referring to the SULA as a policy-driven tool for an integrative knowledge assessment of strategies, programmes and projects linked to local needs and livelihoods and capable of assisting policy makers to scrutinize and appreciate intricacies of the development process. Hence, ongoing structural transformation and economic growth can only be supported by rapid technological progress in the energy sector as a means of uplifting socio-economic and environmental well-being in the context of climate adaptation (Walker & Salt, 2006: 32).

The World Bank (2009: 4) contends that the gains of building resilience into current development paradigms would far surpass the cost of rehabilitation, emergency relief and recovering from dangerous climatic changes in Africa. However; the report regrets the fact that current mitigation strategies are not well adjusted to the needs of Africa. For example, Africa has the highest level of untapped hydropower resources in the world but lacks the ability to harness it. Therefore, the international community should put in place policies that would allow Africa to fully exploit their hydropower resources to enable people become resilient to climate threats.

All in all, Wilbanks and Kates (2010: 723) caution that at the community level, resilience is entrenched in related social, economic and environmental structures distinct to a specific area. Consequently, community resilience must strengthen the community's ability to anticipate, respond to, prepare for and recuperate from multilayered environmental stressors (Tyler & Moench, 2012: 312). It should address issues of health and local safety while recognizing that communities are not self-sufficient but linked to other communities, nations, regions and the world. In all, community resilience should be an on-going process that would enable people to adapt to changing climatic conditions (Pisano, 2012: 12-13).

## **2.7. Summary**

The continent of Africa remains the most vulnerable to climate change impact. In a continent where only a small percentage of its population has access to power-driven services, large amounts of its renewable energy sources still remain unexploited. The way that climate change is linked to sustainable development and livelihood necessitates community-based adaptation projects. Sustainable development remains at the heart of current and future climate adaptation projects in the field of environmental management and development. The Kyoto protocol was the pacesetter for sustainable development strategies to revoke the anthropogenic causes of climate change. The negative impact of climate change will retard economic growth and sustainable development if appropriate institutional and infrastructural capacities are not enhanced. Climate-resilient development is the way forward for South Africa to meet its emission reduction target, MDG seven and forge ahead with its post 2015 development tenets. This chapter has provided a snapshot of current scientific works and new investigations on sustainable development paradigms associated with global climatic changes. It is a rigorous effort to summarize a range of issues focusing on sustainable urban livelihood approaches, national response strategies, drivers of climate change in the context of South Africa within the global world debate. The ensuing chapter presents the methodological layout of this treatise.

## CHAPTER 3

### RESEARCH METHODOLOGY

*“Let us stand together to make our world a sustainable source for our future as humanity on this planet” (Nelson Mandela, 2004)*

#### **3.1. Introduction**

In this chapter, the research methodology utilized in the study is outlined. The methodology provides multifaceted explanations of phenomena within the themes of the study. These include the research approach, design, data collection and analysis. It is vital to note that the research approach for this project is qualitative. Literature reviewed helped to keep the investigator alert with the topic and to highlight existing knowledge on the subject. Research design strove to outline the research plan which assisted the researcher to attain the planned objectives. Methods of data collection and analysis are also delineated to stipulate how data was obtained and, analysed, as well as packaged into a treatise.

#### **3.2. Research questions**

For this treatise, Cosmo City, an urban peripheral and low-income community under the CoJ, was the main unit of analysis. Hence, the following questions were addressed in this study:

- What is the impact of SWHs on sustainable development?
- How do SWHs help in building livelihood resilience to climate change in Cosmo City?
- What are the existing sustainable development strategies put in place by the CoJ to enhance climate change resilience within the municipality?
- What challenges are associated with the effectiveness of SWHs on sustainable development?
- What suggestions can be advanced to ensure that SWHs are effective in reducing GHGs in order for boost sustainable development?

### **3.3. Research Paradigm**

This research project as a pragmatic as it is, was entrenched, but not limited on two philosophies; the constructive research paradigm and a relativist ontological interpretation of reality used in qualitative studies. This opinion will offer a space for diverse phenomenon based on scientific knowledge (Yin, 1989). As revealed in the review of literature, Odeku and Meyer (2009 and 2010) used this paradigm to establish facts on climate change mitigation and adaptation strategies in South Africa; Sanwal (2008) employed this approach to cross examined the sustainable development perspective of climate change; Chang *et al* (2011) in their study on the dissemination of solar water heaters in South Africa and; Walker and Salt (2006) through this approach linked resilience thinking within sustaining ecosystems. Hence, the researcher emulated this approach to unravel the impact of mitigation and adaptation strategies on sustainable development. Similarly, it is vital to point that factual knowledge will be used to authenticate concepts used in the study. Hence, the researcher on an interactive basis with the subjects under investigated was able to take this further by putting it into a specific context, renewable energy (in this case SWHs).

As mentioned above, the research paradigm embedded in the research methodology is the interpretivist paradigm. With respect to this research, various methods will be deployed to establish different views of the phenomenon investigated, in this case SWHs and sustainable development. A sample of 30 respondents was investigated in-depth over a period of two months to explore complexities surrounding the issues under study. The researcher sought to comprehend meanings individuals give to these phenomena through analysis of relevant texts, face-to-face interviews and observation of participants within their natural setting and geographical context. Description of impact was done from the point of view of participants as validated through their words, images and phrases. For this study, the science of climate change is driven by human interest and actions (that is, socially constructed). Factual knowledge from respondents will be used to authenticate concepts used in the study. Sustainable development is here considered as a practical and moral solution to climate change threats. Therefore,

the investigator will look at the totality of human action and focus on meanings that translate into impact. The interpretivist model helped the investigator answer the research questions stated above. Hence, the description of occurrences and interpretation of responses that emanated from respondents enabled the researcher to comprehensively answer the central research question of how SWHs impact on sustainable development.

### **3.4. Research Approach**

The overall research approach is qualitative in that data was obtained through structured interviews and open-ended questionnaires. My research is basically an interpretive account of how SWHs impact on sustainable development through narrative explanations of phenomena under study (SWHs and sustainable development). More so, what makes this research qualitative is that interviews were exploratory to enable an in-depth explanation of issues raised regarding their experiences, feelings and what people think about SWHs. The investigator equally undertook document analysis (legislations, academic journals and policy manuals) to contextualised the study and relate knowledge already articulated by others in the area of study. In addition, data was qualitatively organised by ways of coding, categorising, comparison with literature reviewed and inferred through thematic analysis and an interpretive table. Over and above, this research relied heavily on inductive reasoning to interpret and give meaning to words, ideas and phrases as used by respondents in the course of the investigation. Therefore, the investigation commenced by means of onsite observation (in Cosmo City), identification of key informants and a literature search to see how SWHs influences sustainable development. The explorations of these patterns progressive culminated in theory building by way of explanation.

The case study method enabled the researcher to investigate the community in-depth and interact with community members on a one-to-one basis. Wlokas (2011) used this approach to examine the contribution of SWHs towards the alleviation of energy poverty in South Africa, particularly in the low income communities of Kuyasa and Zanemvula as corroborated in the literature reviewed. The approached was deemed appropriate

here in that it allowed the researcher to hunt information and provide clarifications on issues discussed which enabled the extraction of relevant data from respondents in Cosmo City and the CoJ. Worthy of note is the fact that the investigator deliberately used different data sources not only to confirm the findings but equally to get a comprehensive knowledge of the investigation as suggested by Creswell (2003: 3). This option gave credibility to the Cosmo City case study in that validated and established data was sourced from primary sources (structured interviews and open-ended questionnaires) with confidentiality respected.

The case study approach equally allowed the researcher to observe issues investigated so as to comprehend what exist beyond that which was reported by respondents (Burns and Grove, 1997: 249). This enabled the researcher to pinpoint and assessed some of the effects of solar water heaters on sustainable development. The consequence of which were the proposed recommendations to hurdles identified in order to avoid them in the future.

All in all, in order to avoid generalization of finding for this study, the investigator narrowed this scholarship to Cosmo City and probed on climate change adaptation and mitigation strategies employed by the CoJ. This again assisted the investigator to scrutinize resilience strategies adopted by residents of Cosmo City and got more insight into the reason behind the ineffectiveness of SWHs on sustainable development in order to better this adaptation tool. Therefore, the case study method was the most realistic way to achieve the objectives of this study.

### **3.5. Data collection tools**

The tools used here provided the researcher with qualitative information on the subject under investigation. Data collection was collected over a two-month period. Data collection in Cosmo City, the main focus area of the study and the site where the sustainability impacts were established, lasted for six weeks. While that with the CoJ would last for two weeks to provide a deeper insight on sustainable development strategies rolled out by the municipality. A literature study of available texts in the field of sustainable development and climate change was sourced from academic journals,



protocols, government gazette, conference proceedings and other publications and used as secondary sources to obtain information SWHs, sustainable development and climate change. The case study method was explored to collect data in a methodical way. The tools below were used to gather data:

- **Structured Interviews**

An interview guide comprising both structured and semi-structured questions was designed to direct this process. Face-to-face interviews were conducted with residents of Cosmo City and assisted the investigator to probe and adjust the research tool to accommodate responses from informants. The researcher made use of a research diary notebook to fully capture all information provided. Fetterman (1989 in Neuman, 1997: 361) acknowledges the usefulness of taking notes by stating that most of the research data is in the form of notes. It is said that good notes form the bricks and mortar of field research. The use of recorders or cameras was not appreciated by the respondents as they viewed them with much suspicion. The researcher was accompanied by someone who acted as an interpreter in instances where the respondent could not express his or herself in English. It is important to note that interviews are adaptive, and allow data collection on a range of possible subjects, source-rich data, and allow the researcher to build a rapport with the respondents. Data collected from interviews formed core parts of primary data for the investigation, especially when it came to assessing the impact of solar water heaters on sustainable development.

- **Open-ended Questionnaires**

Both structured interviews and open-ended questionnaires constituted primary instruments of data collection for this research. Questionnaires were formulated out of the literature reviewed and linked to the research question. The questionnaire was designed to complement the interviews and was electronically mailed to councilors who gave a policy perspective on the investigation. Maponya and Mpandeli (2012) used questionnaires to investigate impacts and adaptation options related to climate change and agricultural production in South Africa. Preceding this process, the researcher had

a face-to-face discussion with a municipal official who gave some background information on the climate change situation of the CoJ and its response mechanisms.

The researcher equally used triangulation in that interviews and questionnaires were deployed and the Likert scale caricatured to assess some of the responses that emanated from respondents on a particular subject. For example, there were instances where the researcher had to make follow-up questions and interviews with the respondents as well as engage in deeper discussions on some of the issues raised by respondents. The researcher however, ensured that only data relevant to the research was sourced, analysed and presented

- **Secondary sources (documentary)**

Secondary data was obtained through the review of relevant literature. As earlier indicated in the review of literature, studies on sustainable development and climate change abound. Information sourced through literature review complemented the data gathered through primary sources and assisted the researcher in the writing of the treatise. Literature reviewed was meant to contextualize the topic, as well as assist the investigator to comprehend the topic by exploring studies hitherto carried out by other researchers. The literature was also exploited to establish a conceptual base of the subject under investigation, as well as position it within existing theories. Most of the related literatures were acquired from the internet, library and the municipality of Johannesburg.

### **3.5.1. The population and the sample**

A total of 30 respondents were sampled and investigated however, only 27 knowledgeable individuals were selected for data quality and analytic purposes. Respondents for the research were purposefully selected so as to generate useful data for the investigation in line with the objectives of the study. The population sampled consisted of 25 residents of Cosmo City using solar water heaters and two municipal managers directly responsible for this project and informed on the subject matter.

### **3.6. Data Analysis**

Data gathered through primary and secondary sources is organized according to themes and then analysed. The research design precisely the literature reviewed already made it realistic for the researcher to sort the data in accordance with the themes and questions responded to. The data analysis for this study was grounded on the sustainable urban livelihood analytical framework used by Knutsson (2006) and Wlokas (2011) in their investigation as elaborated in the review of literature. Leedy and Ormrod (2006: 77) positions that the investigator should assemble ideas which they identify with during their literature review. The data was scrutinized in a systematic way. The explanations were built on experiences. The researcher mimicked the Likert scale used to evaluate responses in statistical analysis to code and score some of the responses related to awareness level on climate change and to limit time spent with each respondent as showed in Chapter 4.

### **3.7. Validity and reliability**

In this research, triangulation was used in that the researcher deployed multiple methods of data collection and data analysis in line with the research design. A maximum sample population of 25 was covered to give credibility to the study and it included the main group of interest needed for this study. The fact that most respondents were part of this project when it was initiated was a plus for the credibility of findings presented here. Also, two municipal officials who not only are the direct service provider but equally climate change expert with enormous experience on the subject under investigations made the findings credible and trustworthy. Evidence was validated as knowledge through the following ways:

*Descriptive validity:* an honest account of information sourced from respondents in Cosmo City was reported by the researcher in words and quotes.

*Interpretive Validity:* interpretive validity was ensured through a comprehensive integration of respondents' experiences, opinions and thoughts by means of direct quotes, phrases and expressions as understood by the investigator.

*Theoretical validity:* the theoretical explanations developed on this study were used to determine if it matches with the data collected from respondents in Cosmo City. This gave credibility and validated findings as knowledge.

*Triangulation:* In this research, triangulation was used in that the researcher deployed multiple methods of data collection (theories, frameworks, interviews, review of literary texts, policy documents and legislations) and data analysis (coding and thematic analysis) in line with the research design. A maximum sample population of 30 was targeted. This gave credibility to the study as it included the main group of interest needed for this study. The fact that most respondents were part of this project when it was initiated was a plus for the credibility of findings to be presented. Also, information was obtained from a municipal official who not only are the direct service provider but equally climate change expert made the findings trustworthy. This helped to eliminate the researcher's own bias.

### **3.8. Ethical considerations**

This study was conducted following the research codes of the Nelson Mandela Metropolitan University; the investigator consent agreement was stated on the questionnaire and interview guide. However, respondents in Cosmo city did not sign the consent form but gave verbal approval before the interviews began. The researcher explained to the respondents their freedom to withdraw from the interview process at any time if they felt uncomfortable. The consent note clearly stated the purpose, methods, anticipated benefits, and potential risks of the study and was endorsed by respondents before and throughout the data collection phase. On the whole, the nature of the investigation was explained to respondents at the start of the enquiry. It was made known to respondents that their involvement in the investigation was voluntary. In sum, confidentiality was respected and their identity anonymously reported.

### **3.9. Limitations of the study**

- **The Research is based on the study of the impact SWHs have on sustainable development in Cosmo City; therefore its findings cannot be generalized.**

It is important to state here that, though the study undertook the review of relevant literature to provide a background to the research topic and detect best practices, it might not be generalized that their experiences also apply to the entire Johannesburg metropolitan area. This implies that the achievements and learning documented in other communities in South Africa should not be generalized to be those of Cosmo City. Nevertheless, it is worth mentioning that there were similarities and differences perceived. Thus, this helped the researcher to draw inferences and make recommendations on the subject investigated.

- **Resource constraints**

As an academic project, the study was completed within months of its initiation. A research project of this nature would require an enormous amount of resources such as time, funding and labour. Consequently, this investigation was not as far-reaching as in an ideal research project because of limited resources and its nature as an academic project finalized within months of commencement. Nonetheless, all attempts were made to contact all relevant respondents and sourced data relevant to respond to questions modelled in this research project.

- **Bias**

The researcher is a student and a foreign national not situated in the community used as a case study for this research. The investigator neither speaks nor understands any of the local South African languages. She relied in some instances on an interpreter. Against this backdrop, the data process was unconsciously open to some form of bias. Nevertheless, it is worth mentioning that the researcher undertakes this project as an autonomous researcher. However, the researcher ensured that she conforms to scientific methods of investigation.

### **3.10. Summary**

This study had as its purpose to assess the impact of solar water heaters on sustainable development. In this regard, the researcher attempted to develop an understanding of the aspects that either restrain or encourage the use of the solar water heater as a means to achieve sustainable development in Cosmo City. To do this, the

investigation was conducted from a case study perspective using the qualitative research process. The research methodology outlined above will facilitate the collection of data for the realisation of this study. The subsequent chapter will present the research findings.

## CHAPTER 4

### FINDINGS AND DISCUSSION

*“The strategist who is unconcerned by sustainability is akin to an architect who cares not whether their building stands or falls” (James Mackenzie, 2010).*

#### **4.1. Introduction**

This chapter sets out the main findings gathered in Cosmo City and the discussions thereof, in particular, the findings on the impact of solar water heaters on sustainable development. In this age of technological revolution, it is now commonly acknowledged that for a developing economy like South Africa an alternative to coal as an energy supply source is needed. To some degree, solar water heaters are considered as an appropriate option to bringing development that is sustainable. Solar water heaters are a growing and viable competition to convention energy generation sources that are highly pollutant in nature, coupled with enormous operating and maintenance costs involved. In fact, solar water heaters represent a suitable option for coal-driven economies. It is a cost-effective mechanism capable of providing sustainable and affordable energy to local consumers in developing countries.

Data was sourced from Cosmo City and CoJ in which expert opinions were explored to address policy issues on the study. The selection of respondents in Cosmo City cut across a social spectrum so as to contain bias. Respondents included community residents using solar water heaters. Information was gathered with open-ended questions to allow the discussions to delve into unexpected but relevant issues with anonymity safeguarded. A total number of twenty-seven respondents provided information for this investigation.

Information was gathered through face-to-face interviews with the help of a structured interview guide designed in the form of a questionnaire (see Appendix 2). The interview guide was organised into six main sections. A total sample of 30 respondents participated in the interview process and 27 knowledgeable responses selected for analysis and interpretation. The first part was allied to the biographical data of the informants and, for confidentiality purposes, this information is anonymously disclosed.

The second responded to climate change awareness and perception; the third part dealt with sustainability assessment; the fourth delved into policy issues; the fifth examined challenges and the last section proposed a statement to incite discussion with municipal officials.

This chapter is divided into two sections. The first section encapsulates an examination of the data sourced. The second part of the investigation will present the discussions of the findings and their linkage to the literature reviewed. The ensuing outline situates the findings within context.

#### 4.2. Climate change awareness

In order to set the ball rolling on the subject of investigation, the researcher probed the respondents' level of climate change awareness. The rating of responses were from 1 to 5 where 1 denotes "least awareness" and 5 denotes "highest awareness" is an attempt to accommodate varied understandings on the subject matter as expressed by respondents and shown on Table 4.1 below.

Concept	Respondents	Levels of awareness	Highest level of awareness
Climate change	1	3	5
	2	2	5
	3	5	5
	4	3	5
	5	4	5
	6	3	5
	7	3	5
	8	2	5
	9	4	5
	10	3	5
	11	2	5
	12	2	5
	13	2	5



	14	4	5
	15	5	5
	16	3	5
	17	4	5
	18	2	5
	19	3	5
	20	4	5
	21	3	5
	22	4	5
	23	5	5
	24	4	5
	25	3	5
	26	5	5
	27	4	5

Table 4.1. Respondents’ level of awareness on climate change

Table 4.1 depicts the respondents’ awareness level about climate change on a scale of 5 which gives a calculated mean of 3.3, indicating that respondents have a certain level of knowledge of the concept of climate change that underpins this investigation in Cosmo City. In their own words and activities, most respondents demonstrated unconsciously a sound knowledge of climate change. To be precise, 4 respondents had expert knowledge on the subject and only 6 respondents (respondents 2, 8, 11, 12, 13, 18) swung below average but gave a meaningful contribution to this investigation as will be revealed later. The total awareness level (3.3) on climate change demonstrated by respondents confirmed that climate change is a threat as they expressed warnings that much needs to be done to mitigate such threats, otherwise sustainability will be elusive.

**4.2.1. An overview of climate susceptibility in Cosmo city**

**Do you think climate change is a threat in Cosmo City?**

Most respondents(n=21) unanimously agreed that climate change is a threat in Cosmo City because temperatures are becoming increasingly hot in summer and during winter

it is extremely cold. They even stated the worst case scenario to be flooding wherein parts of Cosmo City are inundated when rain falls continuously over a long period of time. Another reported that *“the installation of these solar geysers in Cosmo City is as a result of climate change to reduce pollution into the atmosphere.”* Municipal officials (n=2) settled that *“recently, the CoJ has encountered not so common climatic conditions, such as the recent snow in 2012. Severe climatic changes, which result in floods, heat wave, hail or thunderstorms, affect the lives of the majority of people residing in informal settlements.”*

**As an individual do you think you have the responsibility to save energy for future use?**

All respondents acknowledged the fact that they do have the responsibility to save energy for future use but emphasised that electricity consumption from households constitutes just a small proportion. *“If the government is serious about saving energy, then it should look at businesses and industries in Johannesburg because they are the ones using a lot of electricity. You cannot compare the amount of electricity Shoprite uses per day to that consumed by households per week or month. Even though I am using a solar heater, I still switch off before going to bed. This is my own little way of contributing to saving electricity for future use,”* noted one respondent.

In another measure, respondents (n=24) stated that they use energy saving devices and bulbs to save energy, such as compact fluorescent light bulbs, switching off lights during the day and in unused rooms, washing clothes with cold water, regulating the fridge to reduce ice build-up, open windows to bring in cool air instead of fans during summer, and the planting of trees and vegetable gardening. One curious respondent snapped, *“We do a lot to save energy in the future; we use small appliances like irons, normal fridges, kettles, et cetera. But, people in Joburg use deep freezers, dishwashers, computers, sophisticated electronics and appliances that consume more electricity.”* However, one respondent pointed out that she can only save energy during summer.

**Is there any community-based environmental protection initiative in Cosmo City?**

Respondents (n=26) freely attested that there are no community-based environmental protection initiatives in Cosmo City. However, one respondent highlighted that *“during community meetings, we are always reminded of the need to plant trees so as to protect the environment and make our community beautiful.”* It is however done on an individual basis, not as a community-based activity. This view was supported by the municipal authority who reiterated that *“Cosmo city forms a small fraction of COJ, but the City has its own climate change strategies.”*

### **4.3. Sustainability impact**

#### **What development challenges do you think affect Cosmo City?**

Respondents (n=26) enumerated a host of issues infringing on development and growth in Cosmo City. They include high crime rate, theft, vandalism, corruption, unemployment, poverty, increasing population density, disease and above all the absence of a police station and public health care facility in Cosmo City. Added to this, the municipal councillor revealed that *“Cosmo City consists of mixed development, RDP for people who have been moved from nearby informal settlements. The biggest challenge is that large numbers of households are not working. This has resulted in them renting their houses and returning to the informal settlement where they don’t have to pay rent.”*

At the level of the municipality, it was exposed that *“the CoJ is the major contributor to the South African economy with lots of business activities. This has resulted in migration of a large number of the population in and around South Africa to the City looking for job opportunities and places to reside. The high population number resulted in demand in energy usages which is the main contributor to GHG emission. Any reduction of greenhouse gases, regardless of the amount, is important, if CoJ is to reach its target for the low carbon city.”*

#### **What sort of energy do you use for cooking and heating?**

Nearly all (97%) of respondents (n=26) used electricity for cooking and heating. 21 respondents use electric kettles and 5 respondents boil water on the stove. 17

respondents owned two-plate stove, while 9 respondents use the four-place cooker. Respondents could not state whether people have stopped using firewood and paraffin for heating and cooking. One respondent indicated, *“I cannot exactly claim that people here are no more using firewood or paraffin for heating and cooking because many people in Cosmo City do not even have a regular source of income; they depend on government grants.”*

**In your opinion, do you think solar water heaters have an impact on the development of Cosmo City?**

At the individual level, respondents (n=19) acknowledged that SWHs have impacted on their development in that they are able to bath and wash dishes with warm water more often, compared to when they lived in Riverbend and Zevenfontein. One female respondent reported that, *“SWH has relieved me of the stress of getting up early in the morning to boil water for my husband and kids.”* With regard to the development of Cosmo City, respondents established that the conception of Cosmo City in itself is a great development initiative. They confirmed that the SWH project was a package given to them by the municipality who paid for the heaters and their installation, and the compact fluorescent bulbs. *“We have a community centre, with a library, parks, commercial and retail sites, and industrial park; schools were built, roads constructed and people were employed,”* one respondent replied. Respondents (n=5) identified that most owners of tuck shops, saloons and other petit business use SWH because they are both energy-efficient and cost-effective. This has encouraged a lot of small businesses in and around various neighbourhoods in Cosmo City and also attracted foreigners (predominantly Pakistanis and Somalians) to set up businesses because the rents are affordable.

In terms of service delivery, the municipality acknowledged that the *“installation of solar heaters is just a small part of service delivery.* It recommended that *“one needs to fully examine the hierarchy of needs and cross reference with the installation of solar heaters in Cosmo city”* before one can judge if SWHs have meaningfully contributed to development. It was equally acknowledged that *“the COJ did a study to understand the*

*efficiency of SWH in saving energy. The study showed that there is a significant reduction in electricity usage because of SWH.* Any reduction of greenhouse gases, regardless of the amount, is important, if CoJ is to reach its target for the low carbon city.

**Do you think solar water heaters have helped reduce your electricity cost?**

The common response to this question was “yes”. One respondent substantiated that compared to where they formally lived; it has helped a lot to reduce cost *“because instead of buying electricity to heat water, you rather buy something different.”* Average household income spent on electricity stood at between 100 to 500 Rand for those with fridges, four-plate electric cookers, television, electric kettles and other household appliances mostly during winter, for a household size of between three to five persons. For the municipality of CoJ, it was noted that *“the amount of electricity used for heaters were replaced by solar heating. People are able to save money which they would have used to buy electricity to boil water.”*

**Do you think the use of solar heaters has changed your electricity conservation behaviour?** Most respondents were in accord that their electricity conservation behaviour had changed with the SWH. They declared that they use hot water only when it is most necessary and make sure that the heater is switched off after 21 hours. However, respondents acknowledged that behaviour change is a process and not a once-off thing; a majority of respondents (n=23) admitted that this is not done on a regular basis. One respondent explained that the municipality undertook a lot of awareness-raising campaigns and consultation with the community during this project to change people’s behaviour on the use of electricity.

**Do you think solar water heaters have helped reduce poverty in Cosmo City?**

The general response to this question was “no”. Respondents (n=13) indicated that poverty is rampant in Cosmo City but acknowledged that it provided employment for some people who were trained as technicians to carry out repairs and maintenance works on the SWH. *“...at least they can put food on the table for their family,”* emphasised one respondent. They also attested that SWH brought about improved

service delivery to their community in terms of provision of water, good roads and schools in the community. However, the majority of the population are dependent on social support systems. One respondent complained that *“we can’t eat SWHs; we need good jobs to take care of ourselves and family.”*

### **What role do SWHs play on sustainable development in Cosmo City?**

The voice of the municipality was that *“It reduces the amount of energy used by the community from Eskom, subsequently reducing emissions that result from burning of the coal. Energy is the centre stage of every development.”* He went further to explain that climate change and sustainable development *“are interlinked, and it’s difficult to separate them. Severe climate change results from development that relies on fossil fuel.”* The respondent referred to SWHs as a “game changer” in the reduction of GHG in the municipality. *CoJ is not an exception in this matter; most of the anthropogenic emissions result from the energy sector.”* Respondents (n=16) adhered to the fact that SWH significantly contributes to sustainable development. In the words of one respondents, *“in Riverbend and Zevenfontein, the use of paraffin and wood was common and it was very dangerous as it caused a lot of fire disasters that led to loss of lives and property.”* Another respondent added that *“the smoke from paraffin and wood makes our eyes sore and contaminates the air we breathe. SWHs have made life easier and better for us here in Cosmo City, I no longer have to buy firewood. I use that money now for my children’s breakfast.”*

### **What are the challenges in using solar water heaters in Cosmo City?**

The limited sunshine during winter is the main problem. The cold causes the water to freeze; as a consequence hot water is scarce during winter, for bathing, heating, washing and other domestic use. Respondents (n=9) recalled that the water from SWHs is not enough for domestic usage for households with more than four persons. If they have to do washing and take a bath within the same timeframe, they have to boil water on a kettle or cooker. Seventeen respondents referred to the issue of leakages. One respondent explained that when *“the plastic balls inside the bucket break, water leaks all day. It needs someone to always be in the house in case it happens.”* Another

challenge is that of repairs and maintenance wherein people do not have money for repairs when the heaters break. Most respondents were of the opinion that the municipality should have made provision for routine checks and maintenance. Finally, the municipality is constrained by funds to support *“upcoming projects that promote climate change resilience environment.”*

#### **4.4. Policy drive**

It was divulged that the role of the municipality fits into climate change and environmental protection issues in that it *“implements policies and strategies, compared to national or provincial governments which only draft those policies.”* The CoJ plays an active role in championing climate change projects and opening opportunities for the private sector to realise the opportunities available in a new growth path while recognising that there is no private sector involvement in the Cosmo City project. The respondent agreed that *“there are glimpses of development adhering to sustainable growth path, like green buildings, solar powered traffic lights and use of renewable energy.”* He added that awareness campaigns assisted and were a vital step for a community-based approach that seeks to promote renewable energy and more importantly, community buy-in to ensure sustainability. Community members were employed to *“install SWHs; further than that participants received further training on how to install the system.”* He recounted that legislations regarding climate change resilience are enabling in that they *“provide the framework for developing strategies to enhance climate change resilience.”*

##### **4.4.1. Strategies to build livelihood resilience to climate change within the CoJ**

- Energy efficiency and energy transition projects to reduce greenhouse gases
- Solar Water Heaters
- Landfill Gas to Energy
- Rapid Bus transit (BRT).

It was emphasised here that for energy efficiency to be sustainable, it entails community buy-in in order that *“energy transitions offer opportunities for future generations.”*

##### **4.4.2. Sentences to incite discussions**

Sentences put to the municipal official to provoke discussions confirmed that the installation of solar water heaters needs to be complemented with other energy-saving measures, not only in the residential sector but also with stringent and effective policies in the manufacturing and industrial sectors. Enough policies have been drawn; however, their *“implementation depends on the success of those policies.”* Also, participatory community-based projects founded on indigenous knowledge and know-how remains at the periphery of South Africa’s development trajectories. It was recalled that *“if the community buy into any project, it is bound to succeed, as the community will become pioneers of such projects.”* It reaffirmed that the post-2015 sustainable development agenda and the City of Johannesburg 2040 strategy are theoretically promising but implementation remains an issue *“for a more equitable and sustained future.”*

#### **4.4.3. Additional comments**

When open to additional comments respondents (n=11) posited that development can only be sustained if people are employed and economically empowered; and be able to educate their children to university level, so that they will then be able to make meaningful contribution to society. Respondents (n=5) insinuated that land be allocated to them so that they carry out small scale vegetable and fruit farming.

#### **4.5. Discussion of findings**

The guiding research question for this study was: what is the impact of solar water heaters on sustainable development in Cosmo City? From the various interviews, interactions and observations, a number of insights were drawn. The findings presented above reveal how SWHs have contributed in building livelihood resilience to climate change in Cosmo City, a low-income community on the outskirts of Johannesburg. By means of a deductive approach, these findings were examined using the theoretical and analytical framework discussed earlier in Chapter Two, and as a consequence, the succeeding themes emerged as significant findings of the study and answered the research questions in this study.

##### **4.5.1. Conceptual clarity**



The researcher observed that the manner in which an idea is enunciated and understood as important in the development process is a key aspect to obtain buy-in from stakeholders. This was apparent at the community level wherein the research had to explain the basic meaning of sustainable development before respondents could react to the questions and conversations that ensued thereafter. It was only then that 55% of respondents (n=15) came to divulge information regarding the impact of SWHs on their livelihoods and sustainable development in Cosmo City. Thus, it is important to emphasise that it is only when people understand the meaning of a subject can it receive buy-in from the community level (SDSN, 2012).

#### **4.6. The impact of SWHs on sustainable development**

There was a divergence of views on the socio-economic and environmental impact of SWHs on sustainable development in Cosmo City. 86% of respondents (n=23) appreciated the environmental benefits accrued from the solar water heaters in Cosmo City as being viable and just through the greening of the Community with the planting of local trees and shrubs to help curb possible erosion - a preventative measure aimed at strengthening the community's ability to adapt, respond to environmental shocks and recuperate from it thereafter. This goes hand in hand with the promotion of food gardening to improve household self-sufficiency and protect the environment. Moreover, the use of paraffin and firewood as a source of energy for heating and cooking has almost disappeared within the community. This has brought about an improved quality of life and a significant reduction in atmospheric pollution. These findings resonate with the views expressed by Walker and Salt (2006); World Bank (2009); Wilbanks and Kates (2010), Pisano (2012) and SDSN (2012).

The socio-economic conditions still remain dire in Cosmo City vis-à-vis sustainable development indicators. Though respondents (n=24) acknowledged that the project had led to the building of schools, provision of pipe-borne water, recreational facilities and roads, there are still gaps to be filled in that 70% of respondents (n=19) depend on welfare grants and social support from the government for their livelihood subsistence. 36% of respondents (n=9) rely on household income earned by a family member from a

low-paying job in the community or Johannesburg. Social inclusivity remains an illusion as most families do not have the financial capacity to support their children at university level education as chastised by Bannister (2002). It was observed by the researcher on the field that many youths in the community possess unmarketable skills, low education levels that are less competitive and are not needed in the job market. This has further contributed to widen the inequality gap hitherto created by the legacy of apartheid (Madzwamuse, 2010). Six respondents complained that *“our problems are beyond the mere installation of these heaters, the provision of water; our children need good education, good jobs and we have children to look after.”* Other respondents raised the issue of youth delinquency, teenage pregnancy, theft of electricity and telephone cables in the community (Wlokas, 2011) and; corruption in the allocation of RDP houses in Cosmo City - the reason behind some of the recent service delivery protests carried out by residents of this community. The most outstanding issue that was raised by 96% of respondents (n=26) was the absence of a public health utility and police station in the community. 63% of respondents (n=17) were of the opinion that they would have preferred the construction of a hospital rather than the installation of SWHs. One respondent alluded that *“many people in this community are suffering from HIV and AIDS, high blood pressure and other illnesses. We need a hospital here because we do not have taxi money to go to Johannesburg all the times. This explains why some people are inconsistent in taking their medication like ARVs or checking their blood pressure and sugar levels. We are really pleading that the government act fast and save us from the stress.”* The arguments presented here undermined propositions raised by CoJ (2009); Foster *et al* (2011); SDSN (2012); Ziuku and Meyer (2012) who cautioned that sustainable development must provide social safety nets for the poor without compromising the fulfilment of their basic human rights.

Conversely, respondents (n=9) applauded community consultation, education and awareness programmes of the project as an avenue that opened the space for them to contribute in the decision-making process hence, thus enabling the project to be community sensitive (Yanda & Bronkhorst, 2011; Black, 2011). A comprehensive approach was used to mobilise community residents before, during and after the

implementation and installation of the SWHs. A sense of shared responsibility for all stakeholders involved (City of Johannesburg, 2011). This encouraged community buy-in as some of the resident homes were used as model houses, reflecting the essence of community involvement and local knowledge as the foundation for meeting local needs as highlighted by Knutsson (2006); DEAT in Odeku and Meyer (2009); Bindra and Hokoma (2009).

Unemployment and poverty alleviation are deep-seated in all spheres of life in Cosmo City. The completion of the project led to the retrenchment of people who were hired during this project as plumbers and technicians. This has resulted in loss of skills acquired on the job through training as reported by five respondents. Respondents solicited the construction of a “big shopping mall” to create more employment opportunities. One respondent castigated the absence of a solar water heater manufacturing plant in the community as an indicator that the project is not sustainable enough for the community. However, respondents (n=14) acknowledged that during the project it was agreed that people were employed and trained as plumbers and technicians to continue with repairs and maintenance work within the community but it was short-term employment (Wlokas and Ellis, 2013). Respondents (n=6) agreed that the installation of SWHs resulted to the growth of small businesses within Cosmo City due to the low cost of electricity. One respondent revealed that he spends approximately R100 a month on household electricity consumption and close to R250 a month on his laundry shop. This has enabled him to save money for other household needs and an improved capital base for his business, views shared by (Wlokas, 2011; Wlokas and Ellis, 2013).

#### **4.7. Livelihood resilience strategies to climate change in Cosmo City.**

Livelihood strategies employed by respondents are worth upholding. This include the practice of urban agriculture in the form of food gardening to ensure household food security (Black, 2011), tree planting by community residents, the use of compact fluorescent bulbs subsidised by ESKOM during the installation of the heaters; the use of two-plate stoves for heating and cooking; involvement in income generating activities

such as tuck shops (Wlokas, 2011); opening windows and doors during the day to let in natural light, switch off lights in rooms that are not in use and the heaters before going to bed; and use of less sophisticated electronic appliances at home. Interesting is the fact that 60% of respondents (n=15) attested that their efforts at conserving energy would not make any significant impact because people in Johannesburg are “*using heaters in winter and sleeping under electric blankets.*” This confirms the dilemma expressed by Ijumba and Sebitosi (2010); Tyler and Moench (2012), who suggested a uniform approach to energy conservation and behaviour change in the use of SWHs in South Africa.

#### **4.8. Strategies to enhance climate change resilience in the CoJ**

Findings in the field (n=2) concurs with the literature that strategies to mitigate or lessen climatic threats within and around the CoJ are all geared towards a transition to a low-carbon economy as a key focus of the CoJ’s climate change strategy (Glemerec, 2010; City of Johannesburg, 2011). To this end, climate change goals have been mainstreamed into various policies and plans of the municipality, precisely the CoJ’s energy and transport policies, so as to contribute meaningfully in global emission reduction. The transition to a low-carbon economy was listed by CoJ’s official as the best way, in terms of adaptation and mitigation, to go green in making Johannesburg a smart and liveable city, reinforcing Pisano (2012) transformability rationale on renewable energy. These strategies are explained below:

- *Bus Rapid Transit (BRT) system:* transport is at the heart of CoJ’s economy. Respondents (n=1) revealed that the Bus Rapid Transit (BRT) system - Rea Vaya BRT and the Gautrain high-speed rail link connecting Johannesburg to Tswane, and Johannesburg to OR Tambo airport - has the potential of bridging the inequality gap between various social strata within the municipality. Not only have they contributed significantly in reducing GHG emission, but have also helped to absorb the shocks from the ever increasing global fuel pricing, hence challenging the frequent price hikes on taxi fares within the municipality.

Unfortunately, findings from the field in Cosmo City revealed the absence of Rea Vaya bus route and Gautrain linking Cosmo City neither to the economic heartland of Johannesburg or to the country's political capital, Tswane. Respondents (n=9) noted that "*Gautrain is meant for rich people; we cannot afford it; it is not meant for us.*" 41% of respondents (n=11) were completely ignorant of such transport systems. This put into question the very essence of social inclusivity as articulated by Madzwamuse (2010). Consequently, the population remains vulnerable to fluctuating fuel prices which have translated to high taxi prices to key economic, social and political destinations around the province.

- *Building Sustainable human settlements:* building sustainable human settlements is a strategy which seeks to drive informal settlements towards a sustainability trail. The respondent (n=1) purported that the aim here is for inclusivity through the upliftment of informal habitat so as to alter the apartheid-based landscape configuration of the municipality by means of provision of social facilities like the resettlement programme of Cosmo City.
- The respondent (n=1), mentioned that the implementation of local renewable energy networks such as solar, wind, turbines, urban neighbourhoods, low-income communities and new residential areas, are attempts to reduce dependence on coal-powered electricity to drive energy conservation in the CoJ.
- Promotion of urban agriculture to ensure local food self-sufficiency through the use of resources-efficient measures was another strategy reported by the respondent. She explained that in order to strengthen climate change resilience and environmental protection within the municipality, the CoJ is encouraging urban agriculture in the form of vegetable and fruit gardening so as to supplement the nutritional needs of families and augment household income (City of Johannesburg, 2009).
- Respondent (n=1) pinpointed the provision of safe, secure and shaded route and footpath as an eco-mobility strategy to promote climate change resilience. By encouraging cycling, walking and wheeling, it would help reduce transport emissions and stimulate the growth of low-volume non-motorised public transport

system. This strategy is “*environmentally just and socially inclusive,*” she reaffirmed as reflected in the City of Johannesburg (2011).

#### **4.9. Hurdles to the effectiveness of SWHs on sustainable development**

The primary impediment remains that of the water not hot enough during winter to meet individual and household needs. Households with more than four persons struggle to get enough hot water for bathing and heating in the morning, one respondent replied. This has prompted some residents to request for an electric backup for their heaters, as noted by seven respondents and confirmed by Ijumba and Sebitosi (2010) and Wlokas, (2011). Another respondent mentioned that SWHs are “*cheap technology brought to us. Because they are free we cannot complain, we just have to take them as they are without any questions.*”

Another obstacle named is that of vandalism and theft of parts and connection cables of SWHs. 40% of respondents (n=11) thought it is planned by those who do the repairs and maintenance so as to have them hired for maintenance and repairs thereof. He also blamed this on the high rate of youth delinquency in the community. Illegal wiring is another problem which has caused abrupt damages to some of the SWHs installations as purported by Wlokas (2011).

Poverty is also a hurdle to the effective use of SWHs in Cosmo City. Respondents (n=8) noted that most residents are unable to replace the subsidised fluorescent compact bulbs when broken. They still believe that is it the responsibility of the municipality to often check for replacement. Hence, some have replaced the broken bulbs with energy-consuming bulbs and this attest that behaviour change is still an issue within the community. An opinion shared by Ijumba and Sebitosi (2010).

Finally, the lack of local producers of SWHs, coupled with budget constraints, has been a major obstacle for the municipality and has halted the large roll-out of SWHs within the municipality and in particular low-income communities, reported two respondents.

#### **4.10. Summary**

This chapter has presented the findings and discussion on the impact of SWHs on sustainable development, specifically, in Cosmo City. The findings presented some of the intricacies associated with the use of SWHs and livelihood strategies deployed by residents to conserve energy for future use. According to the findings, some of the factors linked to sustainable development strategies and previously stated in foregoing chapters, were established and some were not applicable within this context. Livelihood strategies aimed at building resilience to climate change must be uniform within the same geographic setting so as to create meaningful impact in the long-run. Poverty alleviation and behaviour change are significant factors that need to be dealt with, if we want SWHs to speak to sustainable development. Above all, for development to occur, the people have to be content with their status. A shared vision towards the desired future must offer an opportunity for mobilizing people towards desired change. Thus, in order to establish a momentum for development, it is vital to consider these aspects. Development is a process that involves technological manoeuvres and unless such is skilfully handled, it could be a calamity of good intent. The ensuing chapter provides a conclusion and some recommendations based on the study.

## **CHAPTER 5**

### **CONCLUSION AND RECOMMENDATION**

*“Short term dash for cash economic solutions hinders progress towards a better, more sustainable world” (Phil Harding, 2013).*

#### **5.1. Introduction**

This closing chapter provides an outline of the case study investigated and proposed recommendations on how to enhance the effectiveness of SWHs so as to build livelihood resilience to climate change in order to achieve development that is just and equitable for all citizens. Areas of further research on this topic are also suggested so as to complement this study.

#### **5.2. An outline of the Cosmo City case study**

The results that emanated from this research were sourced within Cosmo City and from the CoJ. The research sought to investigate the impact of SWHs on sustainable development. According to findings exposed, discussions were construed and corroborated as per the literature reviewed and some were not applicable to the context of the study. Nonetheless, some robust evidence emerged from the findings to substantiate the key role of renewable energy (in this case SWHs) in sustainable development, and a significant strategy capable of building livelihood resilience to climate change for low-income communities in countries in transition.

The literature reviewed and the methodology deployed greatly contributed to understanding the impact of SWHs on sustainable development in Cosmo City from a livelihood and resilient perspective. The institutional backing provided for this project is a step towards ensuring its long-term sustainability. Although this study was not premised on investigating the level of awareness on climate change, its inclusion, however shed light on the need for conceptual clarity with the respondents in order to set the ball rolling for information gathering, analysis and its interpretation thereof.

#### **5.3. Recommendations based on the findings**



Understanding that mitigation and adaptation are inseparable has informed strategies against climate inconsistency within the CoJ. The development pathway has to be carefully and systematically thought through so as to enhance sustained growth without compromising scarce resources, the human rights and dignity of the poor and a historically disadvantaged population within any geographic milieu. The significant level of awareness around climate change within Cosmo City authenticates various strategies embarked upon by the municipality to avert climate threats and environmental degradation. Hence, the below propositions are put forth to policy makers to render any such strategies robust, accommodating and effective.

*Education and awareness:* it is important that education and awareness be intensified to enkindle behaviour change on energy use and conservation rather than the more frequent blackouts and load shedding. Capacity building at the institutional and community level for actors in the field will help reduce the gap of ignorance and bring about the desired change needed. Failure to do this will dilute efforts and prospects of reducing greenhouse gas emission. Education will enable people to acquire skills that are competitive in the job market, the spillover of which will be a general improvement in standards of living within the community and a shared responsibility in environmental protection.

*Climate change needs political buy-in at all times.* The issues around climate change are cross-cutting; a proper dialogue between stakeholders will assist in driving the agenda forward.

*Provision of social safety nets:* for any sustainable development project and programme to be comprehensive, it has to embody the vital components and structures that impact directly on peoples' daily lives such as hospitals and security. The absence of a public hospital and a police station in a community that is disease- infested and crime-ridden is a puzzle to the very notion of sustainable development. This is a grave development challenge that cannot be overlooked if development is to be taken in the words of Amartya Sen. In the same line of thought, employment opportunities have to be created

within the community to move people out of the poverty trap. Only through this way can the community be empowered to own the project and ensure its sustainability.

Respondents listed a number of recommendations such as:

- Improving the technology of SWHs so that enough hot water is produced throughout the year;
- Permanent employment for those who were trained on the installation of SWHs;
- The municipality to complete the provision of ceilings to all residents of Cosmo City;
- The municipality to propose the establishment of a community-based trust, to repair any leakages and replace permanently damaged heaters;
- Finally, increased budget allocations for large scale roll-out of SWHs within the CoJ. Otherwise if a majority of households within the municipality continue to use grid electricity, the impact of SWHs on sustainable development will remain minimal if not insignificant for years to come.

### **5.3.1. Recommendations for future research**

This investigation was intended primarily to investigate the impact of SWHs on sustainable development, precisely in Cosmo City. Consequently, the findings affect only Cosmo City and should not necessarily reflect those of other low-income communities and any other municipality, except given that it is a case study. Against this backdrop, it is suggested that similar investigations in Como City in the future should target the below areas:

- A comparative analysis of the impact of SWHs and electric geysers on sustainable development in Cosmo City. A study of this nature would demonstrate whether SWHs are effective in conserving energy.
- A community-based approach to alleviate energy poverty in Cosmo City is needed. An investigation of this stature would probe into community-based mechanisms that seek to strengthen climate change programmes in the community.

- Further studies need to be conducted to determine whether SWHs have helped change energy consumption behaviour in Cosmo City, given that a lot still needs to be done on climate change awareness around the CoJ. Behaviour and attitude changes are slow.

#### **5.4. Post script**

Climate change remains a global threat to the very essence of human existence irrespective of age, class, race, gender and location. The post script for this study is an opportunity for me to give back to the community of Cosmo City and the CoJ what they have offered to me. The findings of this enquiry reflect Cosmo City. The CoJ gave an insight into policy issues around SWHs in Cosmo City. The researcher was provided with valuable, resourceful and official documents used in the course of this study. Thus, it is expected that this research will drive policy in the right direction in order to create a sustainable, liveable and resilient municipality through provision of smart infrastructures.

#### **5.5. Conclusion**

This treatise contends that the installation of SWHs in Cosmo City made a sustainable impact to development by conserving energy, improves quality of life and strengthened resilience amongst community members. The sustainable urban livelihood approach complemented by principles underpinning sustainable development was deployed in the analysis of the impact SWHs on sustainable development. Outcomes from structured interviews conducted in Cosmo City and corresponding questionnaires emailed to councilors in the City of Johannesburg revealed that SWHs installed in Cosmo City have contributed in building livelihood resilience to climate change and has impacted significantly in the low-income vicinity of Cosmo City. The mitigation of energy poverty through constant power supply for cooking, heating and lighting has positively impacted on sustainable development. Nonetheless, it remains a challenge to assess the real of technology on people. However, what was easily affirmed is the correlation between the introduction of SWHs and the development of Cosmo City. This correlation was found by asking questions about livelihood before, during and after the installation of this technology device. In the case of Cosmo City, it relied on strategies deployed by the

City of Johannesburg from the initiation to the installation process and the thereafter. From the commencement of the project, the community of Cosmo City was actively involved and participated in the project from start to finish. By so doing, they approved and sanctioned the project's legitimacy. Issues of leakages, vandalism and poor maintenance; less heating in winter and insufficient hot water availability for households with more than four members were cited as the key hurdles for SWHs in Cosmo City. Also, the inability to continue with the use of energy saving bulbs is a setback to energy conservation and sustainable development in Cosmo City. Fortunately, this cannot be linked to the installed SWHs in Cosmo City but an issue of accountability on the part of both municipal authorities and community members.

The impact of SHWs in consolidation human capital can be seen through improved quality of life, employment creation, skills and knowledge acquisition, reduction in air pollution and a near complete shift from the use of firewood and paraffin as a source of energy which is significant to sustainable development. As a result of this project, the community can now pride itself of additional amenities such as educational facilities, a clinic, roads and infrastructural development; commercial and recreational facilities. This has supplemented their social and physical capital. The financial capital of households in Cosmo City also received as boast through jobs created even though this was momentary, alongside a reduction in energy cost. From a gender perspective, a key outcome was a reduction of women's workload and time saved from looking for firewood to meet the energy needs of their households and other family members. It can therefore be said that renewable energy programs are a perfect platform in achieving development that is sustainable. SWHs are effective in conserving energy if a comprehensive and uniform strategy is adopted to mitigate climate inconsistencies. Community resilience should be on-going to enable people adapt to climate change. A large amount of solar power in South Africa remained untapped in a country that is coal-driven.

***“Keeping people on side is a precondition of making any progress on sustainability issues”  
(Jonathon Porritt, 2012).***

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**APPENDICES**  
**APPENDIX A: ETHIC CLEARANCE**



**ETHICS CLEARANCE FOR TREATISES/DISSERTATIONS/THESES**

*Please type or complete in black ink*

**FACULTY:** Business and Economic Sciences

**SCHOOL/DEPARTMENT:** Development Studies

I, (surname and initials of supervisor): Pavel, P. the supervisor for (surname and initials of candidate) Mbeng R.N. (student number) 213443007

a candidate for the degree of MASTER OF ARTS IN DEVELOPMENT STUDIES

with a treatise/dissertation/thesis entitled (full title of treatise/dissertation/thesis):

THE IMPACT OF SOLAR WATER HAETERS ON SUSTAINABLE DEVELOPMENT IN COSMO CITY.

considered the following ethics criteria (*please tick the appropriate block*):

	YES	NO
1. Is there any risk of harm, embarrassment or offence, however slight or temporary, to the participant, third parties or to the communities at large?		✓
2. Is the study based on a research population defined as 'vulnerable' in terms of age, physical characteristics and/or disease status?		✓
2.1 Are subjects/participants/respondents of your study:		
(a) Children under the age of 18?		✓
(b) NMMU staff?		✓
(c) NMMU students?		✓
(d) The elderly/persons over the age of 60?		✓

(e) A sample from an institution (e.g. hospital/school)?		✓
(f) Handicapped (e.g. mentally or physically)?		✓
(g) Socially/economically disadvantaged?		✓
3. Does the data that will be collected require consent of an institutional authority for this study? (An institutional authority refers to an organisation that is established by government to protect vulnerable people)		✓
3.1 Are you intending to access participant data from an existing, stored repository (e.g. school, institutional or university records)?		✓
4. Will the participant's privacy, anonymity and confidentiality be disclosed/revealed?		✓
4.1 Are you administering a questionnaire/survey that:		
(a) Collects sensitive/identifiable data from participants?		✓
(b) Does not guarantee the anonymity of the participant?		✓
(c) Does not guarantee the confidentiality of the participant and the data?		✓
(d) Will be distributed electronically (e.g. online via email/web link)?		✓

*Please note that if ANY of the questions above have been answered in the affirmative (YES) the student will need to complete the full ethics clearance form (REC-H application) and submit it with the relevant documentation to the Faculty Ethics Co-ordinator.*

and hereby certify that the student has given his/her research ethical consideration and full ethics approval is not required.

Pavel Parks



02/08/2013

**SUPERVISOR(S)**

**DATE**



**HEAD OF DEPARTMENT**

8/8/13

**DATE**

Regina Nso Mbeng

02/08/2013

**STUDENT(S)**

**DATE**

## **APPENDIX B: INTERVIEW GUIDE / QUESTIONNAIRE**

### **Section 1: Demographic information of respondents**

1. Gender
2. Age
3. Marital status
4. Educational level
5. Ethnicity
6. Occupational status
7. Household size
8. Fuel for cooking
9. Energy for heating
10. Monthly household expenditure on electricity consumption
11. Position held in the department

### **Section 2: An overview of climate susceptibility in Cosmo City**

1. Do you think climate change is a threat in Cosmo City?
2. As an individual do you think you have the responsibility to save energy for future use?
3. Is there any community-based environmental protection initiative in Cosmo City?
4. Are you involved in any community-based environmental protection initiative in Cosmo City?  
If so explain.
5. Do you believe GHG emission is a serious issue in the CoJ?

### **Section 3: Sustainability impact**

1. What do you understand by sustainable development?
2. Is there any link between climate change and sustainable development?
3. Would you consider solar water heaters effective in emission reduction in CoJ?
4. What development challenges do you think affect Cosmo City?
5. In your opinion, do you think solar water heaters have an impact on the development of Cosmo City?
6. Do you think solar water heaters have helped reduce your electricity cost?
7. Is the water from the solar heaters enough for your domestic usage?
8. In your opinion, do you think solar water heaters are effective at conserving energy?
9. Do you think the use of solar heaters has changed your electricity conservation behaviour?

10. Do you think solar water heaters have helped reduce poverty in Cosmo City?
11. Do you think solar water heaters have improved service delivery in Cosmo City?
12. What type of renewable energy sources are being exploited by CoJ?-
13. In your view, is energy a key aspect of sustainable development in the CoJ?
14. In your opinion have solar water heaters helped reduce electricity cost for the Municipality?
15. In your view, was the community fully involved in the solar water project of Cosmo City?
16. Are there any community-based mitigation strategies to climate change in Cosmo City?

#### **Section 4: Policy issues**

1. How does the role of the municipality fit into climate change and environmental protection?
2. As a government body, what climate proofing strategies have you put in place to combat the adverse effects of climate change?
3. Would you consider these strategies sustainable enough for the CoJ?
4. Is development proceeded in a sustainable manner in the CoJ?
5. What role does the municipality play in facilitating climate change initiatives within the private sector?
6. Is the private sector involved in climate change mitigation in Cosmo City?
7. How does the municipality promote the development of a community-based approach to climate change mitigation?

#### **Section 5: Challenges**

1. What are the challenges in using solar water heaters in Cosmo City?
2. What factors in your opinion hinder the municipality from being actively involved in climate-resilience development?
3. Are all the legislations relating to climate change resilience, enabling?
4. What additional support is required from the national government for the CoJ to be proactively involved in climate change resilience?

5. What recommendation(s) would you propose to make the use of solar water heaters more sustainable in Cosmo City?

**Section 6:** Statements to incite discussions

1. The installation of solar water heaters needs to be complemented with other energy saving measures not only in the residential sector but stringent and effective policies in the manufacturing and industrial sectors.

2. Participatory community-based projects founded on indigenous knowledge and know-how remains at the periphery of South Africa's development trajectories.

3. The post-2015 sustainable development agenda and the City of Joburg 2040 strategy is one promising step for a more equitable and sustained future.

4. Any other additional comment(s)?

*THE END*

***Thank you for your cooperation***



**Nelson Mandela  
Metropolitan  
University**

*for tomorrow*

**PERMISSION TO SUBMIT FINAL COPIES  
OF TREATISE/DISSERTATION/THESIS TO THE EXAMINATION OFFICE**

*Please type or complete in black ink*

FACULTY: BUSINESS AND ECONOMIC SCIENCES

SCHOOL/DEPARTMENT: DEVELOPMENT STUDIES

I, (surname and initials of supervisor/promoter) Mr. PAVEL, P.

and (surname and initials of co-supervisor/co-promoter) \_\_\_\_\_

the supervisor/promoter and co-supervisor/co-promoter respectively for (surname and initials of candidate) Mbeng, R. N.

(student number) 213443007 a candidate for the (full description of qualification)

**MASTER OF ARTS IN DEVELOPMENT STUDIES**

with a treatise/dissertation/thesis entitled (full title of treatise/dissertation/thesis):

**THE IMPACT OF SOLAR WATER HEATERS ON SUSTAINABLE DEVELOPMENT**

It is hereby certified that the proposed amendments to the treatise/dissertation/thesis have been effected and that **permission is granted to the candidate to submit** the final bound copies of his/her treatise/dissertation/thesis to the examination office.

*[Signature]*

**SUPERVISOR / PROMOTER**

*30/Apr/14*

**DATE**

*And/ Or*

\_\_\_\_\_  
**CO-SUPERVISOR / CO-PROMOTER**

\_\_\_\_\_  
**DATE**