THE IMPACT OF ENVIRONMENTAL POLLUTION ON PUBLIC HEALTH WITH
SPECIFIC REFERENCE TO SASOLBURG INDUSTRIAL AREA,
SOUTH AFRICA

By

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ABSTRACT

The Mining industry in South Africa is viewed as the backbone of the country’s economy, while benefiting from this engine of economic development, its impact on the environment and health has been of a major concern to different stakeholders. The majority of people acknowledge the role of mining in the economy and the country. Others put more emphasis on public health and the environment. The aim of the study was then to assess the impact of environmental pollution and public health on the Sasolburg community from a developmental perspective. The present study can be described as a quantitative descriptive survey that uncovered serious levels of pollution in Sasolburg that had dire health consequences for people involved. The findings of the study indicate that residents live with the constant smell of a variety of chemical pollutants released both by normal production and by periodic incidents. They experience chronic respiratory symptoms, burning eyes, hearing deficiency and skin irritations. The study revealed that environmental pollution consequences affecting residents are inversely related to distance from the mines. The results obtained in this study are evidence that environmental pollution in the Sasolburg area is a definite risk to the health of people living within the surrounding area. Although indicating the need to carry out a comprehensive study, the results call for immediate action to prevent continued public over-exposure to environmental pollution.

Keywords. Environmental pollution, public health, Sasolburg.
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LIST OF ABBREVIATIONS

DEAT- Department of Environmental Affairs and Tourism
HRA- Health Risk Assessment
MNC-Multinational Corporations
NGO-Non-Governmental Organisation
SEF-Sasolburg Environmental Forum
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Chapter 1

1.0 Introduction and Background of The Study

1.1 Introduction

Mining has been one of the features of South African society since the discovery of diamonds and gold in the late 1800s. Madihlaba (2002) in McDonald (2002:156) argues that the mining industry has played an important role in the political, social, and economic fabric of the country and had an enormous environmental impact on South Africa. However, Madihlaba (2002) maintains that the mining industry is not only the largest single producer of solid waste, but it also accounts for almost two thirds of the total waste stream. The industry has an indirect impact on a wide range of land, air and water resources thereby impacting on the public health of the communities in which these mines are located (Madihlaba, 2002 in McDonald 2002:156).

Garcia-Perez, Boldo, Ramis, Oppan, Perez-Gomez, and Lopez-Abente, (2007:13) further argue that in relation to public health, there has been growing interest in the development of useful statistical methods for detection of patterns of health events linked with pollution sources in recent years. It is indicated that raised incidence of the disease outbreak in the target population living near to the source or directional preference related to a dominant wind direction may provide evidence of such a link. Garcia-Perez, et al (2007:) reported statistically significant associations between lung cancer risk and residential proximity to smelters, complex industrial areas, and other emission sources. There was some evidence that leukaemia and lymphomas occurred in the neighbourhoods that contained industrial sites. The modelling of distance effect to sources of pollution under isotropic or anisotropic assumptions is complex and there are very limited examples in the literature. To date, most pollution source studies concentrate on incidence or mortality of a single disease (Garcia-Perez et al, 2007).
According to Jacobs (2006:6) apartheid town planning could be seen as the fundamental factor that ultimately led to the formation of such forums as Bellville, and Sasolburg Environmental Forums. Town planning under the apartheid regime saw it fit to locate poor and then disenfranchised people in close proximity to industries. As these people were not considered citizens in their own country, the environmental and health impact resulting from the proximities of people and industry was not a matter of concern for the apartheid regime. This was the case with Sasolburg and a number of other townships in the Western Cape, as well as other regions in the country.

Sasolburg is a town in the Free State Province about one hundred kilometers south of Johannesburg. It is named after Sasol company which operates in South Africa. This company refines coal into petrol and manufactures other chemical based products. Sasol owns a number of chemical industries in the town including NATREF, an oil refinery which it co-owns with Total, the French-owned oil company (Groundwork, 2003). Sasolburg is composed of four communities, namely: Coalbrook, Vaalpark, Welgelegen West and Zamdela.

On the outskirts of Sasolburg there is a black township called Zamdela which is located in the Metsimaholo Municipality. It is situated in the heart of the chemical industries. It is located in the west, downwind from the heavy industry zone. According to Kolanchu (2011:4), Zamdela came into being in the 1950s on the south east part of the Sasol Refinery plant as a residential area for mainly black workers employed by Sasol. Workers were drawn initially for the construction industry and then supplied labour to the chemical plants. Informal housing began to appear alongside the formal township in the 1970s. After the mid-1990s’ government transformation, Zamdela became a home to thousands of residents.

According to Bench Mark Foundation (2010:32) Zamdela township is affected by flares which are vivid during the day and night. Residents live with the constant smell of a variety of chemical pollutants released both by normal production and by periodic incidents. There is a huge waste coal-ash dump whereby the dirty black ash is blown by the wind into the community and the residents inhale unhealthy air with toxicants.
According to Diab, Muller, and Matooane (2006:159) inadequate air quality legislation and poor enforcement led to the development of air pollution hot spots in many of South Africa’s heavily industrialized areas. Examples include South Durban and the former Vaal Triangle (Sasolburg, Vanderbijlpark, and Vereeniging). Diab et al (2006) maintain that in these locations, ambient air quality levels frequently exceed internationally recognized guidelines and standards designed to protect public health, with the result that human health concerns are mounting.

According to Diab et al (2006) many studies (Diab and Scott, 1999, Naidoo et al., 2006, Terblanche, 1998 and White et al, 1996) are in agreement that in the case of South Durban, poor air quality and fears of negative health impacts have led to sustained community activism that resulted in the initiation of a large health study in the area. The main problems of pollution emanate from the widespread domestic use of biofuels (coal, kerosene, wood and dung) in urban townships and smaller towns throughout the country. In the highveld, poor communities rely on coal for domestic heating, cooking and lighting largely as a result of an inability to afford electricity.

In coastal areas, the use of kerosene or paraffin is more prevalent (Jones, Aitken, and Luckin, 1996), although the resulting air quality problems may not be as visibly apparent as those from domestic coal burning, significant negative health effects arise from the use of all these domestic fuels. Diab et al (2006) mainatain that South Africa is characterized by air pollution problems that are typical of highly industrialized nations, as well as those of developing countries. Controlling air pollution to improve public health presents many challenges and is the responsibility of the new National Environment Management: Air Quality Act (No. 39 of 2004) promulgated in February 2005. The Act heralded a paradigm shift in air pollution control in South Africa and importantly, places great emphasis on the control of air pollution for the protection of public health (Diab et al, 2006).

This act is founded on the underlying principle of striving for cleaner air and through a system of ambient air quality standards, aims to achieve an environment that is not harmful to human health or well-being. Diab et al. (2006) pointed out that, the legislation represents a shift from limited source-based emission control to ambient air quality management, coupled with pollution minimisation through regulating emissions.

Given this background this study intends to look at how the mining industry in South Africa has polluted the environment which has affected public health. A case study of the Sasolburg
community will help in understanding how environmental pollution has impacted on the public health of the community. A review of the development of policy to address these environmental concerns and the role of civic society in pushing for environmental reforms, will also be scrutinised.

1.2 Problem statement
The increase in recent decades in the number of community-based environmental organizations dedicated to removing or banning industrial hazards from their neighbourhoods indicates that concern over the impact of industrial activity on public health is widespread: for example, the Tsoga Environmental Centre in Langa, Cape Town, the Modulaqhowa Environmental Project in Botshabelo, in the Orange Free State and the Mafefe Environmental Protection Committee (Khan, (2002) in McDonald 2002:31). Given that industrial activity is noxious and threatening, and that residential proximity to such activity is highly undesirable, it is reasonable that many people find residential proximity to industrial activity to be chronically stressful. Furthermore, Khan (2002) stresses that industrial and governmental decision makers are often anonymous or distant figures who have few if any ties to local communities. Moreover, decisions about safe pollution levels, pollution mitigation, and economic development are often made with little or no consultation with local communities, and sometimes such decisions are made in the face of significant community protests. Individuals who live in industrial neighbourhoods may lack the resources to enable them to escape such neighbourhoods (McDonald, 2002). It is with this understanding that the present research has been formulated to explain the impact of environmental pollution on public health and the role of government, private sector and NGOs in the management of the industries.

1.3 Research questions
The research question is how has environmental pollution (specifically air and water pollution from industrial processes) affected the public health of the Sasolburg community in the past ten (10) years? Subproblems of this statement include the following:

- What are the effects of environmental pollution on the health of the Sasolburg community?
• To what extent has environmental pollution impacted on the public health of the Sasolburg community?

• What measures have been put in place by government to reduce the impact of environmental pollution on communities that are in proximities of industrial pollution?

• What are communities affected by environmental pollution doing to mitigate its effect on public health?

• What are the companies involved in industrial pollution doing to minimise the effects of environmental pollution on public health?

• How can different stakeholders (community members, government, industries and NGOs) join hands together to reduce the impact of industrial externalities on the environment?

1.4 Objectives of the study

The specific objectives of the study are as follows;

• To analyse the effects of environmental pollution on public health in Sasolburg.

• To examine the current government environmental protection policies that ensure safety of residents around industrial areas.

• To explain the views of Sasolburg community with regard to industrial pollution and the impact it has made on the public health.

• To understand the company position on environmental pollution and mitigation policies that enhance public health.

1.5 Summary

This chapter looked at problem identification, through background of the study. It also looked at what motivated the researcher to carry out the study, this was achieved through the covering of research objectives and research questions. Chapter 2 will link up with this chapter by focusing on the review of literature related to the field of study.
Chapter 2

2.0 Literature Review

2.1 Introduction
This chapter deals with the review of literature related to the study in line with the study objectives. Focus in this chapter will be on the definition of literature review, general overview and background information about environmental pollution, brief background information about environmental pollution in the Sasolburg area, effects and control measures of environmental pollution and finally summary of the chapter is given.

Marrian and Simpson (1984) define a literature review as a relative essay that integrates, synthesizes and critiques the important thinking and research on a particular topic. According to Leedy (1997) literature review is a very important component of research study and its purpose is to succinctly evaluate the state of the art in the areas of study under investigation. He summarized the purpose of literature review by noting that researchers indeed belong to a community of scholars who have already journeyed into the unknown to bring back a fact, a truth or bring a point to light. Studying literature related to the study helps the researcher avoid unnecessary duplication and also helps identify new directions that need to be pursued. Having enough knowledge of related literature helps the researcher to carefully select meaningful and relevant research methodology and data collection instruments for use during the period of study.

2.2 Environmental pollution: a general overview
Pollution is the introduction into the environment of any substance property including radiation, heat, noise and light that results in direct harmful effects to humanity and the environment, that makes the environment less fit for its intended use (DEAT and DWAF, 1998:5). Environmental pollution is a wide-reaching problem, it can be found everywhere on the globe and it is likely to influence the health of human populations is great. Nobuku (1993:146) defines environmental pollution as any activity done by corporations or individuals which compromises the health and/or environment of other persons in a localized
area, where the causal link is clearly established. The literature indicates that over the past years there has been increasing global concern over the public health impacts attributed to environmental pollution. Environmental pollution is tangled with the unsustainable anthropogenic activities, resulting in substantial public health problems. Human exposure to pollution is believed to be more intense now than at any other time in human existence (Khan and Ghour 2011:277). Pollution does not destroy and harm only the air, the water and the environment but also human beings, animals and plants, it therefore affects everyone on earth.

According to Matooane et al (2004) South Africa is no exception to the environmental pollution problems emanating from increased industrialisation. The effects of air pollution, both direct and indirect, are felt throughout the country particularly in areas of heavy industrial development such as the South Durban Industrial Basin and the Vaal Triangle. The effects are not only limited in the above mentioned areas but extend in areas where households rely on nonelectric sources of energy such as kerosene, dung and coal for household energy needs. Environmental pollution in China is a profoundly urgent concern and for good reason in that the country is faced with severe environmental challenges that must be met in order to prevent the destruction of the forests, the extinction of species, the loss of land to desert, and the disappearance of potable water. The impact of environmental damage is not limited to the environment but it also affects the people living there and the damage is caused by the country’s rapid economic development (Goelz, 2009:155).

2.2.1 Types of environmental pollution
There are many different types of pollution but not all types of pollution can be visible. However, they all harm our ecosystem whereby it includes all living organisms and how they interact together and with their environment. Most types of pollution are linked and people all around the globe need to carefully choose how they should live their lives to ensure that they are trying to put a stop to increasing pollution. The types of pollution that affect humans can include among others, the following:
2.2.1.1 Air Pollution

The air we breathe is an essential ingredient for people’s wellbeing and a healthy life. It is unfortunate that people are exposed to polluted air around the world (Khan and Ghouri, 2011:278). Air pollution is referred to as anything that contaminates the natural composition of the chemistry of the air. Polluted air contains one or more hazardous substances, pollutants or contaminants that creates a hazard to general health. This means that anything that disturbs the natural state of our atmosphere is considered air pollution. Examples of things that might contaminate the air we breathe are if there are too many gases, smoke and other vapours that cannot through a natural process be removed and cleared away. The main pollutants that are found in the air include particulate matter, lead, ground-level ozone, heavy metals, sulphur dioxide, benzene, carbon monoxide and nitrogen dioxide. It is indicated that particulate and related air pollution at high levels pose hazards to human health. (Khan and Ghouri, 2011:278).

The literature indicates that air pollution is caused by natural and man-made sources of ambient air pollution which include tobacco smoke, combustion of solid fuels for cooking, heating, home cleaning agents, insecticides, industries, automobiles, power generation, poor environmental regulation, less efficient technology of production, congested roads, and age and poor maintenance of vehicles. The natural sources include incinerators and waste disposals, forest and agricultural fires (Khan and Ghouri, 2011:278).

The air pollution situation in South Africa is no different to that of other developing countries. The main sources of ambient air pollution in South Africa are burning of coal, oil and natural gas in industrial processes, power generation and vehicles. Apart from industrial causes, human beings contribute to indoor air pollution which results from burning of coal, wood, kerosene and other non-electric energy fuels for domestic energy needs, cigarette smoking, the use of insecticides, benzene and other toxic substances (Matooane et al, 2004:1). Air pollution is the main area of concern as it is a problem throughout the country and citizens breath unhealthy air. Particulate matter is one major air pollutant that makes China’s air quality unhealthy, it is a result of diesel exhaust, coal-fired power plants, and other sources (Goelz, 2009:160).
2.2.1.2 Water Pollution

Human beings have to drink clean and safe water for their wellbeing and healthy life. In the contemporary world, water is recognized as a key to environmental sustainability, human beings unfortunately seem to have access to polluted water. Water pollution is when the water is no longer pure and contains bacteria or chemical impurities. It is indicated that polluted water consists of industrial discharged effluents, sewage water, rain water pollution and pollution by agriculture (excessive use of fertilizers washed away in waters) or households which cause damage to human health or the environment. Health and quality of soils and vegetation are affected by water pollution. The literature indicates that some effects of water pollution manifests immediately while others take a long period to be recognised. Poor quality water causes health hazards and death of human beings, aquatic life and it also disturbs the production of different crops (Khan and Ghouri, 2011:278).

In South Africa water is a scarce resource. Pollution from the large increase in municipal and industrial waste disposal and also due to improper sanitation, is an immense threat to water resources. The majority of people in South Africa are poverty stricken and there is water insecurity in their communities. There is a link between poverty and water supply; for improvement of people’s lives is not complete until there is provision of reliable, safe water supply. South African rural poor mainly rely on the water from the river, pond, and streams for their daily needs. They use water from the above-mentioned sources without boiling it and yet that water might be contaminated, posing serious health risk to the people (Makgoka 2005 :2).

Mostly the measured chemicals parameters from contaminated water include arsenic, cadmium, calcium, chloride, copper, fluoride, total hardness, nitrate, and potassium. It has been found that too much access to above mentioned chemicals leads to various diseases. It can lead to skin lesions, sensory loss, nausea, vomiting, diarrhoea, kidney damage and bone pains (Makgoka, 2005 :4).

Rapid industrialization in China has led to a deterioration of water quality in the country’s lakes and rivers. China’s cancer rate has increased in recent years, and stomach cancer and
liver cancer have increased, particularly in rural areas. There is also a severe deterioration in the water quality of the country’s rivers and lakes. Too much usage of fertilisers by farmers and industrial waste water dumping from manufacturing industries have rendered the water in many lakes and rivers unfit for human consumption (Johnson, 2008:2).

2.2.1.3 Land or Soil Pollution

Land pollution is one of the major forms of environmental catastrophe the world is facing today. Land pollution is when something happens to the soil or land that it no longer can keep its growth rate or if something disturbs the natural balance of growth in that land. The main causes of environmental pollution are improper management of solid waste. Heavy metal industries have produced wastes that are deposited into landfills without special precautions and the majority of the population live in close proximity to waste sites. Many heavy metal industries have caused serious soil pollution (Khan and Ghouri, 2011:279).

It is argued that when the soil where food is grown is polluted, it can contaminate the plants. This is particularly a problem when the plants are fed to animals that are later consumed as food. This is because the chemicals polluting the land become more concentrated as they move up the food chain. When an animal eats the contaminated plant, its body retains some of the pollutant, which is then passed on to the person who eats the meat from that animal. This can cause genetic changes, cancer and birth defects in some cases (Myers, 2010).

2.2.1.4 Noise Pollution

Noise pollution is when humans make and produce high levels of noise, which are beyond the regular level of noise. Noise is defined as unwanted sound and it is perceived as an environmental stressor and nuisance. Exposure to noise causes effects on health and well-being. The potential health effects of noise pollution are numerous, pervasive, persistent, and medically and socially significant (Goines and Hagler, 2007:287). Continuous noise over a lifetime in industrial settings can lead to a progressive loss of hearing. It is argued that that noise disturbs activities and communication, causing annoyance. In some cases, annoyance may lead to stress responses and there-after symptoms and possibly illness. Exposure to noise
disturbs sleep proportional to the amount of noise experienced, and it may increase blood pressure, heart rate and finger pulse amplitude as well as body movements. (Medical Research Council, 1997:9). It is also indicated that symptoms among industrial workers regularly exposed to high noise levels in settings, such as schools and factories, include: nausea, headaches, argumentativeness and changes in mood and anxiety. It has been reported that there are effects of noise on social performance whereby noise may act as a stressor, may mark speech, and may give rise to intentional changes away from social cues (Medical Research Council, 1997:19).

2.3 Background of environmental pollution in the Sasolburg area

Industrial activity in Sasolburg consists of metallurgical, petrochemical (Sasol and Natref), chemical (Sasol, Karbochem and Sasol Polymers), and power generation (Letabo Power Station, southeast of Sasolburg (Witi, 2005:29). It is indicated that South African industries are not being held accountable for their air pollution. Excessive air pollution from industrial production in the Sasolburg area is affecting the residents' health in general and the respiratory system in particular (Coetzee et al, 1986:339). Residents of Zamdela township living on the fence-line of chemical and petrochemical industries, and are exposed to a combination of toxic emissions that seriously compromise the health and quality of life of the community. This is a result of racist apartheid era industrial planning which forced black workers and communities to reside in close proximity to mines (Groundwork, 2003:5).

Zamdela township is visibly affected by flares which are vivid day and night, as flaring is a common practice. According to Bench Mark Foundation (2010:32) residents live with the constant smell of a variety of chemical pollutants released both by normal production and by periodic incidents. There is also a huge waste coal-ash dump whereby the dirty black ash is blown by the wind into the community and the residents inhale unhealthy air with toxicants. Chemical industries endanger the lives of the surrounding communities by polluting the environment and exposing communities to potential chemical disasters. Excessive air pollution from industrial production in the Sasolburg area affects the residents' health very negatively and especially the respiratory system (Coetzee et al, 1986:339).
2.3.1 Effects of environmental pollution on public health

In Sasolburg residents who are young, old or infirm, those living with HIV and people living in poverty are particularly at risk. It is indicated that Sasol workers often get a double dose of toxicants because they live near polluting factories as well as working in them. Zamdela communities are residing in the heart of various chemical industries and they suffer the health cost of these industries. There are many diseases that are discovered in the community whereby many people suffer from irritation of the eyes, nose and throat, headaches, dizziness, wheezing and other asthma symptoms, nausea and chest pains or heart diseases (Bench Mark Foundation (2010:33).

Literature also indicates that air samples, taken by residents in and around Sasolburg, had elevated levels of toxic pollutants. It is indicated that six of the seven bucket samples during air monitoring taken in Sasolburg showed very high levels of benzene. The long-term exposure to this chemical could manifest in anaemia and leukaemia, it weakens the immune system, causes defatting of the skin, and to women it causes irregular menstrual periods and decreased ovary size. The supporting evidence in statistics from clinics in the area indicated a high rate of anaemia or lack of iron in the body. High levels of hydrogen sulphide were also detected linking this chemical to respiratory problems, which was also supported by clinic reports of high prevalence of asthma and other lung conditions in Sasolburg (Groundwork, 2003:17).

The water pollution situation in South Africa is typical of that in many other countries. The effects of water pollution are similar everywhere, though the literature on industrial water pollution in Sasolburg is not documented. Countries all over the world are concerned with the effects of unclean drinking water because water-borne diseases are a major cause of morbidity and mortality. In China water pollution causes skin lesions, sensory loss, nausea, vomiting, diarrhoea, kidney damage and bone pains (Makgoka, 2005 :4). These are common diseases that are being experienced in Sasolburg due to chemical pollutants from the industries.

Wastes from industry serve as major sources for all water pollutants. Many major industries contribute significantly to water pollution. It is directly evident that water pollution affects the health of Sasolburg community very badly, since local industries heavily pollute the area
on a daily basis. Water quality management should be the effort of the local industries to control the physical, chemical and biological qualities of water. The Sasolburg industrial complex is the largest in the Freestate and industries pollute water by dumping the effluents in the Vaal River. The effects of air pollution on water quality, water resources, human and animal health, and agriculture mean that there should be prevention and monitoring of pollution, adequate treatment of waste water and water conservation. Pollution of water with heavy metals affects the fish immune system and leads to higher incidence of infectious diseases. In many industries, chromium is often found in the effluents which is the major cause of pollution of surface and groundwater (Saxena et al, 2006:209).

2.4 Environmental pollution control in South Africa

2.4.1 National Environment Management: Air Quality Act. 2004

The aim of the above mentioned act is to reform the law regulating air quality in order to:

“protect the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development while promoting justifiable economic and social development; to provide for national norms and standards regulating air quality monitoring, management and control by all spheres of government; for specific air quality measures; and for matters incidental thereto” (RSA, 2005).

Sasolburg, Vanderbijlpark and Vereeniging are collectively known as the Vaal Triangle area. This area forms the largest industrial complex in South Africa (Nieuwoudt et al, 2009:775). Air quality management in the Vaal Triangle Air shed Priority Area is primarily the minimisation, management and prevention of air pollution, which aims to improve areas with poor air quality and maintain good air quality throughout (RSA, 2009:iii). The industries in Sasolburg are subject to the regulatory authority of the national Department of Environmental Affairs and Tourism (DEAT). Sasol and its subsidiaries do ambient air monitoring in and around Sasolburg. Five monitoring stations are located at the Sasolburg Provincial Hospital, Boiketlong Community Hall in Zamdela, A.J.Jacobs Primary School, Leitrim and Steam
Station 2. Pollutants monitored include sulphur dioxide and hydrogen sulphide. At the Leitrim monitoring station, nitrous oxide, ozone and benzene are also monitored. Sasol has installed fourteen air monitoring sample points on the Natref fence-line to monitor for benzene, toluene, ethyl-benzen and xylene compounds and sulphurous compounds. The monitors have detected high concentration of benzene in excess of US guidelines (Groundwork, 2003:28).

The literature indicates that there was a community monitoring in Zamdela using the Bucket Brigade introduced by Groundwork. Bucket samples were taken by Zamdela monitoring committee and twenty various chemicals were identified where fifteen are listed as toxic air pollutants by United States Environmental Protection Agency (USEPA) (Groundwork, 2003:28). The chemical industries do not necessarily report on all their operations or give figures for each individual plant. Reporting is not verified by government regulators and therefore relies on the honesty of polluters (Groundwork, 2003:27).

2.4.2 Water Pollution Policy

The United Nations has set some guiding principles for water pollution control, stipulating that pollution should be prevented rather than treating its symptoms. In the past the remedial actions taken to clean up polluted sites and water bodies were more expensive than applying measures to prevent pollution from occurring. Over the years, wastewater treatment facilities have been installed and improved in many countries but water pollution still remains a problem, including in rich countries (Helmer and Hespanhol, 1997:17). It is indicated that the countries should apply the polluter-pays-principle, where the cost of pollution prevention, control and reduction measures are borne by the polluter. The concept is not new but has not yet been fully implemented by many countries despite the fact that it is widely recognised that the perception of water as a free commodity can no longer be maintained (Helmer and Hespanhol, 1997:18). An important element in water pollution control strategy is the formation of realistic standards and regulations. It is written that countries should encourage participatory approach with involvement of all stakeholders where the importance of water pollution control awareness will be raised among policy makers and the general public (Helmer and Hespanhol, 1997:19). These authors also indicate that there should also be promotion of international co-operation on water pollution control, the trans-boundary water pollution typically encountered in large rivers requires international co-operation and co-ordination of efforts (Helmer and Hespanhol, 1997:20).
The *South African policy* on water pollution management (National Water Act, 1998) covers inland waters, both surface and groundwater, as well as estuarine and marine waters. Issues that are considered in the policy include among others; river catchments as basic management units; land uses affecting catchment water quality; water quality requirement as specified by the catchment water users; management of storm water from industrial and urban areas; point sources of pollution, e.g. sewage treatment works and industrial waste water treatment works; diffuse sources of pollution, for example, polluted base flow originating from industrial areas (RSA, 2000:27).

Manufacturing and mining industries have significant impacts on water quality. The deterioration in water quality is a significant indicator of the degree of stress being placed on South Africa’s water resources. It should be noted that having water that is too polluted to use is nearly as bad as having no water at all. In the Vaal Triangle, efforts are put in place to reduce water pollution whereby there is desalination and reuse of wastewater by Rand Water. The recycling of polluted wastewater is already being practised extensively in Vaal Triangle area. It is indicated that desalination of water in the Vaal River from the mines is regarded as a solution to water quality problems, since clean water can be used to keep salinity levels down and the transfer of re-used water to other catchments also helps to reduce salinity loads on the Vaal River (Muller *et al*, 2009:22).

Kashimiri (2011:4) indicates that there are four fundamental strategies cited by the United Nations to combat water quality problems; The first one is the prevention of pollution, where pollution prevention strategies focus on the reduction or elimination of waste at the source. In industry, solutions include reformulating products so that they produce less pollution and require fewer resources including water during their manufacture. The second strategy is the treatment of polluted water where contaminants result from domestic, industrial or agricultural activities, wastewater must be treated before discharging. Treatment strategies for contaminated water range along a continuum from high-technology, low-energy, low-energy, biologically and ecologically focused approaches (Kashimiri, 2011:4).

The third strategy is the safe use of wastewater whereby wastewater is often disposed of into water bodies, ideally following treatment to render it environmentally safe. It is explained that it can be safely used even when it is not treated. The fourth strategy is the restoration and
protection of ecosystems whereby healthy ecosystems provide water quality benefits in the form of water purification often at a lower cost than subsequent engineered efforts to clean contaminated water (Kashimiri, 2011:5).

2.5 Summary
This chapter a review of literature related to the study of environmental pollution and its effects on public health. Here I chapter reviewed literature on the general overview of environmental pollution, focusing mainly on the background information about environmental pollution in the area of study. I also covered more information on the effects and control measures of environmental pollution in general and how they apply to Sasolburg. The next chapter will look at research methodology used to inform the backbone of this research project in Sasolburg.
Chapter 3

3.0 Research Methodology

3.1 Introduction

In this chapter, I was concerned with the description of research methodology to be adopted in carrying out this study. According to Babbie & Mouton (2001) methodology is defined as the systematic and logical study of the principles guiding research. It is concerned with how the researcher established knowledge about his/her study and how the researcher can convince others that his/her knowledge is correct. Here the discussion on the research methodology will be focused on the research design, population of study and sample size, sampling design and procedures, instrument design, instrument validity and reliability, data collection procedures, data presentation, analysis and interpretation.

3.2 Research design

A research design is a plan or strategy of how a researcher intends to conduct research inorder to address the research question (Babbie & Mouton, 2001:77). According to this definition a research design focusess on the end product, formulates a research problem as a point of depature, and focuses on the logic of the research. The present study can be described as a quantitative discriptive survey that used questioannaires and interviews as its major tools for data collection. The survey designs are often of a more quantitative nature, requiring questionnaires as a data collection tool. Respondents are idealy selected by means of radomised sampling methods (Fouche & de Vos, 2008).
3.3 Population of study

Population is a term used to set boundaries on the study units. It refers to individuals in the universe who possess specific characteristics (Strydom, 2011). McBurnet (2001) refers to the population as a sampling framework. A population is the totality of persons, events, organisation units, case records and other sampling units with which the research problem is concerned. The present research study population consisted of all residents of Zamdela Location in Sasolburg, employees and officials from Sasol company, government and municipal employees, health officials and the NGO community.

3.3.1 Sample and sampling procedure

A sample comprises elements or a subset of the population considered for actual inclusion in the study, or it can be viewed as a subset of measurements drawn from a population in which the researcher is interested. Samples are studied in order to understand the population from which it was drawn. A sample is a small portion of the total set of objects, events or persons from which a representative selection is made (Strydom, 2011).

Since it was difficult to ascertain the exact size of the population in Sasolburg a purposive sampling was used to select the participants for this study. It involved deliberate selection of particular units of the universe for constituting a sample which represents the universe (Kummer, 2008:14). It entails obtaining information from specific target groups. The participants of the study were, one (1) environmental management representative from Sasol company, five (5) Sasol employees, one (1) health expert from the local health centre, (1) representative from the local Municipality, one (1) representative from Environmental NGO and ten (10) Sasolburg residents: giving a total of 19 participants. The sample figures do not represent a significant percentage of the population because the researcher targeted key informants due to their availability and convenience. Furthermore, the sample was also directed at obtaining results from a variety of perspectives - from the community, the polluting company itself, NGOs, clinics as well as local municipality.

3.3.2 Data collection

The self-administering questionnaire was distributed by hand to the respondents who were given time to respond to the questionnaire. After two days the questionnaire was collected.
The Environmental pollution and public health risk questionnaire (Appendix A), which was the major data collection tool for the present study was presented to the ten (10) Zamdela community members purposively selected as well as five (5) Sasol company workers. It is a tool that was developed by the researcher and piloted to assess its validity and reliability. The document is divided into 5 sections; demographics, health assessment, proximity to the mine, section D is environmental justice and epidemiology of public health standards.

Open-ended questions (Appendix B) were asked on the policy implementation, environmental mitigation, and the role of the NGO in mitigating environmental injustice and they were targeted to the environmental management representatives from Sasol industries, health expert from the local health center, local municipality and the NGO community. Closed questions are quick to administer and can be easily coded and analysed, while open questions should be used where possible replies are unknown or too numeruos to pre-code (Kelley et al, 2003:263). The researcher administered the questionnaire and conducted the interviews.

3.3.3 Data analysis and interpretation
After the data was collected, it was coded and analysed with the help of the Statistica software package. Graphs, pie charts and tables were presented as a way of adding clarity to the results. A statistical analysis of the data confirmed the research hypothesis. Qualitative data helped clarify the role played by the Sasol industries, the government and the NGO community in mitigating the impact of environmental pollution on public health.
Chapter 4 Research Results

4.0 Data presentation, analysis and interpretation

4.1 Introduction
In this chapter the data that was collected using the questionnaire is presented, analysed and interpreted. Section A presents personal data that was gathered through the questionnaire and section B presents respondent’s opinions on the subject of study. Each question is presented and analysed separately, followed by the researcher's remarks commenting on the outcome of each question.

4.2 Results and interpretation

4.2.1 Demographics

Figure 4.1 Age group

Data collected in this survey indicated that the majority of respondents in Zamdela township were elderly, between the age of 40 and 50 years.

Two (2) respondents representing a 33% response rate indicated that they are in the 20-30 age-group, ten (10) representing a 67% response rate are in the 40-50 age-group, whilst three
(3) representing a 20% response rate were in the 50-60 age-group and there were no respondents in the sixty and above age-group.

Figure 4.2 Gender

Here, data indicated that the majority of respondents were male. In the figure above nine (9) respondents, representing a 60% response rate, were male while six (6) representing a 40% were female. This shows that there was a fair representation of gender making it possible to generalise the findings according to gender.
In the population approached, 7 (47%) were married, 3 (20%) were single, whilst 2 (13%) were divorced and 3 (20%) were widowed. This shows that the study covered people in all the social set-up in terms of marital status.

In the doughnut above it is shown that, of the respondents approached, 10(67%) were blacks, 2(13%) each, were white and coloured and 1(7%) were Asians. This shows that the study was not segregating in terms of race, it covered all races and the results can be accepted as a true
reflection of all races. The study also showed that the sample represented demographics in Zamdela and Sasolburg.

**Figure 4.5 Level of education**

![Graph showing educational levels of respondents.](image)

The graph above shows the educational levels of respondents. Seven respondents have matric, five have diploma, three had a bachelor’s degree and no respondent had a post graduate degree. This generally shows that all our respondents had gone to school at one time or another giving confidence in the response quality as they all had the ability to read, understand and write the questionnaire.
Figure 4.6 Employment

The pie chart above shows that 7(47%) of the respondents were not employed and 8(53%) were employed. Most of the employed respondents were working in different plants of the Sasol company.

Table 4.1 Period of employment on current job

<table>
<thead>
<tr>
<th>Period of Employment in Years</th>
<th>Number</th>
<th>%age rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5 years</td>
<td>1</td>
<td>12,5</td>
</tr>
<tr>
<td>6-10 years</td>
<td>6</td>
<td>75</td>
</tr>
<tr>
<td>11-15 years</td>
<td>1</td>
<td>12,5</td>
</tr>
<tr>
<td>16-20 years</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20+ years</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The table above shows that 1(12,5%) each had been employed for a period of 1-5 and 11-15 years, whilst the majority 6 (75%) had spent 6-10 years at their current jobs.
4.2.2 Health Assessment

Figure 4.7 Exposure to toxic substances (air or water?)

Only one respondent indicated that he/she was never exposed to toxic substances, two indicated that they were occasionally exposed to toxic substances while five indicated that they were often exposed to toxic substances. The majority (seven) indicated that they were very often exposed to toxic substances. An analysis of these results will show that the people in the area of study are exposed to toxic substances.

Table 4.2 Haematological tumours in the last 10 years

<table>
<thead>
<tr>
<th>Haematological tumours</th>
<th>Number</th>
<th>%age rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>10</td>
<td>67</td>
</tr>
<tr>
<td>Occasional</td>
<td>5</td>
<td>33</td>
</tr>
<tr>
<td>Often</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Very often</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The data in the table above shows that 10 (67%) of the respondents indicated that they have never suffered from haematological tumours and 5(33%) occasionally suffered from the
diseases. Haematological tumours refer to the haematological cancers which are: leukaemia, where abnormal white cells start to grow in an uncontrolled manner and production of normal blood cells is reduced patients experience symptoms of unusual bruising, bleeding and recurrent infections. Lymphoma are cancers of white blood cells developing in the lymphatic system, usually presenting with swollen lymph glands but sometimes affecting other parts of the body. Myeloma is a bone marrow cancer that can cause damage to the bones, often leading to severe back pain and damage to the kidneys. These are cancers arising from abnormal blood or bone marrow cells. They are rare diseases, accounting for less than five percent of all registered cancers.

**Figure 4.8 Admission in hospital for any illness associated to environmental pollution in the last 10 years**

In the pie chart above it can be seen that 2(13%) of the respondents indicated that they have never been admitted in hospital, 4(27%) indicated that they were occasionally admitted to hospital due to an attack by environmentally associated diseases, whilst 3(20%) indicated that they are often admitted to hospital due environmentally associated illnesses, 6(40%) indicated that they were very often admitted to hospital due to environmentally associated illnesses. This analysis shows that in this group people are usually admitted to hospital due to environmentally associated illnesses.
Figure 4.9 Have you ever been diagnosed of any of the following diseases: lung cancer, leukaemia and lymphomas?

Figure 4.9 above shows that 5(33.3%) of the respondents had been diagnosed with either lung cancer, leukaemia and lymphoma. The other 5(33.3%) were not sure whether they were diagnosed of the diseases, while the other 5(33.3%) indicated that they were not diagnosed of any of the diseases. It can be concluded that people suffer from the above mentioned diseases in Sasolburg.

Figure 4.10 Has anyone from your family died of any of the above diseases in the last 10 years?

Yes
No
Not sure
5(33.3%)
5(33.3%)
5(33.3%)
Five respondents representing 33% of the response rate indicated that one of their family members died of the diseases while ten representing 67% of the response rate indicated that there is no record of any of their family members who died of the diseases.

**Table 4.3 Distance from the mine in the last 10 years**

<table>
<thead>
<tr>
<th>Distance</th>
<th>Number</th>
<th>%age rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5km</td>
<td>15</td>
<td>100</td>
</tr>
<tr>
<td>6-10km</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10+km</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Fifteen respondents representing a 100% response rate indicated that they stay within the 0-5 km radius within the mining area. This revelation shows that all the respondents are living in an area where they can easily be attacked by the diseases that are as a result of mining activities.

**Table 4.4 How long have you stayed in Sasolburg?**

<table>
<thead>
<tr>
<th>Years</th>
<th>Number</th>
<th>%age rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5years</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>6-10years</td>
<td>5</td>
<td>33</td>
</tr>
<tr>
<td>10+years</td>
<td>7</td>
<td>47</td>
</tr>
</tbody>
</table>

Three respondents, representing 20%, indicated that they have been staying in Sasolburg between the period of 0-5 years. The other five, representing 33%, indicated that they have been staying in the area for 6-10 years, while the seven respondents who were the majority of the population representing 47%, indicated that they have been the residents for 10 years and above. This shows that the respondents represented the whole population in terms of the variations of the years they stayed in the area.
Table 4.5 How often do you encounter the following? (Noise, dust, dangerous equipment)

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Occasion</th>
<th>Often</th>
<th>Very Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Dust</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Dangerous equipment</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
</tbody>
</table>

Hundred percent (100%) of the participants reported that they encounter noise, dust and dangerous equipment. This is basically because of their proximity to the mining environment.

4.2.3 Environment and Justice

Figure 4.11 Do you have community programmes to mitigate environmental pollution?

Two respondents representing a 13% of the response rate indicated that there some community based programmes to mitigate environmental pollution in their areas of residence, while ten representing 67% of the response rate confessed ignorance of the presence of such programmes and three representing 20% of the response rate indicated that were not sure of
the presence of such programmes. This can be interpreted to mean the majority of the respondents 67% + 20% are not really aware of such programmes in the community.

Community programmes include community awareness programmes where they train the community about the awareness of the importance of a clean environment around them.

**Figure 4.12 Do you think these programmes are effective?**

![Pie chart showing responses](image)

Only 1(7%) indicated that the programmes are effective, 3(20%) were not sure whether the programmes are effective and 11(73%) indicated that the programmes are not effective.

The educational programmes assist the community by making them aware of the challenges they face as a result of environmental pollution, what and how the community can do to mitigate environmental pollution. They empower the youth of Zamdela to act positively towards curbing environmental pollution and its hazards through youth projects.
Table 4.6 Do you think the government department responsible is playing its role in mitigating environmental pollution?

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>No</td>
<td>12</td>
<td>80%</td>
</tr>
<tr>
<td>Not sure</td>
<td>3</td>
<td>20%</td>
</tr>
</tbody>
</table>

Twelve respondents representing an 80% of the response rate indicated that the government department responsible for mitigating environmental pollution is not doing its duties effectively while 3(20%) were not sure. It can be seen that there was no respondent who indicated that the department is doing its duties effectively. This is a challenge to the National Department of Environmental Affairs review its aim towards environment.

Figure 4.13 Is the municipality helping in mitigating the effects of environmental pollution?

It can be seen that 1(7%) each indicated yes and not sure that the municipality is helping in mitigating environmental pollution, whilst 13(86%) indicated that the municipality is not helping at all in mitigating environmental pollution.
Only 1(7%) indicated that NGOs are helping in mitigating environmental pollution, 3(20%) indicated that they are not sure whether NGOs are doing something or not to mitigate environmental pollution. The majority 11(73%) indicated that the NGOs are not doing anything to mitigate environmental pollution.

The NGO has tried to join hands with the municipality and Sasol mine in mitigating environmental pollution but the effort does not seem to be fruitful. The aim was to form a group that will be responsible for monitoring Sasol production in terms of how many pollutants are released daily. The stringent penalties would be given to Sasol and that would compel the company to reduce the level of pollution it causes in the area.
Figure 4.15 Are health facilities adequate to deal with victims of environmental pollution?

One each representing a 7% each of the respondents reported that yes and not sure that the health facilities in the area can cope with victims of environmental pollution, however, the majority 13(86%) reported that the health facilities in the area cannot cope with victims or cases of environmental pollution.

Table 4.7 Do you think current policies that deal with environmental pollution are being adhered to by the companies in Sasolburg?

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>0%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>14</td>
<td>93%</td>
</tr>
<tr>
<td>Not sure</td>
<td>1</td>
<td>7%</td>
</tr>
</tbody>
</table>

In the table above no respondent indicated that the policies are being adhered to, only 1(7%) was not sure whether the policies are being followed or not. However, the majority 14(93%) indicated that the policies are not being adhered to.
4.2.4 Epidemiology of public health standards

Table 4.8 How many of each of the respiratory admissions has been recorded on a monthly basis in 2012?

<table>
<thead>
<tr>
<th>Respiratory diseases</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma</td>
<td></td>
</tr>
<tr>
<td>Bronchitis</td>
<td></td>
</tr>
<tr>
<td>Lung cancer</td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td></td>
</tr>
<tr>
<td>Other respiratory diseases</td>
<td></td>
</tr>
</tbody>
</table>

Response to this question could not be recorded as Chris Hani Clinic, Metsimaholo Clinic and Zamdela Clinic indicated that they cannot provide the statistics as there are no separate records for patients treated for environmental pollution related diseases and other diseases. So statistics on the respiratory admissions recorded on a monthly basis in 2012 could not be validated because of poor record keeping. Therefore cases of asthma, bronchitis, lung cancer, pneumonia, and other respiratory ailments could not be ascertained.

4.2.5 Interpretation of results from interviews carried out with representatives from Sasol, NGO, municipality and clinic.

Interviews were carried out with health and safety representative from Sasol, a chair person of The Vaal Triangle Environmental Management Group, acting Director of Metsimaholo Local Municipality and the Sister-in-charge at Zamdela Clinic. An interview schedule carrying four questions was used for the interviews.

4.2.5.1 The effects of environmental pollution on public health

From the interviews carried out, the interviewees pointed out the major effects of environmental pollution.

The local NGO, Vaal Triangle Environmental Management Group indicated that residents do not enjoy air quality that is not harmful to their health and well-being. The Sasolburg Environmental Committee, which coordinates the community air monitoring program in
Sasolburg, took air samples in the area using bucket brigade air monitoring method. These samples measured eighteen different toxic chemicals in the air, most of which were at levels which can affect human health. The results of these samples have been reported to the community and the council.

The acting Director of Metsimaholo Local Municipality reported that environmental pollution affects soil and vegetation due to acid rain and it causes climate change. Acid rain is caused by emissions of sulphur dioxide and nitrogen oxides which combine with the water in the atmosphere to produce acids. Acid rain weakens the trees by damaging their leaves, limiting the nutrients available to them and poisoning them with toxic substances from the soil. It was indicated that climate change is also directly linked to industrial pollution because South African industry is based on the fossil fuel burning which is the main reason for the massive increase of carbon dioxide (CO2) emissions. Climate change attacks the health of the residents with dirtier air and water, threats to food supplies, and causes stress on, and possible collapse of, many ecosystems that purify air and water.

The sister-in-charge at Zamdela clinic mentioned that air pollution leads to development of acute health problems and chronic respiratory symptoms and burning eyes. Many children who live in close proximity to the mine are the most affected. High-risk groups such as the elderly, infants, pregnant women, and sufferers from chronic heart and lung diseases are more vulnerable to air pollution. Children are at greater risk because they are generally more active outdoors and their lungs are still developing. Exposure to air pollution can cause both acute and chronic health effects. Some acute health effects include eye irritation, headaches, and nausea while some chronic health effects include decreased lung capacity and lung cancer resulting from long-term exposure to toxic air pollutants.

The sister-in-charge at Zamdela clinic, further reported that noise pollution leads to hearing deficiency. The elderly and mine workers are the most affected group in the community. The young and hospitalised people are also affected. Young children are unable to protect their hearing and rely on their parents to keep them from constant exposure. The elderly may not have the capabilities to protect their hearing if they are disabled by mental or physical illnesses, they also need assistance from those who are in good health. Patients in the hospital are not safe from the effects of noise either. The effects include elevated blood pressure, noise-induced hearing loss, sleep disorders, and irritability. In addition, noise pollution also creates a decrease in performance at work and schools due disturbances it causes.
The local NGO, (The Vaal Triangle Environmental Management Group) mentioned that water pollution leads to skin irritations, burning sensations in the throat and chest and stomach-aches. The polluted water has undesirable colour, odour, taste, organic matter contents, harmful chemical contents, toxic and heavy metals, oily matters and industrial waste products. A survey of industrialized zones in Sasolburg shows that ground water has become unfit for drinking due to high concentration of toxic metals and chemicals and there is also bacteria contamination. It was also indicated that water pollution causes hypertension and coma due to excess of copper, heavy doses of zinc salts cause vomiting and cramps. It was reported that mercury is very toxic and an excess of it in the human body causes headaches, abdominal pain, diarrhoea and even death. It may cause impairment of vision and muscles and it disturbs the reproductive system. It also causes insomnia, memory loss, gum inflammation, loosening of teeth and loss of appetite.

According to the sister-in-charge at Zamdela Clinic, toxic effects of Sasol emissions of hydrogen sulphide (H$_2$S), and exposure to this toxin result in coma, convulsions, headache and gastrointestinal disturbance. In addition, H$_2$S is a broad-spectrum poison affecting the eyes, respiratory system and central nervous system. Sasol refuses to acknowledge the toxic effects of their emissions of hydrogen sulphide yet the surveys made by various stakeholders indicated that it releases thousands of H$_2$S emissions in South Africa annually. All the interviewees were in agreement on the effects of environmental pollution which was a sign that people know the consequences of not caring for the environment.

4.2.5.2 Environmental pollution impact on public health.

It was highlighted that environmental pollution has impacted negatively in the Sasolburg area. Some of the major impacts mentioned in the interviews were:

Residents live with the constant smell of a variety of chemical pollutants released both by normal production and by periodic incidents. At first people were unaware of the hazardous exposure to chemicals because they were excited that industries brought jobs and growth in the area. Residents experience diseases such as asthma, bronchitis, TB, pneumonia, sinusitis, cough and dizziness. Those who are young, old, infirm, people living with HIV and those living in poverty are particularly at risk. In addition to that, the chemicals cause irritation of the eyes as a result of the dirty black ash that is blown from the waste coal-ash dump. Many people in the area have burning eyes due to the exposure to a variety of toxicants. Apart from that, infants suffer from ear, nose, skin and throat diseases, coughs, wheezing, pneumonia and
asthma attacks. The air quality in the area is not healthy for children and the environment that they are exposed to when playing is not safe. They are exposed to dirty water which smells very bad. That contributes to skin problems as well as respiratory diseases. The noise from the industries during production damages the hearing system of the children.

Furthermore, the sister-in-charge at Zamdela clinic indicated that the ambient levels of benzene cause leukaemia and cancer of blood forming organs. Residents are exposed to higher levels of benzene in the air because they live near hazardous waste sites, petroleum refining operations, petrochemical manufacturing sites, and gas stations. Most importantly individuals employed in industries that make or use benzene, are exposed to the highest levels of benzene. About half of the air breathed in by residents exposed to high levels of benzene passes through the lining of their lungs and enters their bloodstream. It was also indicated that exposure to benzene is harmful to the reproductive organs. Some women workers who breathed high levels of benzene for many months had irregular menstrual periods, these women showed a decrease in the size of their ovaries.

The negative impact on mental health is more pronounced for minorities and the poor than it is for whites and wealthier individuals. This is due to inequality in education, income, and occupation which exacerbates the gaps between the health of the haves and the have-nots. Residential proximity to industrial activity is psychologically harmful due to the fact that the majority of residents perceive industrial activity negatively. They perceive it as a potential health threat or a sign of neighbourhood disorder. The residents find residential proximity to industrial activity to be stressful and therefore for them to live near industrial activity, they encounter worse mental health than those who do not live near industrial activity.

It is a fact that all the interviewees are aware of the impact caused by environmental pollution.

4.2.5.3 Policy measures to reduce the impact of environmental pollution.

The interviewees indicated that there are some policy measures put in place by government to control environmental pollution. Some of the policy issues raised include;

The South African government implemented the National Environmental Management: Air Quality Act 2004. The outcome of the efficient and effective implementation of Air Quality Act is of course ambient air that is not harmful to health and well-being of all across the
nation. This legislation controls hazardous chemical substances to reduce smell. Sasolburg is in Vaal Triangle area and air quality management in this area is primarily the minimisation, management and prevention of air pollution, which aims to improve areas with poor air quality and maintain good air quality throughout. In the Vaal Triangle air quality is generally considered to be poor as a result of the multitude of the industrial pollution sources. The area is called the Vaal Triangle Air shed Area as it has been identified as one of the national air pollution hot spots and it is believed to have extremely poor air quality and potentially causing problems in the future. Air Quality Management implementation Plan was developed as a monitoring tool for the improvement of the air quality. The plan aims at the reduction of the number of human and environmental health risks, while reducing the amount of emissions in a cost effective manner. The plans development relates to the provisions as specified by the Air Quality Act.

There is a monitoring station placed by the government in the area in one of the primary schools which is managed by a private consultant instead of the local municipality. The community claim that the municipality does not have the capacity to manage the monitoring station and they believe that there are many problems about the station. These make the residents doubt that the station is effective.

**Organisational effort to mitigate environmental pollution.**

Each interviewee indicated what his/her organisation is doing to mitigate environmental pollution.

- Sasol

Sasol mentioned that it is committed to act responsibly and with due regard to the effects of its operations and products on the environment. It monitors and audits environmental performance of all its operations and activities according to internationally accepted environmental management standards. Apart from that, it conducts environmental impact assessments when establishing new facilities. In 2010 Sasol proposed to construct a gas engine power plant and it appointed an independent environmental assessment practitioner (EAP) to undertake environmental authorisation process. An application was submitted to the National Department of Environmental Affairs (DEA) to be given a project reference number.
Furthermore, it adopted the best affordable technology to limit emissions because it believes that the quality of the air, water, and soil should be protected for the continued benefit of all ecosystems. The engine behind this is that the needs of present and future generations will be met. In addition, it promotes environmental awareness and responsibility among employees, customers, suppliers and the community at large. It also supports research into the protection of the environment.

Sasol reported that it promotes continual improvement in environmental, health and safety performance. It also controls, through sponsorship and resources, community involvement in environmental protection in Zamdela. It does these as a way of showing conformity to environmental legislation as well as safety and health legislation. Sasol gives education sponsorship for students who are willing to pursue their career in maths and science. The expectation is that they should contribute towards environmental mitigation with the knowledge they acquired.

I think Sasol is not doing enough to mitigate environmental problems. They pollute the environment daily with different harmful toxicants. The health of Zamdela residents are badly affected by pollution from Sasol. The best it can do is to reduce the level of pollution by implementing new technology that will be used for production. Sasol contradicts with its studies that it conforms to environmental legislation because it is the major emitter of pollutants in Sasolburg. The efforts it makes cannot be effective because it does not seem to change any time soon. The government has to consider health of the people before economic gains from Sasol and it has to take stringent decision towards this company.

- Non-Governmental Organisation

The Vaal Triangle Environmental Management Group in Sasolburg has been putting pressure on Sasol to reduce its environmental impact and to be transparent. It has been fighting to encounter industry’s greenwash through awareness programmes. It is responsible for air monitoring in the area and air samples have been taken which reveals various toxic chemicals in the air. The Vaal Triangle Environmental Management Group mentioned that it appreciates the fact that Sasol provides jobs to the local residents but that does not mean that, Sasol has to pollute the air they breathe. It emphasises that Sasol is only looking for profit and does not care about the health of the people. It also reported that Sasol puts the blame on the residents, claiming that they pollute the environment by using coal for cooking. The Vaal
Triangle Environmental Management Group did not agree with these claims but it argues that Sasol should be accountable for environmental consequences and stress it puts on people.

The Vaal Triangle Environmental Management Group has been negotiating with the department of health to be involved and the department must conduct a study in Sasolburg to check the number of affected people and take steps against Sasol. The company must take responsibility for the damage they have done to the air the residents breathe, as well as their health.

It creates environmental pollution awareness campaigns, where they create a stage performance in which they talk about the problems of environmental pollution in general. These efforts from The Vaal Triangle Environmental Management Group are effective because the residents voluntarily participate by sensitising others about the environment. The community is empowered by these efforts and people’s response is very good and they also show support to The Vaal Triangle Environmental Management Group. The group advocates for sustainable development and for it to be attained, Sasol will have to reduce its emissions contributing to climate change. The collaboration of NGOs participate in marches against Sasol, they try their best to make sure that Sasol adheres to the principles of sustainable environment.

- Municipality

It has not done much except making environmental awareness programmes, participating in sports, schools, health and hygiene awareness. It is currently planning the strategies in order to make awareness in an effective way because well planned strategies will increase the residents’ knowledge.

The municipality, in partnership with Sasol have an environmental year plan review on how to mitigate environmental pollution which is currently being reviewed. Hopefully the plan will bring fruitful results or changes in the area. This is because in the past years, the effects of industrial pollution have been severe despite the negotiations that the local municipality made with Sasol. With the new plan between Sasol and the municipality, there is hope that things will be better.

- Zamdela Clinic

It provides the health services to the community as it is responsible for giving quality health to the patients. Some residents claim that the clinics in the area do not seem to offer solutions
or understand the cause of their sicknesses. The fact is that people are diagnosed and are given proper treatment. There is adequate medication for various diseases caused by industrial pollution. The common diseases that people contract in the community are asthma, bronchitis, TB, pneumonia, sinusitis, cough, dizziness, impaired hearing, skin irritations and diarrhoea. All age groups in the community get good services from the clinic. The sister-in-charge at the clinic indicated that the clinic is well equipped to deal with any of the chronic diseases mentioned above. The clinic effectively manages to help its patients who are affected by the toxic substances from the industries. The population in the community would decrease if health centres were not effective.

The clinic educates the community on general health and encourages them to have regular check-ups. The clinic plays a pivotal role in increasing public awareness of chemical hazards. The local media is used to educate the community about industrial pollution and communication is through the language that the community understands. Residents are encouraged to work together to curb the problems caused by the industries. Most importantly people should immediately go to the health centres when they perceive signs of sicknesses in their bodies.

Based on the data gathered through interviews, it is clear that these organisations are doing something to mitigate environmental pollution. Among the stakeholders mentioned above, Sasol is the least in minimising environmental pollution despite the efforts it makes, because it is the major cause of all the environmental problems in Sasolburg. The Vaal Triangle Management Group is the most effective stakeholder in environmental pollution mitigation. In addition to the two main stakeholders above, there are some pressure groups in the area (Sasolburg Environmental Committee and Converse Group) that always lobby to Sasol and health authorities for solutions to their problems.

4.3 Summary

This chapter focused on the presentation, analysis, and interpretation of the data collected. Generally, in this chapter it has been indicated that Sasol is responsible for environmental pollution in the Zamdela location and The Vaal Triangle Management Group is trying to mitigate the problem caused by Sasol. The next chapter will discuss the summary of the study, findings, conclusions, and recommendations.
Chapter 5

5.0 Conclusion and Recommendations

Conclusion
The main question of the research was; how environmental pollution (specifically air and water pollution from industrial processes) affected the public health of the Sasolburg community during the last 10 years? The sub-questions to the study were as follows: To what extent has environmental pollution impacted on the public health of the Sasolburg community? What measures have been put in place by government to reduce the impact of environmental pollution on communities that are in proximities of industrial pollution? What are communities affected by environmental pollution doing to mitigate its effect on public health? What are the companies involved in industrial pollution doing to minimise the effects of environmental pollution on public health? How can different stakeholders (community members, government, industries and NGOs) join hands together to reduce the impact of industrial externalities on the environment? The results of the research can sufficiently answer the research question and sub-questions. After a thorough investigation in Sasolburg, it was clear that residents of Zamdela Township who are located in the heart of chemical industries face serious health hazards due to pollution emanating from the industries.

The results obtained in this study is evidence that environmental pollution in Sasolburg area poses serious risks to the health of people living within the surrounding area. The communities close proximity to the mine are exposed to different toxic substances and chemicals which cause dangerous diseases. People experienced problems such as respiratory problems, skin irritations, tumours, burning eyes, headaches, hearing deficiency, dizziness and hypertension, which is a nutrition deficiency related disease. The bad odour from the flares burning day and night affects children badly and the black smoke they inhale daily cause asthma and TB. The water that the residents use is polluted and negatively affects their vegetation and health. Residents lose lives due to the effects of harmful air quality in the area.

The research focused on the relatively low priority by the public health community accorded to environmental pollution compared to human wastes. The critical reason for this
prioritisation was the potential for acute health effects from human wastes as compared with the belief that environmental pollution has only indirect effects. The department of health normally responds to industrial wastes when they endanger the potable nature of water supplies or interferes with water and sewage treatment processes. Within the public health community, however, a relatively small group of interdisciplinary professionals argued for attention to the indirect health effects of industrial wastes and their impacts on the totality of the environment.

Experience gained in the process of conducting this study indicates a great need to link environmental pollution and human health. The majority of the respondents in this study identified Sasol as the engine of industrial pollution which causes dangerous diseases to the community due to visual cues of flares, coal ash dumps and hazardous smell. It has to be taken into consideration that the environment has to be sustainable and everyone in South Africa has a right to live in a healthy environment. Any kind of pollution is harmful to human beings and everything that surrounds them. The needs of present generation in Zamdela have to be met without compromising the needs for future generations. Thus, systems are required to be put in place for providing more knowledge that will be useful in recognition, diagnosis and management of environmentally related illness.

The findings of this research disagrees with those of the Transvaal study and reflects the difficulties in research on air pollution and health and may be related to the fact that the industrial processes and the resultant pollutants in Sasolburg are different from those in the eastern Transvaal Highveld where the only pollutants measured were smoke and carbon dioxide (Coetzee et al. (1986). The air samples in Sasolburg revealed that there are various dangerous toxic substances emanating from industrial production. The diseases caused by the toxicants help to find out which pollutant causes a certain disease.

Communities need to mobilise around their right to clean environment and healthy living conditions, while understanding the role that industry plays in creating employment and boosting the economy. Some members of the community formed some groups create awareness that their environment is polluted and how people should treat certain diseases. The whole community should participate to try and negotiate with the Sasol company to take their grievances into consideration. Government needs to develop more appropriate
legislation in the interests of the communities they represent. The Sasol company claims to adhere to the principles of Air Quality Act which stipulates that there should be ambient air that is not harmful to health and well-being of all across the nation. This claim is not true because Sasol is the major polluter of toxicants in Sasolburg. According to the responses from the community and Sasol workers, the Sasol claims do not stand. Residents inhale polluted air every day and Sasol does not seem to reduce its pollution at least to the barest minimum. The industry participation in creating employment and boosting the economy will become compulsory with respect to their permit conditions, industry needs to be challenged to move beyond their narrow concern with profit margins and put people first by understanding that they have a social responsibility towards their workers, the surrounding communities and the environment (Jacobs, 2006).

The problems caused by industrial pollution raised an alarm, not only to the residents affected, but to the neighbourhoods. The Vaal Triangle has been declared as air shed priority area by the government due to immense pollution in the area. Sasolburg has been used as an example of pollution hot spot by many researchers. This led to a massive environmental NGO community development. The NGOs, like the residents, advocated for environmental justice from Sasol. They urged the government to make stringent conditions on the company without looking at economic benefits.

**Recommendations**

Based on the findings of this study the following recommendations are made:

Health facilities should be equipped with appropriate analytical systems that will enable the use of biological samples for the purpose of diagnosis and monitoring of suspected environmental related cases. Sensitive equipment for carrying out environment and health related research are needed to provide a better and quicker approach in data generation. This indicates the need to establish an institution that will appropriately address environmental versus health issues. Such a facility will be handy for long-term monitoring, provision of guidance and be a reference point in future studies.
Although indicating the need to carry out a comprehensive study, the results call for immediate action to prevent continued public over-exposure to environmental pollution. Close monitoring of children should be done to monitor their health and provide appropriate medical attention meant to check effects of the pollution. A general check up on the children and adolescents should be conducted with a focus on establishing the extent of over-exposure to environmental toxicants. More environmental samples, including air samples, should be analysed to evaluate the environment.

There is need for measures to be instituted for proper mine management to minimize the risk of environmental pollution that pose a risk to human health. The industries in Sasolburg should receive higher fines for exceeding emissions standards and they should be accountable for their actions. They should train the volunteers on how to respond to chemical disasters, for example, what they have to do when there is a gas leakage. Production of environmental pollution should be reduced by using less pollution generating means in various mining activities. Groups interested in clean environments, such as sportsmen and manufacturers who require high quality water process in communities should push for a broader state legislative mandate in regard to pollution control.

Countries should create environmental management boards with responsibility for industrial wastes. Sasol should disclose annually all chemicals and volumes used for evaluation of its operation in order to substantiate the community’s arguments that the company pollutes the air they breathe. The company should first demonstrate that the technology they will use when opening new plants will be that of low emission flow process.

The municipality should issue a sound plan that will incorporate the use of the local media to educate the community about dangers of industrial pollutants. It should stipulate how the resources will be allocated to protect the community. These messages should be in the local languages to avoid communication misunderstanding. The municipality should also make use of a variety of social networks to set up dialogue about industrial hazards education, taking into consideration that the majority of the youth and young adults use these networks to communicate.
References


Medical Research Council, 1997. IEH report on THE NON-AUDITORY EFFECTS OF NOISE. 


Myers, J. E. 2010. How does Land Pollution Effect Your Health? 
http://www.livestrong.com/article/144128


Witi, J. 2005. Report on Ambient PM 10 and PM2.5 Estimates from Monitoring Stations Data. CapeTown:Cape Penensula University of Technology.
Appendix A

QUESTIONNAIRE

The purpose of this study is to carry out an assessment of environmental pollution and public health risk for the Sasolburg community. The questionnaire comprises five sections. Section A solicits the biographical data of respondents, Section B covers the health assessment, Section C proximity to mine site, Section D: environment and justice and Section E covers epidemiology of public health standards. All the information you provide will be treated as confidential and would be used for research purposes only. You may complete the questionnaire anonymously. Please indicate your response to the options provided by making a cross or a tick (X ;√) in the appropriate boxes or write on the spaces provided. Thank you kindly for your willingness and time to complete this questionnaire.

Section A.

Demographics

1. What is your age group
   
   20-30
   40-50
   50-60
   60+

2. What is your gender?
   Male
   Female

3. What is your marital status?
   Married
   Single
   Divorced
   Widowed

4. What is your race?
   White
5. What is your level of education?

- Metric
- Diploma
- Bachelor’s degree
- Post graduate degree
- Other (specify)

6. Are you employed?

- Yes
- No

7. If yes for how many years have you been employed on the current job?

- 1-5
- 6-10
- 11-15
- 16-20
- 20+

Section B Health Assessment

8. Have you ever been exposed to toxic substances (air or water)?

- Never
- Occasion
- Often
- Very often

9. Have you ever suffered any haematological tumours in the last 10 years?

- Never
- Occasion
- Often
- Very often

10. Have you ever been admitted in hospital for any illness associated to environmental pollution in the last 10 years?

- Never
- Occasion
- Often
- Very often
11. Have you ever been diagnosed of any of the following diseases?

Yes
No
Not sure

12. Has anyone from your family died of any of the above diseases in the last 10 years?

Yes
No

Section C Proximity to mine site

13. How far have you stayed from a mine in the last 10 years?

0-5 km
6-10 km
10+ km

14. How long have you stayed in Sasolburg?

0-5 years
6-10 years
10+ years

15. How often do you encounter the following?

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Occasion</th>
<th>Often</th>
<th>Very often</th>
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</thead>
<tbody>
<tr>
<td>Noise</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dust</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Dangerous equipment</td>
<td></td>
<td></td>
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<td></td>
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</table>

Section D Environment and Justice

16. Do you have community programmes to mitigate environmental pollution in your area?

Yes
No
Not sure
17. If yes briefly describe them
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

18. Do you think these programmes are effective?

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<tbody>
<tr>
<td>Yes</td>
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<tr>
<td>No</td>
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<tr>
<td>Not sure</td>
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19. Are you able to explain how they assist the community
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

20. Do you think government departments play any role in mitigating environmental pollution?

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<tr>
<td>Yes</td>
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<td>No</td>
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<tr>
<td>Not sure</td>
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21. Is the municipality helping in mitigating the effects of environmental pollution?

<p>| | |</p>
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<tbody>
<tr>
<td>Yes</td>
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<tr>
<td>No</td>
<td></td>
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<tr>
<td>Not sure</td>
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</table>

22. May you list any programmes that the municipality is involved in to mitigate the effects of environmental pollution?
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................
........................................................................................................................................

23. Do NGOs assist in the mitigation of environmental pollution on public health?

| Yes |     |
24. What types of programmes are being done by NGOs?

- [ ] No
- [ ] Not sure

25. Are health facilities adequate to deal with victims of environmental pollution in your area?

- [ ] Yes
- [ ] No
- [ ] Not sure

26. Do you think current policies to deal with environmental pollution are being adhered to by the companies in Sasolburg?

- [ ] Yes
- [ ] No
- [ ] Not sure

**Section E Epidemiology of public health standards**

27. How many of each of the respiratory admissions has been recorded on a monthly basis in 2012?

<table>
<thead>
<tr>
<th>Disease</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asthma</td>
<td></td>
</tr>
<tr>
<td>Bronchitis</td>
<td></td>
</tr>
<tr>
<td>Lung cancer</td>
<td></td>
</tr>
<tr>
<td>Pneumonia</td>
<td></td>
</tr>
<tr>
<td>Other respiratory diseases</td>
<td></td>
</tr>
</tbody>
</table>

Thank you for your time and cooperation.

Lineo Moshanyana
Researcher
Appendix B

Interview schedule for the Sasol Company, NGO, municipality, Zamgela clinic.

- What are the effects of environmental pollution on public health?
- To what extent has environmental pollution impacted on the public health of the Sasolgurg community?
- What policy measures have been put in place by government to reduce the impact of environmental pollution on communities that are in proximities of industrial pollution?
- What are you doing as an organisation to mitigate environmental pollution in the area of influence?
APPENDIX I

PERMISSION TO SUBMIT A TREATISE/DISSERTATION/THESIS
FOR EXAMINATION

Please type or complete in block ink.

FACULTY: Business of Economic Studies

SCHOOL/DEPARTMENT: Development Studies

Surname and initials of supervisor/promoter: MG. T. C. ONAMO

Surname and initials of co-supervisor/co-promoter: MUSHANYANA L. G.

(student number): JH0218233, candidate for the (full description of qualification):

Masters in Development Studies


THE IMPACT OF ENVIRONMENTAL POLLUTION ON PUBLIC HEALTH WITH SPECIFIC REFERENCE TO JAMILA INDUSTRIAL AREA

I hereby certify that we give the candidate permission to submit this dissertation/thesis for examination:

SUPERVISOR / PROMOTER

CO-SUPERVISOR / CO-PROMOTER

DATE

DATE
ETHICS PROFORMA FORM

Please type or complete in black ink.

FACULTY: BUSINESS AND ECONOMIC SCIENCES

SCHOOL/DEPARTMENT: DEVELOPMENT STUDIES

I, (surname and initials of supervisor) CONVOE, T

the supervisor for (surname and initials of candidate) MOKHOKANA L. G.

(student number) 210218889

A candidate for the degree of

MASTERS IN DEVELOPMENT STUDIES

with a thesis entitled (full title of thesis):

THE IMPACT OF ENVIRONMENTAL POLLUTION ON PUBLIC HEALTH WITH SPECIFIC REFERENCE TO SADIBERG INDUSTRIAL AREA, SOUTH AFRICA

considering the following ethical ethics (please tick the appropriate box):

<table>
<thead>
<tr>
<th></th>
<th>YES</th>
<th>NO</th>
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</thead>
<tbody>
<tr>
<td>1. Is there any risk of harm, embarrassment of offence, however slight or temporary, to the participants, third parties or to the communities at large?</td>
<td>❌</td>
<td>✔</td>
</tr>
<tr>
<td>2. Is the study based on a research population defined as ‘vulnerable’ in terms of age (e.g. children of school-going age, students, and the aged), physical characteristics and/or disease status?</td>
<td>✔</td>
<td>❌</td>
</tr>
<tr>
<td>3. Does the research/ data that will be collected require an ethics clearance number in order to obtain institutional authority for this study?</td>
<td>❌</td>
<td>✔</td>
</tr>
<tr>
<td>4. Will the participant’s privacy, anonymity and confidentiality be compromised?</td>
<td>✔</td>
<td>❌</td>
</tr>
<tr>
<td>5. Will confidentiality on the outcome of the research be required by the institutional authority?</td>
<td>✔</td>
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</table>
Please note that if any of the questions above have been answered in the affirmative the student will need to complete the full ethical clearance form and submit to the Faculty Ethics Co-ordinator.

I hereby certify that the student has given full research ethical consideration and full ethical approval is not required.

[Signature]
SUPERVISOR / PROMOTER

[Signature]
HEAD OF DEPARTMENT

[Signature]
STUDENT

[Signature]
DATE

[Signature]
DATE

[Signature]
DATE

Please ensure that the research methodology section from the proposal is attached to this form.
TO WHOM IT MAY CONCERN

I have examined the thesis of Linda Creec Mothweni student number 210213831, and made recommendations for grammar and spelling corrections.

I have not examined the referencing system, nor the content, argument and language specific to the academic discipline concerned.

Yours faithfully

[Signature]

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Email: janetm@isrinfo.com