AN ANALYSIS OF COMMUNITY AWARENESS TO CHEMICAL HAZARDS IN ZAMDELA TOWNSHIP – SASOLBURG

By

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Submitted in partial fulfilment of the requirements for the degree Masters in Disaster Management

In the

Disaster Management Training and Education Center for Africa

At the

UNIVERSITY OF THE FREE STATE

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2011

DECLARATION OF ORIGINALITY

I, **PUSELETSO KOLANCHU,** hereby present for consideration by the Disaster Risk Management Training and Education Centre for Africa (DIMTEC) within the Faculty of Natural and Agricultural Science at the University of the Free State (UFS) my dissertation in partial fulfilment of the requirements for the degree of Master's in Disaster Management.

I sincerely declare that this dissertation is the product of my own efforts and that no other person has published a similar study from which I might have copied and at no stage will this work be published without my consent and that of the Disaster Risk Management Training Education Centre for Africa (DIMTEC).

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EXECUTIVE SUMMARY

Production and use of chemicals have increased globally over the years. Despite their multiple benefits to human beings, chemicals are reactive, unstable in nature and capable of changing, which can cause chemical accidents. In many instances, chemical manufacturing plants are located close to human dwellings as in the case of Zamdela Township. These chemical plants expose surrounding communities to chemical hazards such as explosion, pollution, gas releases etcetera. Owing to the nature of materials, chemical accidents often require specialised response measures. A more compounding challenge relating to chemical hazards is that they are often not understood by the community. Appropriate measures to deal with chemical hazards are often complex and should be communicated to the local emergency personnel and to the local community through public awareness campaigns.
This study sought to probe what the local authority has done to raise awareness in respect of prevailing chemical hazards in Zamdela Township.

The study found that the majority of participants were not aware of awareness programs being implemented for chemical hazards. There was also an indication from participants that the majority of the community was not aware of procedures to be followed in case of chemical accidents. Positive findings, however, are that the majority of participants indicated that they were involved in community programmes such as volunteerism, education and training and also that they were willing to attend awareness meetings. The results were also supported by the interview with the Fezile Dabi District Municipality disaster management official who confirmed that their focus was more on HAZMAT affecting communities alongside the N1 and N3 roads rather than on the chemical hazards. The results indicated that there was still a lot to be done in educating the community about chemical hazards in Zamdela Township

The study concludes with recommendations which may be used by the municipality to educate the community on chemical hazards, and also on measures to improve awareness campaigns through schools and community organisations.

ACKNOWLEDGEMENTS

I am very grateful to everyone who contributed to this study. I would, however, like to express special appreciation to:

- My study supervisor, Ms Alice Ncube who assumed this responsibility in the past six months and provided incredible leadership which yielded this success.
- The DIMTEC staff who gave me immense support in the course of this study.
- Mr Mmaphaka Tau who provided guidance and support at the start of the study which was the most challenging.
- My husband, Abbey, for encouragement, support and for believing in me. To my daughter, Bontle, for understanding when I had to study.
- To my parents and sister, Puleng, for your encouragement and thank you for babysitting.
- To Mme Ntebo for assisting me with data capturing.
- To Mr Mazibuko of Metsimaholo Local Municipality, Mr. Nhlanhla Xaba of Fezile Dabi District Municipality and other staff members who were kind and helpful.
- To all my friends and colleagues at the City of Tshwane and National Disaster Management Centre for sharing your thoughts and materials that made this study a success.
- To my three energetic field workers Vusi Kaira, Feizel Matroos and Tahleho Mphuthi. Thank you helping me with data collection.

DEDICATION

To my husband Abbey, my daughter Bontle and my entire family, for being patient and understanding while I worked away from home and undertook this study.

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DEFINITION OF TERMS

Social Capital Theory – networks together with shared norms, values and understandings that facilitate co-operation within or among groups (National Statistics, 2003).

Public Awareness – the processes of informing the general public, increasing level of consciousness about risks and how people can act to reduce their exposure to hazards (ISDR 2009).

Disaster Risk Reduction – the conceptual framework of elements considered with the possibility to minimise the vulnerabilities and disaster risks throughout a society; to prevent or limit the adverse impact of hazards, within a broader context of sustainable development (ISDR 2009).

Chemical Hazards – any hazards that result from accidental, deliberate or potential release of a noxious substance into the environment (English Dictionary)

Disaster – means a progressive or sudden, widespread or localised, natural or human-caused occurrence which –

(a) causes or threatens to cause-

1. death, injury or disease;
2. damage to property, infrastructure or the environment; or disruption of the life of a community

(b) is of the magnitude that exceeds the ability of those affected by the disaster to cope with its effects using only their own resources (Disaster Management Act: Act 57 of 2002).

ACRONYMS

EPA	Environmental Protection Agency (US; Denmark)
ISDR	International Strategy for Disaster Reduction
IDNDR	International Decade for Natural Disaster Reduction
UN-IDNDR	United Nations International Decade for Natural Disaster Reduction
NDMF	National Disaster Management Framework of 2005
UNISDR	United National International Strategy for Disaster Reduction
KPA	Key Performance Area
DMA	Disaster Management Act 57 of 2002
SARA	Superfund Amendments and Reauthorization Act of 1986
LECs	Local Emergency Planning Committees
SERCs	State Emergency Response Commissions
UNEP	United Nations Environmental Programme
CAIA	The Chemical and Allied Industries' Association
ICS	Incident Command System
FDDM	Fezile Dabi District Municipality
MLM	Metsimaholo Local Municipality
GDP	Gross Domestic Product
AsgiSA	Accelerated and Shared Growth Initiative for South Africa
AECI	African Explosives and Chemical Industries
MHI	Major Hazard Installations Regulations

CHAPTER 1

INTRODUCTION

1.1 Background

The manufacture, storage and transportation of chemicals are accidents waiting to happen. Chemicals can be corrosive, toxic, and they may react, often explosively. The impact of chemical accidents can be deadly for both human beings and the environment. Chemical accidents are rare, but when they occur they can be disruptive to the lives of the community around chemical plants. In December 1984, the release of toxic gas from the Union Carbide pesticide plant in Bhopal, India resulted in what is still regarded as the worst chemical accident to date. It was reported that half a million people were exposed to toxic chemicals due to gas leakage. More than seven thousand (7 000) people died within days and many more died in the ensuing years. Around one hundred thousand (100 000) people are suffering chronic and debilitating illness (Amnesty International Publications 2004; Dhara 2000:15). Dhara (2000:1) states that an emergency system was virtually non existence, thus adding to the confusion and chaos.

Another major chemical accident happened in Milan, Italy in 1976. A large amount of dioxin was generated by a runaway reactor where 1 800 hectares of land were contaminated and 220 000 people were injured. The local government was informed by the laboratory five days after occurrence of the incident. Owing to the delay in communication, the surrounding community were more exposed and damage spread. Enforced evacuation started after fourteen (14) days and it was too late (Kobayashi & Tamura 1976:1-5).

In South Africa, Umkhonto We Sizwe, the military wing of the African National Congress (ANC) decided in the late 1970s to target oil refineries, fuel depots, the Koeberg nuclear plant and military targets such as Voortrekkerhoogte as part of the fight against the then Apartheid regime (O'Malley n.d). Sasol 1, NATREF and Sasol 2 were attacked by Mkhonto weSizwe Special Operations on the night of 31 May /1

June 1980 (Wikipedia 2011; South African History 1999). There were reportedly no injuries, but damages were estimated at R66 million.

The Koeberg Nuclear Power Station was attacked in December 1982 by Umkhonto we Sizwe. It was also reported that there were no injuries caused by bomb attacks as they only caused damage to these industries (ANC, List of MK Operations n.d).

In 2004, Sasol petrol plant in Secunda, Mpumalanga experienced a giant gas explosion which claimed the lives of six people and more than 100 were injured and in shock. Forty-three of the injured were rushed to the Highveld Medi-Clinic, to receive medical treatment, mainly for burn wounds (South African History 2004). According to reports, there were incidents where the Zamdela community in Sasolburg had been affected. In 2000, the Sasol polymers plant had three serious chlorine gas leaks resulting in the hospitalization of more than 200 people, most of them children from a nearby school (Peek 2000). Chlorine gas can cause serious injury and even death when inhaled in large quantities. It was used as a war gas during World War 1, and is highly regulated by the Environmental Protection Agency (EPA). From the above discussed accidents, it can be noted that factors that contribute to variability in human exposure include:

- Distance of residence from the plant, duration of exposure and activity during exposure.

- The distance of residence from the plant increases the exposure to chemicals. In the case of Bophal, mortality and morbidity decreased with increasing distance from the plant (Dhara 2000:12).

- In terms of duration of exposure, the delay in communication exposed the Milan community to dioxin which resulted in massive damage. Enforced evacuation of community members was done only after 14 days but the damage was already done (Kobayashi & Tamura 1976:1-5).

- Activity during exposure to the gas was certainly a major dose regulating factor in the Bophal case. Gas was released in the form of a cloud which made people to panic and run out of their homes. That resulted in increased ventilatory rates

thereby increasing the dose of the chemical delivered to the respiratory system (Dhara 2000:20).

- In the case of Zamdela, chlorine gas released was in the form of vapour and probably most of the affected children from the nearby school were outside and therefore inhaled it in large quantities (Peek 2000).

South Africa has not experienced chemical accidents to the proportions of the Italian and Indian ones, but the chemical compounds found in raw material and additional chemicals which are used to facilitate refinery operations have a potential to cause major accident with compromised precaution. Bell (2004:22) argues that 'Bhopal type of a disaster' could happen in South Africa because complacency is the enemy of safety. Therefore, proper planning for communities around chemicals industries is crucial to prepare them for possible accidents.

1.2 The petrochemical and chemical industry in South Africa

The South African petrochemical industry is the largest of chemical industries in Africa. It is somewhat unique in that one of the largest refineries uses coal rather than crude oil as a feedstock. The oil from coal refining was established in the early 1950s when the first plant, Sasol 1, was built in Sasolburg in the Free State province. The fuel industry was extended with the commissioning of Sasol 2 in 1982 and Sasol 3 in 1983, both located at Secunda in Mpumalanga Province (Groundwork 2003:7). Crude oil refining also started in the early 1950s in Durban operated by Engen. In 1964 Shell and BP opened a refinery in Durban and Caltex opened one in Cape Town. Again in 1971, Sasol established its own crude oil refinery in partnership with Total at Sasolburg, in the Free State Province. The oil industry's wholesale turnover is in excess of R40 billion per annum, and provides employment to over 100 000 people in South Africa (Groundwork 2003:7).

The Sasol Company is the leader in manufacturing of chemical products in South Africa and the African continent (South Africa 2009). It operates four sites namely Sasol Midlands, Natref, Sasol One Site and Sasol Mining. Sasol Midlands produces vinyl chloride monomer and polyvinyl chloride, polyethylene and sodium cyanide. Sasol One Site produces a variety of products which includes waxes, ammonia, solvents, phenols and nitric acid. Natref refines crude oil to produce petrol, diesel, jet

fuel, liquid petroleum, illuminating kerosene, elemental sulphur, bitumen, different oil grades and liquefied carbon. Sasol Mining operates a coal mine, which supplies Sasol Infrachem steam stations with coal (Sasol Safety Health & Environmental Brief 2006:2).

Reports and studies point to the fact that there is a high demand for the manufacturing of chemicals, especially in developing countries (South African National Profile 2002-2005:2-2). Chemical industries in South Africa constitute 25% of the manufacturing sector, which in turn constitutes 25% of the national Gross Domestic Product (GDP) (Seeletsi & Demana 2006). The chemical industry has been identified by government, together with business and labour, as one of the third priority sectors within the Accelerated and Shared Growth Initiative for South Africa (AsgiSA) programme in South Africa (Seeletsi & Demana 2006). The Sasol Company (through Sasol Chemicals Industries and Sasol Polymers) along with Dow Sentrachem and African Explosives and Chemical Industries (AECI), are the key players in the primary and secondary chemical industry sectors in South Africa.

Sasol is the major socio economic contributor towards the Metsimaholo Local Municipality. The company has a gross geographic product (GGP) contribution that ranges between 50% and 60%, estimated at R4 billion. The company has indirectly contributed towards neighbouring towns of Vanderbijlpark and Vereeniging. Sasol provides 198 391 direct and indirect job opportunities (Sasol Facts 2008:31).

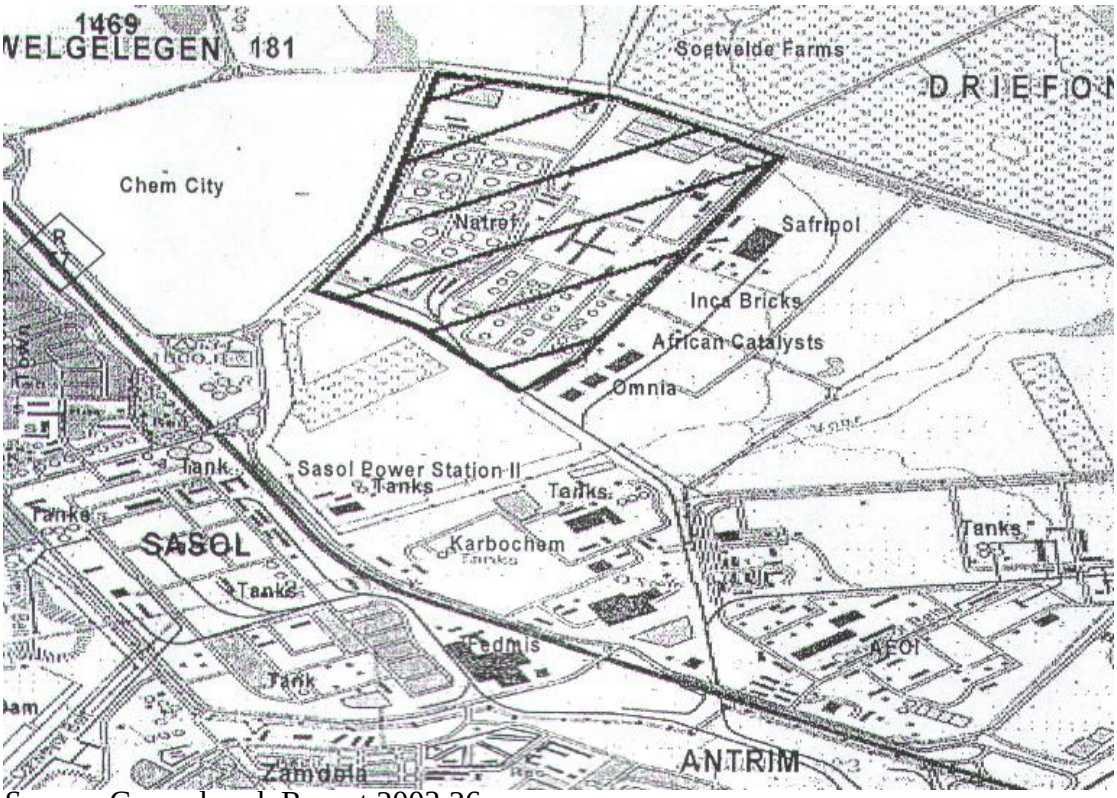
The significance of this background is to provide an understanding of the importance of the chemical industry and its positive contribution to the economy of South Africa. Sasol Company in particular is critical to the study as it owns and operates the Sasolburg chemical manufacturing plant around which the study is based.

1.3 General overview of Zamdela Township

Zamdela is a township of Sasolburg town situated in the Free State Province within the Fezile Dabi District Municipality. It is located in the Metsimaholo Local Municipality. It is situated on the southern banks of the Vaal River and forms part of the Vaal Triangle. It is named after Sasol, the South African company which refines coal into petrol and manufactures other chemical-based products. Zamdela Township was established 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 construction industry, and then to supply labour to the chemical plants (Groundwork 2003: 25; Wagner *et al.* 2005:7).

Informal housing began to appear alongside the formal township in the 1970s. After the mid 1990s government transformation Zamdela Township has become a home to 101 217 residents; (Groundwork 2003:25; Wagner *et al.* 2005:7). Zamdela is positioned downwind from the pollution and chemicals used, produced and released from the surrounding chemical industries (Groundwork 2003:25). As shown in the photo below (Figure 1) , Zamdela is situated very close to the chemical plants.



Source: Groundwork Report 2003:26

Figure 1: Map of Sasolburg Industrial area

The apartheid security legislation, The National Key Points Act (South Africa 1980), which is still under review, prohibited the publication of information on strategic industries. The whole of Sasolburg industrial area was designated as a Key Point in terms of this Act which meant there was no public access to information on the operations of this major player in the chemical industries. Democratic government and the public pressure have produced greater openness and some industries are now publishing annual environmental reports. Information relating to environmental

impact of manufacturing operations remains very partial, however, because reporting is not verified by government regulators and therefore relies on the honesty of chemical industries (Groundwork 2003:27).

Owing to lack of information, the local community assisted by Groundwork formed the Sasolburg Environmental Committee in 2000. The committee coordinates the community air monitoring programmes in Sasolburg, which are mainly on air pollution. Community air monitoring empowers people to become active participants in the production of scientific knowledge about air pollution. They take air samples, to measure toxic chemicals with bucket system and report to the community. In 2002, the samples taken in Sasolburg were found to have very high levels of benzene. The long-term exposure to this chemical could result in anaemia and leukaemia (Butler & Hallowes 2002:32; Groundwork 2003:28).

Groundwork is a non-governmental organisation based in Pietermaritzburg. It focuses on human rights and environmental justice issues which include providing support to communities on combating and challenging industrial pollution issues. The support is offered in the form of technical, legal, scientific, research and campaigning assistance (Groundwork 2011; Peek n.d:1).

Chemical industries endanger the lives of the surrounding communities by polluting the environment and exposing communities to potential chemical disasters. This is despite the socio-economic contribution towards creation of employment, positive impact on the national economy and the benefits for the local community from the operation of the plant. It is not possible to completely rule out accidents which may occur from the operations of chemical plant. It is better to prepare for such hypothetical accidents.

Diouf (n.d:2) indicates that, in many developing countries with economies in transition, there is often very limited and incomplete public awareness and understanding about the severe health and environmental harm caused by chemical pollutants. He further explains that raising awareness of chemical hazards will lead communities to be more careful about highly toxic chemicals (Diouf n.d:2). In addition sections 15 and 20 of the Disaster Management Act (South Africa 2002)

encourage the inculcation of a broad-based culture of risk avoidance, the promotion of education and training throughout the Republic of South Africa and the promotion of research into all aspects of disaster risk management.

To give effect to the above-mentioned provisions, the National Disaster Management Framework (NDMF 2005) has been put in place. It serves as a policy framework under the provisions of the Act to address a diversity of risks and disasters that occur in South Africa, and gives priority to developmental measures that reduce the vulnerability of disaster-prone areas, communities and households (Section 7(1)). The objective of Enabler 2 of the Policy Framework for Disaster Risk Reduction is to promote a culture of risk avoidance among stakeholders by capacitating role players through integrated education, training and public awareness programmes informed by scientific research (NDMF 2005:70).

Within this context, community awareness and effective emergency planning become the most important factors in decreasing the impact of natural and man-made disasters by increasing the preparedness levels of the concerned communities. Public awareness would establish the basis for new dialogue between the industry, government and the community. It would also empower the community to become active participants to matters that compromise their health and safety.

1.4 Rationale for the study

Public awareness is regarded as genuine learning in that individuals will be prepared to take actions to promote safety which may not always be in their own interest (Wisner *et al.* 2006:333). It is further believed that involvement of the community during disaster risk reduction campaigns can enhance their ownership of activities; build a culture of safety, thus building resilient communities (Groundwork 2003:10; Institute for Ocean Management 2007).

The research was influenced by an increasing number of chemical incidents in South Africa and other developing countries. It was also observed that in most instances the community would not be aware of procedure(s) to be taken during these emergencies, resulting in lives threatened and lost in some cases, which could have been avoided.

In the case of Zamdela Township, the study was also encouraged by the closeness of human dwellings to the SASOL petrochemical plant as shown in Figure1 and Figure2. In addition critical facilities such as a number of primary schools, community clinic and taxi rank are very close to the chemical plant.

Chemical accidents such as in the Bophal in India demonstrated the consequences which were highly aggravated by the proximity of dangerous sites to areas with high population density (Christou *et al.*1999). Dhara (2001:11-12) adds that the distance of residence from the Union Carbide plant was considered as an alternative surrogate for exposure based on published literature and confirmed by representatives of the gas victims organisation. He further explains that mortality and morbidity decreases with increasing distance from the plant.

The study is also based on the fact that the Disaster Management Act (South Africa 2002) requires the implementation of risk reduction measures in order to decrease vulnerability of communities at risk. It further encourages increasing community resilience through public awareness, which can be incorporated in school curricula and research and through the use of indigenous knowledge.

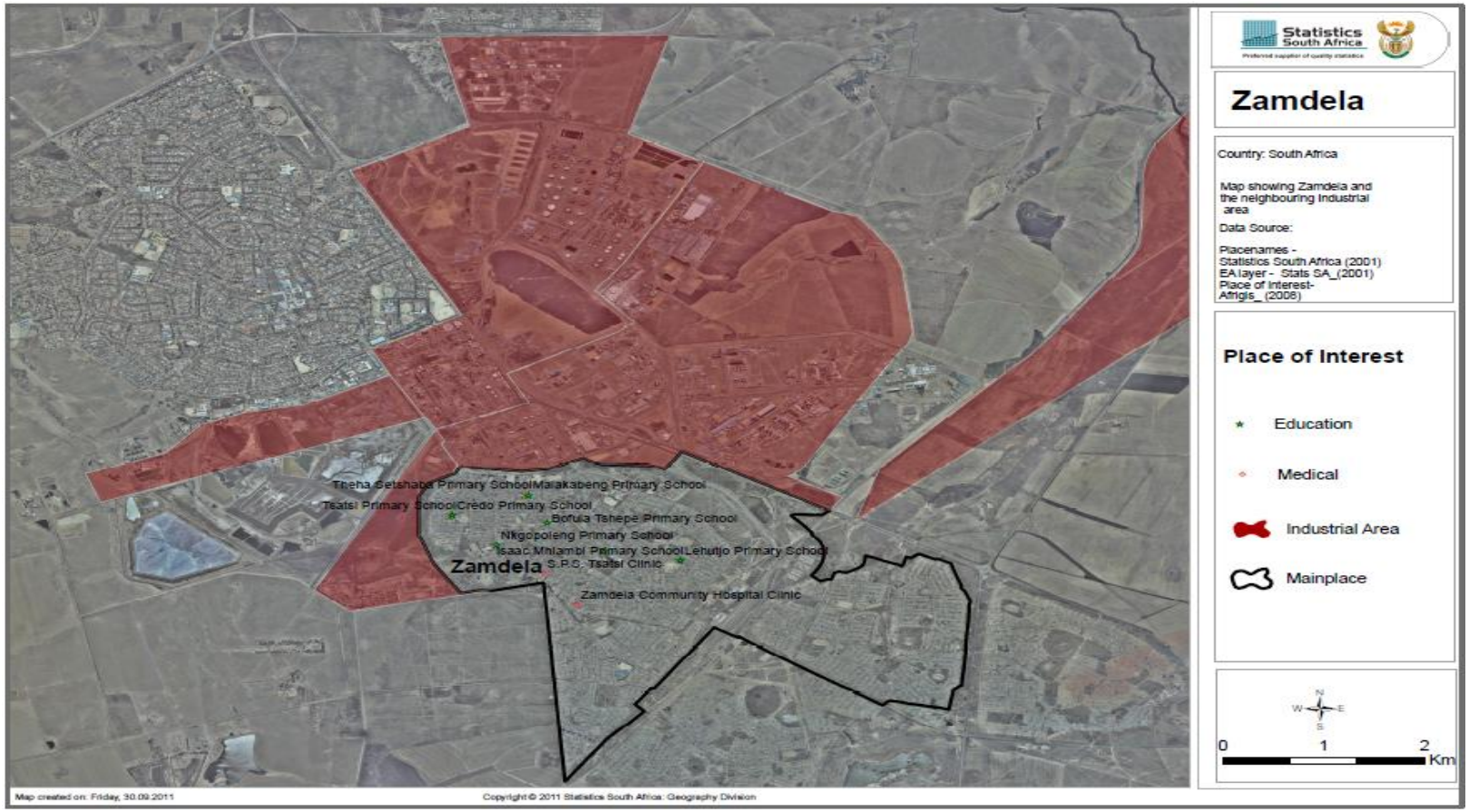


Figure 2: Aerial photo showing Zamdela Township. Source STATSSA:2011

1.5 Research Problem

There is currently legislation in South Africa which places accountability on manufacturers to adopt environmentally safe practices, for example the National Environmental Management Act No. 107 of 1998. There are also regulations such as the Occupational Health and Safety Act No. 85 1993 and Hazardous Substance Act No. 15 of 1973 to promote the safety of employees at the work places, which include the chemical manufacturing industries.

According to South African National Profile (2002-2005:11-8), there is currently lack of information being provided by the chemical industry for use by the general public, especially information relating to health and environmental risks. The profile also indicates that emergency response plans do not always include clearly defined strategies for dealing with the public in the events of emergencies. This is probably because there are currently no regulations in South Africa which places the responsibility on chemical manufacturers to create awareness on chemical hazards within communities where production takes place.

Numerous chemical industry role players including Sasol Company affiliate to Responsible Care[1]. Companies are encouraged through this initiative to voluntarily commit themselves to improve, among others, awareness panels and committees with surrounding communities and the public.

Sasol's Safety Health and Environmental (SH&E) performance target 2010 reported that the company wanted to achieve fewer than three significant fires, explosions and releases per quarter by July 2011. They also reported that they wanted to reduce their emissions intensity by 15% in all their operations by 2020 (Sasol Facts 2010:50). However, not much was said in the same document about initiatives to raise awareness within the surrounding communities.

[1] Responsible Care is the global chemical industry's unique initiative to improve health, environmental performance, enhance security, and communicate with stakeholders about products and processes (International Council of Chemical Associations 2011)

This paper advances the notion that notwithstanding the efforts of the industry in ensuring safety practices, more efforts should be put in place to educate communities on chemical hazards since chemicals are unstable and complex. Chemical accidents often require specialised protective measures and highly sophisticated responses (Levine 1989:142). These responses should be understood by the community in order to decrease the impact of chemical incidents. Levine (1989:143) states that prevention of chemical emergencies is preparation to withstand them by raising awareness on what should be done in case they occur. It is believed that through awareness and understanding, people will voluntarily act to improve environmental conditions and comply with existing laws (Mahindarathne n.d: 619).

Section 32 of The Constitution of the Republic of South Africa 1996 promotes access to information and transparency necessary to substantiate demands for improved environment. The Disaster Management Act No. 57 of 2002 places the responsibility on each district municipality to establish in its administration a disaster management centre. The duties of the disaster management centre include disseminating information regarding disaster management in the municipal area, especially to communities that are vulnerable to disasters in terms of section 44(1)(j). The Major Hazard Installations updated in 2001 place the off-site emergency planning responsibility under the local government emergency services (South African National Profile 2002-2005: 4-37).

The local authorities are therefore responsible to ensure that the communities gain access to information that improves their safety. This study derives its purpose from this perspective, to probe what the local authority has done to raise awareness of prevailing chemical hazards in Zamdela Township.

1.6 Research Questions

The following research questions informed this study:

- Does community awareness of prevailing chemical hazards in Zamdela Township exist?

- Are there early warning systems which are known and employed by the community?

- How is the community educated in respect of disaster preparedness and response in terms of chemical hazards?

- Is there adequate stakeholder participation on matters relating to raising community awareness in the area?

- Considering current initiatives by Fezile Dabi District Municipality on environmental impact of Sasol Plant, what more should be done to enhance awareness and incident management in Zamdela, and who are the critical stakeholders?

1.6.1 Aim

The aim of the study is to assess the state of community awareness on the prevalence of chemical hazards emanating from the operations of Sasol petrochemical plant near Zamdela Township.

1.6.2 Research Objectives

The related objectives were identified as follows:

- To explore participants' knowledge on the prevailing chemical hazards in Zamdela Township.

- To explore participants' knowledge on the existence of early warning systems which are known and employed by the community.

- To evaluate from participants how they educated in disaster preparedness and response in relation to chemical hazards.

- To explore stakeholder participation in the initiatives to raise community awareness on chemical hazards.

- To suggest additional measures for enhancement of current awareness initiatives including an integrated incident command system for use during chemical incidences.

1.7 Research Methodology

1.7.1 Research Approach

De Vos *et al*. (2005:101) note that the nature of the research problem and questions determines the methodology to be used. As this study seeks to explore if the local authority is doing enough to create awareness of chemical hazards, a combined quantitative and qualitative approach was appropriate, that is questionnaire and direct interviews. Quantitative style was considered because there were many cases or subjects involved in the study and its range was more exactly defined. Qualitative method was used to present a detailed view of the topic from the municipal officials in order to answer "what" and "how" questions which according to De Vos *et al.* (2005:102-103) are typical in qualitative.

For quantitative approach, self-administered questionnaire was used to collect data. De Vos *et al*. (2005:166) quotes The New Dictionary of Social Work (1995:51) which defines questionnaire as a set of questions on a form which is completed by the respondent in respect of a research project. A questionnaire is important since it enables quantitative data to be collected in a standardised way so that the data are internally consistent and coherent for analysis (Malhotra 2004:176).

The qualitative research process used to collect data was face-to-face interview with officials of Fezile Dabi District Municipality. De Vos *et al*. (2005:287) quote Seidman (1998:1) who states that you interview because you are interested in other people's stories as they are a way of knowing. In addition, they quote (Sewell 2001:1) who defines qualitative interviews as attempts to understand the world from the participant's point of view, to unfold the meaning of people's and to uncover their lived world prior to scientific explanations. The purpose of interviewing the municipal disaster management official was to understand the status quo of public awareness in Zamdela Township with regard to chemical hazards. The disaster management

officials are responsible for this function therefore would have the experience and understanding of the relevant politics of the area.

1.7.2 Research Sampling

Sampling, according to Kerlinger (1986) as quoted by De Vos *et al* (2005:193), therefore means taking any portion of a population or universe as representative of that population or universe. Population on the other hand refers to individuals in the universe who posses specific characteristics. In terms of this study, the population identified is Zamdela Township residents are exposed to chemical hazards resulting from the operations of the chemical industries. A sample was chosen to help explain some facets of the population. Babbie (1995:194), De Vos *et al.* (2005:193) describe a sample as a subset of measurements drawn from the population in which the study is interested. For the purpose of this study, the samples chosen were areas which were less than 7 km from the Sasol petrochemical plant.

The reason for use of sampling is feasibility as quoted by De Vos *et al*. (2005:194) from Reid and Smith (1981:170). A complete coverage of the total population is seldom possible. Another reason is that even if the study is relevant to the entire population, time and cost considerations usually make this a prohibitive undertaking. The use of samples may therefore result in more accurate information than might have been obtained if one had studied the entire population. This is because, with a sample, time, money and efforts can be concentrated to produce better quality research, more in-depth information and better trained interviewers (Babbie 1995:194, De Vos *et al*. 2005:194).

The study made use of purposive sampling based on a sample composed of elements that contain the most characteristics and typical attributes of the population (Babbie 1995:194, De Vos *et al*. 2005:202). The houses were randomly selected to allow each member of the population to have the same chance of being included in the survey. One family member who qualified to participate in the study (eighteen years and older and residents of Zamdela Township.) in each household, and was requested to complete the questionnaire. One hundred and eighty participants were selected by visiting every sixth house in the selected streets. This method was not followed rigidly

since in some households the eligible members were not available to be interviewed or in some instances there would not be anybody home. To make the sample as inclusive, participants were chosen to include both female and male.

1.7.3 The Pilot Study

According to De Vos *et al.* (2005:205) in order to understand scientific research on a specific problem, the researcher should have thorough background knowledge about it. Leedy and Ormrod (2001:200) add that the pilot study is one way in which the prospective researcher can orientate himself/herself to the project he/she has in mind. In addition Mouton (2001:103) states that one of the most common errors in doing research is that no piloting or pre-testing is done.

De Vos *et al.* (2005:206) quote a definition of pilot study in the New Dictionary Of Social Work (1995:45) as the process whereby the research design for a prospective survey is tested. They again quote Huysamen (1993:205) that the purpose of a pilot study is to investigate the feasibility of the planned project and to bring the possible deficiencies in the measurement procedure to the fore.

For the purpose of this study, the pilot was done by arranging informal meetings with members of the fire department, environmental management official and disaster management official of Metsimaholo Local Municipality. This was to learn as much as possible about their experiences of the area in terms of chemical hazards, accidents that occurred in the past and how those accidents were handled. The pilot study assisted in identification of most suitable volunteers to assist with data collection, appropriate officials to interview and the concerns raised by Zamdela Township community on issues relating to the selected research topic. The pilot study assisted in ensuring that errors on questionnaires were identified before they were administered to members of the community.

1.7.4 Data Collection

Both quantitative and qualitative methods were used to collect data for this study. According to Neuman (2000:124-125) researchers can take multiple measures of the same phenomenon. He further explains that by measuring something in more than one way, researchers are more likely to see all aspects of it. The study made use of

questionnaires and face-to-face interviews to collect data and the process is discussed below.

1.7.5 Questionnaire

For the purpose of this study, the researcher used questionnaires to interview community members which were administered by three fieldworkers. To be included in the survey, participants had to be eighteen years (18) and older and be residents of Zamdela Township. Different age groups were targeted with the purpose of enabling the researcher to understand different risk perceptions from diverse age groups to enhance the reliability and validity of data.

The questionnaires comprised 21 questions which were divided into three sections, namely demographic profile, level of awareness and general proposal on the community involvement. The process for data collection was carried out in a four weeks schedule as depicted below:

Table 1: Data collection schedule

1st Week	2nd Week	3rd Week	4th Week
Two- hour meeting with community volunteers to pilot the questionnaires .	Three-hour session with three fieldworkers to train them on the content of the questionnaires..	Three days of house to house visits by fieldworkers for completion of the questionnaires. Two hour discussion of problems encountered. Three days of house to house visits.	Three days of house to house visits by fieldworkers for completion of questionnaires. Final discussion of the completed questionnaires. Meeting with FDDM and MLM officials including the interview.

Although .180 questionnaires were administered, 30 of them were spoiled since some questions were not properly answered. Data will therefore be based on 150 questionnaires. This data will be described as representative of the residents of Zamdela Township due to the fact that almost all the streets in the study area selected were visited and participants from all genders and different age groups were represented.

Questionnaires were completed by one member from each household. Permission from participants was obtained prior to the questionnaire administration regarding their willingness to complete the questionnaires. The participants were also ensured of their right to anonymity and confidentiality since the majority of residents worked for the chemical industries. No gender preference was applicable with regard to eligibility for participation in the study. This was to ensure that data collected is representative of a reasonable number of community members.

1.7.6 Face-to-face interviews

The researcher used face-to-face and used a semi-structured interview guide with five open-ended questions. According to Leedy and Ormrod (2001:196) face-to-face interviews have the distinct advantage of enabling the researcher to establish rapport with the potential participants and therefore gain their cooperation. They added that personal interviews also allow the researcher to clarify ambiguous answers and, when appropriate, seek follow-up information.

In the case of this study, the researcher was particularly interested to gain an understanding of what the Fezile Dabi District Municipality has been doing in terms of raising awareness of chemical hazards in the Zamdela Township area; to understand their future plans on chemical hazards awareness. The respondent is the official responsible for disaster recovery and public awareness within the Fezile Dabi District Municipality.

1.7.7 Ethical considerations

Babbie (1995:448) quote Webster's New World Dictionary which defines ethical as conforming to the standards of conduct of a given profession or group. In addition, De Vos *et. al.* (2005:57) define ethics as a set of moral principles which is suggested by an individual or group, is subsequently widely accepted, and which offers rules and behavioural expectations about the most correct conduct towards experimental subjects and respondents, employers, sponsors, other researchers, assistants and students. Ethical guidelines also serve as standards, and a basis upon which each researcher ought to evaluate his own conduct.

During the research process, several ethical issues were considered to ensure the safety and privacy of participants as discussed by Mouton (2001: 239 -244) and Babbie (1995:448-452).

- The participants were informed about their right not to participate in the study if they chose to do so. This was to ensure that those taking part in the study did so willingly and without any pressure.

- The participants were assured of their right to privacy in terms of anonymity and confidentiality. This made it easier for community members working for the industry to participate in the study since their names would not be mentioned.

The participants were also encouraged not to include political perspectives during completion of questionnaires.

1.7.8 Data analysis

According to De Vos *et al*. (2005:218) analysis means the categorising, ordering, manipulating and summarizing of data to obtain answers to research questions. Quantitative data in professional research can be analysed manually or by computer. He further explains that data analysis in the quantitative paradigm does not in itself provide the answers to research questions. Answers are found by way of interpretation of the data and the results. For the purpose of this study MS Excel was used to enter data and perform the statistical computations with ease. The results from the questionnaires were analysed to determine respondents' views in relation to the study objectives and research questions. The analysis assisted the researcher to interpret results by comparing it with existing literature.

De Vos *et al.* (2005:333) explain that the purpose of conducting qualitative study is to produce findings. He quotes Patton (2002:432) as saying that qualitative analysis transforms data into findings. This involves reducing the volume of raw information, sifting significance from trivia, identifying significant patterns and constructing a framework for communicating the essence of what the data reveal. De Vos *et al.* (2005:337) quote Patton (2002:446) that the best advice is to read the data collected over and over and over again. The researcher found this to be true that more reading

made it easier to familiarise oneself with the data. The interview itself and typing of transcripts help in the initial process of data analysis. They quote Patton (2002:446) that analysis begins with ideas. Making sense of the data emerges while still in the field and constitutes the beginning of analysis.

Data collected through an interview was transcribed and analysed to establish what the Fezile Dabi District Municipality was doing to create awareness on chemical hazards in Zamdela. A narrative report was written to provide an account of the findings which were then compared with the results of the questionnaires..

1.8 Composition of the Research Report:

This section outlines the structure of the research report by summarising each chapter according to Mouton (2001:122).

Chapter 1 introduces the layout of the research report as well as how the research project was carried out to achieve the aim and objectives. It also gives the reader an overall substance of the research report before reading the whole report.

Chapter 2 introduces the literature review relevant to the study. It also introduces the theoretical framework that is relevant to the study. Legislative frameworks regarding chemical hazards from South Africa and the international community are also discussed. The chapter further discusses how public awareness can be used as a disaster risk reduction component using existing literature as reference.

Chapter 3 concerns the processes used to collect data for the study, data analysis and interpretation of the results.

Chapter 4 presents the conclusions and recommendations derived from data collected.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

A review of literature is aimed at contributing towards a clearer understanding of the nature and meaning of the problem that has been identified (De Vos *et al.* 2005:123). This chapter outlines various literature read on chemical hazards and public awareness. The chapter also analyses chemical legislations of South Africa and other countries. The theoretical framework for the study is discussed by showing its relevance to public awareness and the chapter concludes by summarising the justification of this study.

Chemical substances provide important functionality in a wide range of products. However, the use of toxic chemicals in production is a mounting concern for public health and the environment. Chemicals can be corrosive, toxic and they may often react explosively. The materials used in production of chemicals are relatively unstable and capable of changing so the threats in chemical accidents are complex. Because chemical hazard threats are complex they are not well understood and require specialised protective measures which are often a challenge for communities living close to production plants. Major emergencies involving chemicals can give rise to three categories of health effects: physical injury due to the accident itself, toxicological effects due to the exposure to a noxious substance and psychological stress (O'Mahony *et al*. 2008:356).

Potential hazards from refineries which may impact on surrounding communities include among others, thermal radiation, explosion and boiling liquid expanding vapour explosion (O'Mahony *et al.* 2008:363). The area around the thermal radiation where the degree of heat over the time involved would result in first degree burns and blistering of the skin which will cause death. Explosion could result in effects from window breakage and damaged house structures. In case of boiling liquid expanding vapour explosion, the storage tank will explode into four equal zones resulting in explosion and blast injury, thermal radiation and projectiles and shrapnel. The possible travel distance of a tub rocket can be 1 200m (O'Mahony *et al.* 2008:363).

As indicated in Chapter 1, Zamdela Township and the Sasol petrochemical plant are only separated by a street and this may highly aggravate the impact a should chemical incident occur.

According to Levine (1989:142), chemical accidents still remain much less understood and prepared for than emergencies caused by natural forces. O'Mahony *et al*.(2008:356) also state that there is often little or no provision in existing major emergency plans for assessing risk to public health arising from a chemical incident. The point made is that the protection of public health has to be built into major emergency plans for chemical incidents by extending help beyond the actual emergency site.

According to O'Mahony *et al.* (2008:356), full information on chemical hazards can help to allay public anxiety and limit psychological stress. They further add that early involvement of the public health authorities is important for planning to manage the full range of possible health effects from acute toxicity and long-term effects. Levine (1989:143) also states that the prevention of chemical emergencies is preparation to withstand them if they occur. She added that communities with chemical disaster preparedness plans, even deficient ones, respond in a more coordinated and effective way to chemical emergencies than those without plans. Levine (1989:75) further states that these plans can provide guidance to limit the scope and severity of the effects of chemical exposure.

The effective approach to disaster management is that there must be pre-disaster mitigation measures aimed at avoiding or reducing the impact of disaster (Asian Disaster Preparedness Centre n.d:.2). Pre-disaster risk reduction phase involves public awareness campaigns aimed at conveying and exchanging of information on the safety of the community. The disaster management continuum below (Figure 3) illustrates the sequence of actions which includes mitigation, preparedness and prevention stages of the disaster. Mitigation stage focuses on acquiring knowledge concerning the nature of hazards, vulnerability and capacities. Preparedness stage includes among others ways to increase personal and social protection. Prevention stage involves the implementation of measures aimed at preventing the incident to occur. During pre-disaster phase, the general public and organisations should collect information on preventative measures and put it in use while they learn to work

together as discussed by Levine (1989:143). Poyarkov (2005:3) adds that information should be clear and concise in order to avoid confusion and facilitate information exchange.

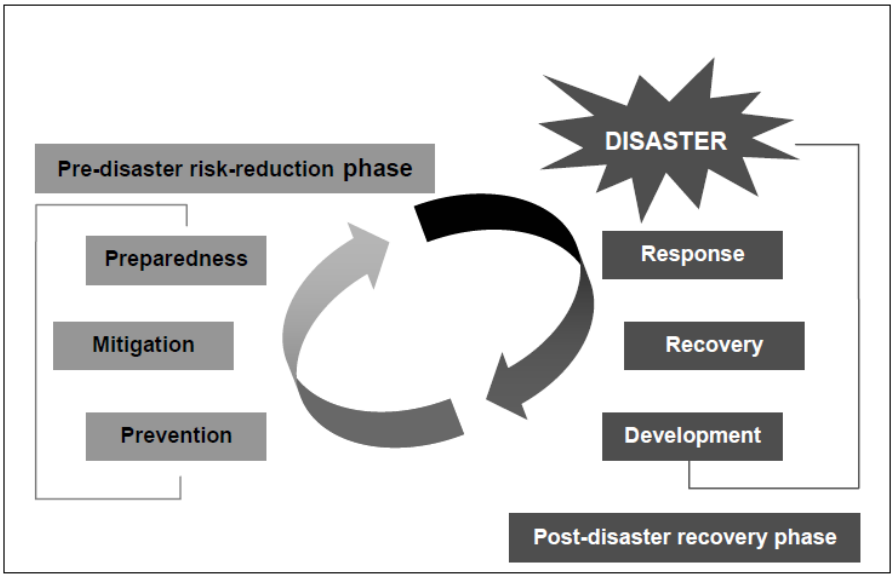


Figure 3: Disaster Management Continuum
Source: Asian Disaster Preparedness Center (ADPC), n.d: 3

Wisner *et al*. (2006:331-333) define public awareness as more than information that is directed at the public, but should be considered as genuine learning to the point where individuals will be prepared to take actions to promote safety. They add that public awareness is a broad process of embracing an ongoing exercise in mutual education between authorities and the public. They further state that the active involvement in hazard protection of localities at risk is essential and marks recognition that patterns of vulnerability and mitigation activities are local in character. Whenever disasters occur, the local communities are most likely to be the first responders as they have a mandate of ensuring their safety and welfare. Hence public awareness should be used to prepare the community in case of emergency. Wisner *et al*. (2006:330) quote Handmer and Penning-Roswell (1990) that public awareness followed by informed action is the bedrock requirement to reduce vulnerability and to develop resilient households, localities and societies.

Public awareness should be conducted in a form of a dialogue providing an opportunity for the public input to the authorities as well as providing information to the public from the authorities. According to Vogel *et al.* (2007:355), policy and

decision-makers in the public and private sectors are important role players in efforts to reduce vulnerability and increase resilience to the impacts of environment. They added that neither will such actions occur, nor will the implementation take place without public consent. According to Poyarkov (2005:2) dialogue will allow the public, public authorities and other interested parties to learn from each other. Vogel *et al*. (2007:353) state that interaction between two worlds comes to what is communicated, how and when, through which channels, for what purpose, by whom and for whom. They also state that communication touches on the relationship between those engaged in the dialogue and their level of mutual understanding.

The public in communities likely to experience chemical emergencies may not be convinced that planning is worthwhile if they have not yet experienced such an event (Levine 1989:81). According to Paton and Johnson (2001:270) people believe that local government should take responsibility for managing both hazards and their safety. Hence Poyarkov (2005:2) states that the public authorities should take steps to provide the public with information which will allow them to understand and develop confidence in the regulatory system's ability to ensure that hazardous installations are operating safely. Vogel *et al.* (2007:353) added that if individuals are to be involved in mitigation and global changes, the information needs to be meaningful and relevant. They also add that people need help to understand both the causes and solutions. That is why communicators should create a sense of urgency but not irrational fear. Poyarkov (2005:2) states that individuals responsible for communicating information related to possible disaster should be specifically trained to understand how to develop information for target audiences and how to deliver it effectively. According to Wisner *et. al.* (2006:333) public awareness can be an effective and efficient tool if local knowledge and trust are taken into account.

Hence literature indicates that public awareness should be participatory, should acknowledge the role of local government and be conducted with a good sense of balance. The roles and responsibilities should during the pre-disaster stage be clearly outlined to achieve this balance. Information is one of the key tools towards enabling and empowering people to act in a sustainable way and in support of public policy.

2.2 Theoretical framework

In order to create an academic context for the study, the researcher identified a theoretical framework for guidance. The theoretical framework that will be used for the purpose of this study is the Social Capital Theory. A theoretical framework is a conceptual model of how a researcher makes logical sense of the relationship among several factors that have been identified as important to the problem (Sakaran 2000). The choice of Social Capital Theory has been motivated by the fact that it encourages the involvement of local people in identifying and solving problems. It is also motivated by the fact that The Social Capital Theory enables individuals and/or groups through collective action to reach desirable outcomes (Silici n.d:2). Public awareness seeks to prepare people for collective efforts in dealing with emergencies. There is a saying that 'Knowledge is Power' which therefore makes public awareness an important component of disaster risk reduction by empowering the communities at risk. It is also believed that education is the development of knowledge and skills to empower people and allow responsible decision-making (Nielsen & Lidstone 1998:18).

The Social Capital Theory, which is "about the value of social networks, bonding similar people and bridging between diverse people, with norms of reciprocity" (Claridge 2004), is deemed as the appropriate theoretical framework for this study, in order to create an academic context. Public awareness is linked to 'The Social Capital Theory' which describes the pattern and intensity of networks amongst people and shared values which arise from those networks. United Nation International Strategy Disaster Risk (UNISDR 2009) defines public awareness as the extent of common knowledge about disaster risks, the factors that lead to disasters and the actions that can be taken individually and collectively to reduce exposure and vulnerability to hazards. The Social Capital Theory therefore clearly links with public awareness since they both have an interest in improving the well being of local people involved in identifying and solving problems affecting the community. The theory also promotes a sense of belonging, valuing diversity in others and similar life opportunities (Babb 2005:11).

2.3 Social Capital Theory in context of disaster management

Disasters can cause both physical damage and losses incurred by social units and the disruption of the unit's routine functioning and within its network of other social units. Whenever there is a natural and man-made disaster, people help one another before they are supported or replaced by government entities (Schellong 2007:2). There is a Sesotho idiom which says '*Motho ke motho ka batho*' literally translated as "a person is a person through dependence on other people". It emphasises the importance of being there for one another as people in order to work and help one another, even during disaster. This sense of moral responsibility produces collective action in times of threat to the community.

Schellong (2007:2) indicates that if there are problems or dissatisfaction among residents, they would not be able to help each other during emergencies. He uses an example that during the Kobe earthquake in 1995, many people had weak links with the larger community and that had enormous influence on the speed of recovery. Schellong (2007:2) quotes Buckland and Rahman (1999) that vulnerability to hazards is directly related to a community's level of development. The level of development is commonly evaluated by economic and social indicators of the community. Furthermore Silici (n.d:3) adds that social interactions may positively contribute to the well-being of given groups or individuals by generating enhanced knowledge about other agents, reduced transaction costs, risk mitigation, improved access to information and technological knowledge and reduction of collective action dilemmas.

Communities and their social networks are very important during and after disaster. The impacted community is a direct and active participant at all phases of dealing with a disaster which are: preparedness, response, recovery and mitigation. According to Schellong (2007:4) out of the four phases above, response phase presents the most socially complex phase of the disaster spectrum. He adds that disasters usually affect the entire community or large segments of social units and are present when the established social systems of the community abruptly cease to operate. Even during this phase social networks continue to operate while new ones are formed because the community needs to initiate recovery in order to meet their needs. Schellong (2007:5)

quotes Haines, Hurlbert and Beggs (1996) that disaster victims and their social networks mostly become resources. He refers to a study of the Flint-Beecher tornado of 1953 where 927 causalities were rescued by spontaneous local groups. These informal groups tend to be based on some previously existing social relationships in the community, such as family, the neighbourhood, the school, friendship bonds and work association.

Social networks model realise social networks in a visual environment. They assist each member in creating or seeking a network of friends, acquaintances, people who share the same interests or are of interest to the member. According to Schellong (2007:4) social capital lowers the transaction costs of information acquisition. He adds that, one means by which information can be acquired is by use of social relations that are maintained for other purposes. The social networking services such as Facebook, Twitter and others are used to gather information on users' social contacts, their interests, construct interconnected social networks and reveal to users how they are connected in the network (Schellong 2007:3). These social networks can be used as a platform for sharing and discussing information on disaster management issues.

The elements of Social Capital Theory underpin the principles behind public awareness as advocated by this study. The pre-disaster stage may be faster and more effective using social networks which will enhance collective actions undertaken by people during emergency situations.

2.4 Three types of Social Capital Theory

1. *Bonding social capital theory* involves connections between people with similar characteristics and/or interests and tends to reinforce homogeneity and exclusivity (McGonigal *et al.* 2005:1).

2. *Bridging social capital theory* involves connections between people from diverse contexts and is seen as inclusive (McGonigal *et al*. 2005:1).

3. *Linking social capital theory* concerns relationships among people with different powers and allows access to resources, ideas, information and knowledge within a community or groups (McGonigal *et al.* 2005:1).

This study is influenced by the first and third types which are more relevant to the main aim to assess the state of public awareness of the prevalence of chemical hazards. The study seeks to look at the way in which public awareness builds connections amongst the residents of Zamdela Township since they are exposed to chemical hazards as described by type one above. It is believed that social systems allow the residents to share information and learn from each other (Silici n.d:5).

The study further focuses on how the local authority forges relationship with the community by sharing of information, ideas and knowledge concerning their safety. The linking social capital theory encourages institutional agreements and cooperative behaviour and supports the link of local groups to wider networks and other institutions. Payarkov (2005:2) states that communication should be two-way, providing an opportunity for public input to the authorities as well as providing information from the authorities to the public. He adds that this will allow the public, public authorities and other interested parties to learn from each other.

2.5 Main aspects of Social Capital Theory

1. *Networks* - lateral associations that vary in density and size and occur among both individuals and groups. According to Dowla (2006:116) information about new economic opportunities is more likely to be shared among members of horizontal networks. The importance of public awareness is ensuring that the information that is shared amongst social groups will be accurate, and precise to the group in respect of the chemical hazards.

2. *Reciprocity* – expectations that in the short- or long-term, kindness and services will be returned. There is a traditional proverb which says “one hand washes the other”. The proverb can be translated as mutual interaction whereby one person supplements the other. Public awareness will enhance the inter-dependency and mutual interactions that take place as people try to help one another during emergencies.

3. *Trust* – willingness to take initiatives or risks in a social context based on assumption that others will respond as expected. Whenever there is a natural and man-made disaster, people help one another before they are supported or replaced by government entities (Schellong 2007:2). This behaviour is prompted by the historical social relationships that are built on trust. Public awareness would assist increase coordination actions taken when people start to help one another during emergencies.

4. *Social norms* – the unwritten shared values that direct behaviour and interaction. People are always prepared to respond with kindness in helping others during emergency situations. It is however critical that the help extended should be guided by information in order to have maximum impact in saving lives. Public awareness plays the role of ensuring that people will know what procedures are appropriate in emergency situations.

5. *Personal and collective efficacy* – the active and willing engagement of citizens in a participative community. According to Silici (n.d:9) participation at community level of all members and especially of the local leadership allows a better understanding and wider acceptance of new ideas and practices. This study seeks to propose that effective public awareness will help promote personal and collective efficiency in dealing with chemical hazards. Community interaction could help speed up the rate of adoption; improve performance and social acceptability of initiatives aimed at preparing for chemical incidents (Narayan & Cassidy 2001).

2.6 Relevance of Social Capital Theory to public awareness

2.6.1 Developing a sense of belonging

Public awareness builds a sense of community and attachment during the preparedness phase in educating the community concerning steps to be taken following a disaster, and increases access to and utilisation of the social network (Paton & Johnston 2001:273). A sense of community also provides insight into the

degree of community destruction and consequently the level of support likely to exist for collective intervention or mitigation strategies. A sense of belonging can be achieved through trust amongst the community and its leaders. Dowla (2006:107) states that trust is based on reputation and that reputation has ultimately to be acquired through behaviour over time in well understood circumstances. He further explains that these constant and regular attempts to build trust cause accumulation of trust over time. At the same time public awareness will be the evidence to the community that leaders are interested in their well-being and can therefore help to build trust. Mutual trust between the leaders and the community will develop a sense of belonging (Dowla 2006:107).

The Social Capital Theory, along with its attributes, may positively contribute to the well-being of individuals and groups by generating enhanced knowledge about the threats, risk mitigation, improved access to information and technological knowledge and risk reduction initiatives (Silici n.d:3). In other words, attachment to a community produces willingness to contribute to its maintenance and its sense of moral responsibility and this is what produces collective actions in times of disaster (Schellong 2007:4). It can therefore be justly concluded that public awareness or education could also develop a sense of belonging within communities since it generates and contributes to the well-being of individuals.

2.6.2 Knowledge transfer

Public awareness can be regarded as transfer of knowledge, which is the acquiring of knowledge from one another. It is also believed that effective transfer of knowledge from one person to another is more productive. Such knowledge transfer among people provides opportunities for mutual learning and cooperation that encourages the creation of new knowledge and contributes to people's ability to innovate. Schellong (2007:4) explains that networks, particularly those characterised by weak ties and structural holes, increase the efficiency of information diffusion through minimizing redundancy, while at the same time encouraging cooperative or supportive behaviour.

Li (1991) records similar findings regarding the pre-disaster phase in which the most frequently reported source of disaster information is that via relatives and friends. It is also believed that the main source of The Social Capital Theory is a continuous

relationship between staff and members (Dowla 2006:104), which will therefore make the transfer of knowledge from the staff to the community easier. Diouf (n.d:2) states that public awareness will strengthen knowledge and information, which will include improved education and training aimed at those who may be exposed to toxic substances at any stage in the lifecycle of chemical intensive production processes.

2.6.3 Improved Communication

Communication plays an important role in any effort to initiate better practices. It is the foundation for engagement amongst people. We communicate for many reasons: to show our love and gratitude, to get attention, to give pleasure, to express anger, to delegate responsibility, to coordinate actions or to share resources and information. The Social Capital Theory and public awareness both encourage interaction among the community at risk through communication. In risk communication, it is often assumed that there are three goals, which are persuasion, education and participative decision making (Bostrom 2003:560). It basically comes down to what is communicated, how, when, through which channel, for what purpose, by whom and for whom.

Communication touches on the relationship between those engaged in the dialogue and their level of mutual understanding of culture, codes of conduct, information needs and capacities (Vogel *et al.* 2007:353). In addition Vogel believes that communication is important since it improves the accuracy of public perception of problems and provides clarification of the public's role in the formulation and implementation of voluntary codes

Assistance in problem identification, definition and searching for better response options can be achieved through communication, which can also build trustful relationships and mutual understanding of capacities over time. Vogel *et al*. (2007: 355) also consider that public and private players are important in any effort to reduce vulnerability or increase a community's adaptive capacity and resilience to the impacts of hazard. He also postulates that without public participation through communication, policies are likely not to be properly implemented. It is believed that weekly meetings among community members can reduce conflicts as they get to know each other and their extended families (Dowla 2006:111). He further states that

weekly meetings increase the exchange of information from elders to other and younger members of the community, which improves communication.

2.6.4 Creation of Networks

Networks can be horizontal, connecting, agents of the same status and power; as well as vertical, connecting unequal agents in uneven relations of hierarchy and dependence (Dowla 2006:115). Putnam (1993) further notes a critical difference between horizontal and vertical networks: a vertical network, no matter how dense and no matter how important it is to its participants, can sustain social trust and cooperation. The Social Capital Theory develops when families are linked to one another in networks such as public gathering networks, which share and reinforce common knowledge and values (McGonigal *et al.* 2005:13).

Public awareness campaigns can be used to establish networks beyond immediate family and kinship groups, forming weak horizontal ties. These meetings could enable community members to expand their social and information networks that can be used to facilitate information sharing about imminent threats. Networks among community members may end up building trust, which can be seen in such aspects as belief in self, belief in others through cooperative learning practices with peers, and belief in the world through acquiring new knowledge that is true and makes increasing sense (McGonigal *et al.* 2005:15).

2.7 Chemical legislations of the Republic of South Africa

Section 24 of The Constitution of the Republic of South Africa, No. 108 of 1996:, states that everyone has the right to an environment that is not harmful to their health and well-being, and it further explains that citizens have the right to correct and relevant information for their safety. In addition, sections 17(1), 39(2)(k) and 53(2)(k) the Disaster Management Act 57 of 2002 requires National, Provincial and Municipal governments to take steps to disseminate such information, especially to communities that are more vulnerable to disasters.

It is clear from the above legislations that the government of South Africa is committed not only ensuring safe environment for its citizens but also promoting

access to information relating to safe environment. The above referred to sections of the National Disaster Management Act place public awareness responsibility on the three spheres of government through dissemination of safety information to the communities. This study will seek amongst other things to explore the extent to which these legislations are implemented within the Zamdela Township.

2.7.1 Laws regarding chemical management in South Africa

Hazardous Substances Act No. 15 of 1973 and Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act No. 36 of 1947. These Acts both regulate the importation, manufacture, transportation, use, disposal and sale of hazardous substances and the fertilizers, farm feeds, agricultural remedies and stock remedies The scope of these acts is limited to above-mentioned areas but do not mention the measures to manage chemical hazards inherent to the production processes and their impact on the public:

- **National Environmental Management Act:**

  The National Environmental Act 107 of 1998 is put in place to regulate environmental protection and enforcement of environmental management laws. The focus of this legislation is good planning and design, which is likely to cause environmental degradation. The Act indicates that the polluter must pay in case of environmental damage. Again, it emphasises that all reasonable measures must be taken to contain the incident and the responsible person must undertake the clean-up procedures and remedy the effects of the incident. It also encourages the inclusion of public in environmental issues.

- **Relevant regulations**

  An important legislation is the Occupational Health and Safety Act No. 85 of 1993 (OHSA) which include the following regulations, General Administrative Regulations (South Africa 1996), Major Hazard Installation (MHI) Regulations as amended (South Africa 1998), Regulations for Hazardous Chemical Substances (HCS) (South Africa 1995), Asbestos Regulations (South Africa 1987), Lead

Regulations (South Africa 1991) and General Safety Regulations (South Africa 1986) which were promulgated under OHSA.

These regulations provide for the health and safety of persons at work and for the health and safety of persons in connection with use of plant and machinery; the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work (South African National Profile 2002-2005:4-11.)

The MHI applies to employees, persons and users who have on their premises quantity of substances, which can pose significant risk of resulting in a major incident that could affect the health and safety of persons outside their premises. The MHI requires that employers should undertake risk assessment of major hazardous installations, which includes description of major incidents associated with that type of installation, estimation for probability of a major incident, copy of onsite emergency plan in case of toxic release and suitable emergency procedures for the risk identified.

The emphasis of the above regulations is employee safety as well as the on-site emergency planning. According to the South African National Profile (2002-2005:4-37) major hazard installations should be advertised in the local newspaper and by way of notices that are placed within the community areas in the vicinity of the installation site.

Local emergency services are responsible for the off-site emergency plan and procedure according to the Major Hazard Installations (MHIs) updated in 2001. This study seeks to probe the initiatives undertaken by the Fezile Dabi District Municipality to ensure compliance to this critical piece of legislation.

However, these MHI regulations place the responsibility on the owner or operator of the installation to determine whether the installation should be classified as a MH, without a more detailed definition of what constitutes a MHI. Furthermore, confusion results from inadequate definition of how the risk assessment should be conducted. Although the regulations specify that the risk assessor is to be an

Approved Inspection Authority, due to lack of accreditation criteria, some insufficiently qualified individual could conduct risk assessment. Due to these problems certain installations that are MHI could have been identified as those that do not pose a major risk.

- **Air Quality Management Act**

The objective of the Air Quality Management Act No. 39 of 2004 is to regulate air quality to protect the environment from pollution and degradation; to secure ecological sustainability while promoting economical and social development. This Act, unlike most of South African acts on chemical regulation, articulates in section 2, a need for public participation in the protection and enhancement of air quality, including public access to information on air quality.

- **The National Road Traffic Act**

The National Road Traffic Act No. 93 of 1996 regulates, amongst others, road safety issues and the transportation of hazardous chemical substances on South African roads. Other regulations published under the National Road Traffic Act (South Africa 1996) and South African Bureau of Standards (SABS) codes of practice have been incorporated as standard specifications into the National Road Traffic Regulations (GNR 1249 2001). These codes have been based on the United Nations recommendations, also known as 'The Orange Book' (South African National Profile 2002-2005:4-16). The codes are incorporated among others as the following, South African National Standards (SANS) 0232-1 which is about transportation of dangerous goods which must provide emergency information system for road transportation. Information such as this becomes helpful during an emergency situation with guidelines of the type of chemicals which are transported.

The existing legislations focus on three key areas, which are: safety in the work place, protection of the environment and consumer protection. They mainly rely on the manufacturers to ensure application of such legislation. Prozesky (1992)

states that more emphasis regarding chemical legislation is placed on the obligation of the employer to inform the employee of the potential and actual health hazards she/he may be exposed to in the workplace. This study sought to acknowledge that communities can share accountability to ensure effectiveness of legislation with a fair level of awareness about the risks along with access to all relevant information.

The South African Chemical Industry is committed to work together with other global chemical industry companies under the auspices of Responsible Care Initiative. This initiative seeks to continuously improve:

- Their workers' health and safety
- Their environmental performance
- Their communication with stakeholders.

It is a voluntary programme with the vision of causing no harm to employees, contractors and the general public via chemical industry operations. It was launched in 1994 in South Africa, after it was initiated in Canada in 1984.

The programme has, amongst other principles, the following two important goals:

- Being concerned about their community
- Sharing information.

From above discussions, it is therefore important to strengthen institutions, laws and policies dealing with chemical issues in a South African context, consistent with international trends. Decision makers need to be informed on chemical issues that the country is facing and be aware of the benefits of international treaties and national institutional and regulatory frameworks as key elements in tackling chemical safety issues (Diouf n.d:1). This will encourage the reporting of such activities to decision makers, for them to monitor and improve chemical management in the country.

2.8 Chemical Legislations in United States of America and United Kingdom

Part of the literature review looked at the chemical legislation in the United States of America as well as the United Kingdom. The purpose is that of establishing the extent of progress made by these countries both in dealing with past experiences as well as strengthening the safety of communities from potential chemical accidents.

2.8.1 United States of America

The United States federal legislature passed the Emergency Planning and Community Right-to-Know Act of 1986, known as SARA. Its main purpose was to encourage and support emergency planning efforts at state and local levels, and to provide the public and local governments with information concerning potential chemical hazards present in their communities. This was brought about by public concerns which intensified following the 1984 Bophal incident in India where a chemical disaster occurred which resulted in EPA creating the Chemical Emergency Preparedness Program in 1985, which was a voluntary programme used to encourage state and local authorities to identify hazards and plan for potential chemical emergencies (Lindell & Perry 2001:169)

The local planning complemented emergency response planning carried out at national and regional levels by the National and Regional Response Teams. During the following year, 1986, Congress enacted the Emergency Planning and Community Right-to-Know Act of 1986, which is also known as Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). SARA Title III required states to establish State Emergency Response Commissions (SERCs) and Local Emergency Planning Committees (LEPCs) to develop emergency response plans for each community (EPA; 2009). This Act further requires that the LEPC's to educate the public about the risks from incidental and routine releases of chemicals and work with facilities in their communities to minimise the risks (Lindell and Perry 2001:169).

In addition, the European Chemical Industry Council emphasised recognition of the right of the public to be given information about industries' environmental behaviour (Prozesky 1992). The Hazardous Chemicals Right to Know Act is used to regulate the

production and operations of chemicals in the United States and other countries in Europe. The purpose of Chemical Right-to-Know Law is to inform the employers, employees, citizens and emergency responders of their rights and responsibilities regarding hazardous chemical storage.

Furthermore the Act requires the employer to provide this information in writing to any person or fire marshal that requests it (Hazardous Chemical Right to Know Act; 2007). Part 3 of the Act focuses on community information regarding hazardous chemicals, clearly stating how any person can request, in writing, a list of chemicals stored or used in the facility. It further explains what should be done in case the employer does not comply. In addition, the United Nations Environmental Programme is linked directly with member countries to build national capacity for the clean production, use and disposal of chemicals and promotes and disseminates state of the art information on chemical safety (UNEP 2009).

2.8.2 The United Kingdom

In Europe, the Seveso accident in 1976 prompted the adoption of legislation aimed at prevention and control of such accidents. The Chemical Industry in Europe is governed by the Seveso Directive (82/501/EEC) which is a legal instrument which has been adopted by all member states. The directive aims at the prevention of major accidents and the limitation of their consequences for man and the environment, with a view to ensuring high levels of protection throughout communities in a consistent and effective manner (Bennett 2004:3; Maddison 2009:1). The legislation required, inter alia:

- The production of a safety report which detailed how major accidents are prevented and controlled.
- An assessment of the possible major accidents, their likely consequences and approximate frequencies.
- The development of on-site emergency plans.

- The production of an off-site emergency plan by the local authorities responsible for such matters.
- Emergency plans having to be tested at a specified frequency.

In the United Kingdom, the Control of Major Hazard Regulations implements this directive. Regulation 4 of the Control of Major Hazard Regulations requires operators to take all measures necessary to prevent, control and mitigate major accidents. Risk assessment is a must in that all significant hazards must be addressed and suitable controls provided. They must also ensure that the objectives of preventing major accidents are taken into account in their land-use policies. They must ensure that appropriate distances are maintained or created between the establishment of a chemical plant and residential areas (Bennett 2004:4; Maddison 2009:2).

Communities near chemical manufacturing plants must be fully informed of the risks that chemical manufacturing plants hold, and the people should be instructed what to do in case of different chemical spills. Area residents are to be instructed by community advisory panels called CAPS in town hall-style meetings. These panels bring up topics such as environmental health and safety issues and provide suggestion on what citizens can do to protect themselves from plant hazards (Pearson 2010).

The methods followed for risk assessment in the United Kingdom provide more flexibility to planning authorities. The bodies involved in the decision-making process are the local planning authorities and the competent authority for the Health and Safety Executives. The chemical plant owner is required to prepare a report showing zoning of areas receiving a dangerous dose of chemicals (Christou 1999:160; Maddison 2009:5).

Christou (1999:168) discusses the zoning of areas receiving dangerous doses of chemicals in the following manner:

- The inner zone is defined by an individual risk exceeding 10 in million per year of receiving a dangerous dose or worse.

- The middle zone is defined by an individual risk exceeding 1 in a million per year of receiving a dangerous dose or worse.

- The outer zone is defined by an individual risk exceeding 0.3 in a million per year of receiving a dangerous dose or worse. These criteria is appropriate for highly vulnerable or a very large public facility.

Consequently Maddison (2009:11) discusses the zoning of areas receiving a dangerous dose of chemicals using the diagram in Figure 3. The inner zone of the contour should be used for chemical plants and other factories. It can be allowed houses to be built in the middle zone. The main factors that determine these levels are the number of persons at the development and their sensitivity. That is why the outer zone should be dedicated to vulnerable members of the society, for example primary schools, old age homes, hospitals and other critical facilities (Maddison 2009:11-12).

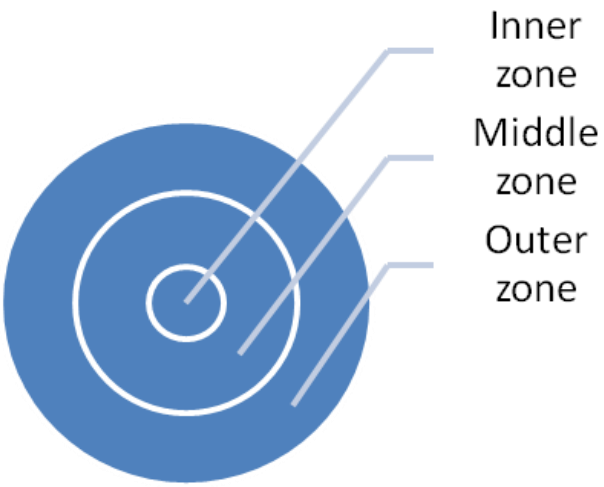


Figure 3:Risk contours (Source: Maddison 2009:11)

2.9 Importance of public awareness for chemical hazards

The impact of chemical accidents can be deadly for both human beings and the environment. Chemical spills and accidents range from small to large and can occur anywhere where chemicals are found (Watts & Hemminger n.d). Furthermore the multiple accidents and diseases due to chemicals, occurring worldwide each year, and more specifically in developing countries have convinced the international community to act urgently. Annually about 20 000 accidental deaths and three million

poisonings due to pesticides are recorded (Diouf n.d:1). South Africa has not recorded a disaster of similar scale to that of Bhopal, but there are, however, incidents recorded as discussed below.

One of the accidents is the occurrence of a petrol fire at the Engen refinery South of Durban on 19 November 2009 when a storage tank was struck by lightning. The refinery is closely surrounded by houses in the suburbs of Wentworth, Austerville, Merebank and the rest of the Bluff residential area. It was reported that thousands of people were on the streets and most of them did not know what to do to protect themselves against chemical fire. It was further reported that some community members had taken their family members out of the area (Carnie & Wicks 2007). Even though there were no injuries caused by the fire, the community was supposed to be familiar with the procedures stipulating that they should stay indoors, seal and close their windows and take other safety precautions.

Figure 4: Engen Durban refinery on fire (*Source: Carnie and Wicks 2007)*

According to Bell (2004:21):

- In 1997, the ANC Daily reported an explosion at Mossgas in a methane reforming unit.

- The Independent Newspaper reported in March 2001 that Sapref in Durban had accidentally released 25 tonnes of tetra-ethyl lead only 200 to 500 metres away from neighbouring homes. A few months before this, Sapref was reported to have spilled a million litres of fuel from a damaged pipeline.

- Sapa reported that, in December 2001, a Petronet pipeline running through the grounds of a primary school at Tongaat just outside of Durban, had exploded, and causing thousands of people to be evacuated from their homes.

- In October 2003, The Natal Mercury reported a diesel leakage of 75 000 litres into a storm water canal.

- In March 2004, Merebank residents complained of gas emissions from the nearby Engen refinery.

- In June 2004, Sapa reported an explosion at Sasol's Secunda plant that killed one person and injured seven others.

- The Cape Times reported a massive oil blowout at the Caltex refinery in Milnerton in July 2004. The blowout, which happened during scheduled shutdown, rained oil-drops on neighbouring cars and houses.

Most of the accidents listed above are linked to Sasol, Sapref and Engen companies. According to Bell (2004:20), South African Instrumentation and Control officials contacted offices at Sapref, Engen and Sasol and offered them the opportunity to give their side of the story. They wanted the three companies to explain any programmes and target regarding critical control measures that they have implemented to minimise the risk associated with potentially dangerous production processes. He indicated that these companies never replied or maybe a response that they cannot talk about this information as it is confidential.

Incidents like these create a need for awareness of chemical hazards among communities around chemical industries. It is assumed that an educated public is able to prepare for, and adapt and respond to hazards, and that education in respect of disaster risk reduction is complex yet essential (Nielson & Lidstone 1999:14). Diouf

(n.d:1) also emphasised that the mounting scientific evidences of dangerous impacts of chemicals on health and the environment and the increasing production and marketing of these chemicals during the past years, have raised concern among the public about the risks that these chemicals represent.

2.9.1 Public Awareness Principles

Public awareness requires:

- *A multi-stakeholder approach* which requires involvement of representatives from various government departments as well as concerned parties outside of government, such as industry, research institutions, labour and public interest groups (United Nations Institute for Training and Research [UNITAR] 2001:1). Chemical management is influenced by, and has impact on, a great variety of institutional stakeholders. A history of environmental management worldwide shows that effective environmental enforcement requires informed consensus on environmental objectives and policies that are based on a good understanding of the shared roles and responsibilities of all players, including the regulator, the regulated community (developers and polluters) and the affected community (Anon. n.d:1).

- *A country-driven process* through which partner countries assess and identify their chemical management needs and link their related activities to national environmental and developmental objectives (UNITAR 2001:1).

- *An inter-sectoral approach* to chemical management in order to facilitate chemical risk reduction and pollution prevention across all stages of the life cycle (UNITAR 2001:1).

2.9.2 Benefits of public awareness

Public awareness has the following benefits in respect to chemical hazards:

- Promotion of the awareness of chemical hazards and improves identification and communication, such as the classification of chemicals and preparations, their clear labelling and understandable safety data sheets.

- Allowing a forum for sharing experiences, views and information on chemical hazards. Information exchange is one key factor to enable actors to avoid hazardous chemicals and to manage risks to users and the environment. The need for better communication throughout the product chain has to be identified (United Nations Environmental Programme 2009).
- Enabling the registration of members active in general or specialist areas of chemical hazards.
- Promotion of the need for specific training and aims at the setting of competency standards.

- Making chemical hazards information available to members and other relevant bodies, will improve the public understanding of chemical safety issues (Chipman *et al*. 1995).

- Helping to alert the community when they need to be alerted and reassure them when they ought to be reassured (Chipman *et al.* 1995). It was further articulated that public awareness will provide people with the tools they need to make informed decisions.

2.10 Disaster Risk Reduction

The International Strategy for Disaster Reduction (ISDR 2009) defines disaster risk reduction as the concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including procedures reducing exposure to hazards; lessening vulnerability of people and property; wise management of land and the environment, and improved preparedness for adverse events. The emphasis is on "improved preparedness for adverse events". Public awareness campaigns are a critical element in ensuring community preparedness and risk reduction. Van Niekerk (2005:6) is of the opinion that reducing risk requires all stakeholders to change their behaviour and perceptions and to place a high priority on safety in planning and development.

2.10.1 International policies for Disaster Risk Reduction

The 1990s were designated as the United Nations International Decade for Natural Disaster Reduction (UN-IDNDR) in an effort to reduce loss from disasters (UN-ISDR; 1994). In 1994, IDNDR organised the First World Conference on Natural Disaster Reduction at which the Yokohama Strategy and Plan of Action for a Safer World was conceived. During the same decade, the IDNDR achieved important results in moving from a culture of reaction to one of prevention, and in forging vital links amongst political, scientific, and technological communities.

When the IDNDR decade ended in 1999, the International Strategy for Disaster Reduction (ISDR) was created, which aimed at building disaster resilient communities by promoting increased awareness of the importance of disaster reduction as an integral component of sustainable development, with the goal of reducing human, social, economic and environmental losses due to natural hazards and related technological and environmental disasters (UN-ISDR 1999).

In 2005, ISDR promoted another World Conference on Disaster Reduction at which the Hyogo Framework of Action was adopted. This document aimed at promoting an effective integration of disaster risk considerations into sustainable development policies, planning and programming at all levels (Stanganelli 2008:92; UNISDR 2005). The Conference focused on reviewing the progress made in implementing the Yokohama Strategy and identified specific gaps that are the basis for their new position paper, which is organised into five key areas:

- Governance, organisational
- Legal and policy framework
- Risk assessment
- Monitoring and early warning
- Knowledge development and education;
- Reducing underlying risk factors
- Preparing for effective response and recovery.

2.10.2 South African Disaster Risk Reduction National Policies

South Africa faces increasing levels of disaster risk, such as the severe floods in the Cape Flats in June 1994, which profiled the urgency for legislative reform in the field of disaster risk management, stimulating the consultative process which resulted in Green and White Papers on Disaster Management. These policy documents afforded an opportunity for consultation with multiple stakeholder groups and provided the platform for development of draft legislation in 2000 that was consistent with emerging international trends in disaster risk reduction, namely the National Disaster Management Framework (NDMF) (South Africa 2005; 1998; 1999).

The aim of the National Disaster Management Act, (South Africa 2002) is to provide an integrated and co-ordinated disaster management policy that focuses on preventing or reducing the risk of disasters, mitigating the severity of disasters, emergency preparedness, rapid and effective response to disasters and post disaster recovery. The act also guides the establishment of national, provincial and municipal disaster management centres, which will promote an integrated and coordinated system of disaster management with special emphasis on prevention and mitigation.

In sections 15 and 20, the National Disaster Management Act encourages the broad-based culture of risk avoidance, the promotion of education and training throughout the republic, and the promotion of research into all aspects of disaster risk reduction (South Africa 2002).

The National Disaster Management Framework of 2005 was developed to give clear guidance on risk reduction activities to decision makers. Van Niekerk (2005:5) emphasised that the development of this framework depends entirely on a multi-disciplinary, multi-sectoral approach to disaster risk. The NDMF gives priority to developmental measures that reduce the vulnerability of disaster prone areas, communities and households. It also places explicit emphasis on the disaster risk reduction concepts of disaster prevention and mitigation as the core principles to guide disaster risk management in South Africa, in keeping with international best practice.

The NDMF comprises four key performance areas (KPA) and three supportive enablers required to achieve the objectives set out in the KPAs. Enabler 2 addresses the requirements for development and implementation of national education, training, public awareness and research needs, and the development of an integrated public awareness strategy, including effective use of media and the inclusion of disaster risk management in school curricula.

2.10.3 South African Local Government Policies

All three spheres of government of South Africa have the responsibility, in terms of the Constitution (South Africa 1996), to "secure the well-being of the people of Republic". Section 152 (1) (d) further requires local government to "ensure a safe and healthy environment".

Each municipality is required, in terms of the Disaster Management Act (South Africa 2002) as well as section 26 (g) of the Municipal Systems Act (South Africa 2000), as part of their Integrated Development Plan to develop a Disaster Risk Management Plan. The Disaster Risk Management Plan should incorporate Enabler 2 of the NDMF requirements on education, training and public awareness. The focus of this study is to give effect to this Enabler 2 of the NDMF in the context of Zamdela Township, specifically in relation to chemical hazard awareness.

2.11 Disaster Risk Reduction Components

2.11.1 Risk Assessment

Risk assessment examines the likelihood and outcomes of expected hazardous events, including vulnerability conditions that increase the chances of loss. The risk assessment information can provide community input for early warning systems regarding hazards (UNISDR 2002: 69). When risk assessments are supported by good monitoring systems, they are essential prerequisites for:

- Effective disaster management and risk reduction planning.
- Sustainable development planning.

- Identifying potential threats that can undermine a development's success and sustainability, making it possible for appropriate risk reduction measures to be incorporated into the project design prior to implementation.
- Shaping focused risk reduction programmes for specific threats.

Risk assessment should heighten awareness of local disaster preparedness teams about obscure, as well as the obvious risk factors that could affect the community if an incident occurs. In the Netherlands, the chemical plant-owner is required to prepare the External Safety Report, which includes risk calculation, quantification of risk including the assessment of probability of occurrence for the various accidents. Consensus has been achieved between the industries and the public authorities on the type of risk assessment to be performed. The measures of risk provided are individual and societal risks. The risk criterion for the maximum individual risk of death in case of existing major hazards is set at 10^{-5} per year (10 in a million per year). This means that no housing is allowed in an area where the risk exceeds this value. This area can for instance be used for agricultural purposes (Christou 1999:166).

For societal risk, the criterion adopted is 10^{-3} / N, N being the number of fatalities. Planning authorities may accept a higher value if there are proper motives such as land use, financial aspects, employment, etcetera (Christou 1999:166).

In the case of Zamdela Township, the risk that the community may be exposed to is due to the proximity of a chemical plant to the houses and dwellings which make them highly exposed to chemical hazard as indicated in chapter 1. The Disaster Risk Management Plan for Fezile Dabi District Municipality identifies the following risks:

- Pollution
- Human epidemics
- Veldt fires
- Informal settlement fires
- Lightning
- Severe winds

The plan further provides generic guidelines emanating from the National Disaster Management Framework without detailing how the above risks will be addressed. However, important, to note is that not much is covered by the Disaster Risk Management Plan and the Integrated Development Plan of the Fezile Dabi District Municipality regarding chemical hazards, including strategies to deal with these hazards.

The Disaster Risk Management Plan regarding the integrated institutional capacity for disaster risk management, mentions the Fezile Dabi District Municipality Disaster Risk Management Advisory Forums, community or ward participation and disaster management volunteers (South Africa 2008). These structures should serve as drivers for Enabler 2 of the DRMF to increase community participation, because the community is regarded as the first responders to any major incident.

2.11.2 Public Awareness

Public awareness is genuine learning in that individuals will be prepared to take actions to promote safety which may not always be in their own interest. They also point to the fact that ordinary people already have some knowledge of and experience in protecting themselves from disaster which is why risk communication should be in the form of dialogue (Wisner *et al.* 2006: 331).

Diouf (n.d:1) outlines that in many developing countries and countries with economies in transition, there is often very limited and incomplete public awareness and understanding about the severe health and environmental harm caused by chemical pollutants. He further explains that raising awareness of chemical hazards will lead people to be more careful about highly toxic chemicals (Diouf n.d:1).

The complexity of disaster management requires more complex multidivisional organisational structure, not only at government level, but at community level as well. Communities should be active participants in the decisions that affect their livelihoods. In other words they should be leaders in the implementation of prevention programmes. The entrance point to dealing with the community would have to be through education. It becomes an agent that evokes their attention and participation (African Centre for Disaster Studies 2002). Community mobilisation will go a long

way in curbing loss of lives, destruction to infrastructure and instilling a culture of prevention.

The constant contact with the residents will make them to be more relaxed and give them an opportunity to ask questions and voice their concerns easily. Awareness raising materials had to be structured in such a way that it will be understood by the community. And that can only be achieved when they are involved during the process.

Public awareness can be achieved through engagement with the media such as local newspapers, radio, television, public gatherings and schools. Schools are regarded as the focal points for raising awareness about disaster risk reduction according to the National Disaster Management Framework (South Africa 2005:79). Public awareness can be an effective tool, especially when it contains useful information relative to the community's life, such as evacuation routes and assembly points (Institute for Ocean Management 2007:58). Various methods can be used, such as poster competitions, in which the community can develop disaster risk reduction posters to raise awareness. This can promote common understanding of risks among local residents and government officials. Involvement of the community during disaster risk reduction campaigns can enhance their ownership of activities; build a culture of safety, and thus build resilient communities (Institute for Ocean Management 2007:58). Mobilising the stakeholders identified by the Disaster Risk Management Plan of Fezile Dabi District Municipality, including broad-based school participation, will ensure enhanced public awareness, thus increasing community resilience.

2.11.3 Knowledge Development

Priority 3 of the Hyogo Framework for Action (2005 – 2015) clearly states that the use of knowledge, innovation and education should be used to build a culture of safety and resilience at all levels. Disasters can be substantially reduced if people are well informed and motivated toward a culture of disaster prevention and resilience, which in turn requires the collection, compilation and dissemination of relevant knowledge and information on hazards, vulnerabilities and capacities (Institute for Ocean Management 2007:58). Information management and exchange strengthen networks, cooperation and partnerships among stakeholders through information sharing.

In addition, Enabler 2 of the National Disaster Management Framework of 2005 addresses the requirement for the development and implementation of national education and training to capacitate role players through informed scientific research. It also outlines the inclusion of disaster risk management in school curricula. An example that children are the best educators concerns an elementary school girl (Tilly Smith, 10 years) with knowledge about tsunamis, who urged evacuation and saved many lives in the hotel area in Thailand (Dengler 2006:53). Schools are therefore a crucial platform for raising awareness about disaster risk reduction.

2.11.4 Political Commitment

The implementation of the intergovernmental guidelines such as the Hyogo Framework for Action 2005 – 2015; Building the Resilience of Nations and Communities to Disaster; the ISDR Framework for Disaster Risk Reduction, and the National Disaster Management Framework of 2005, motivate and guide efforts to reduce disaster risks to vulnerable communities. In addition, the National Disaster Management Act (South Africa 2002) is used as the legal framework to be followed regarding the implementation of disaster management in all three spheres of government.

For disaster risk reduction to be effective, informed action in and across many sectors from health, education and infrastructure to environmental management is required (Commission on Climate Change and Development 2008). There is also a need to develop a vertical integration from local to national and also to decentralise ownership of risk reduction and management to levels at which action can be taken. Engagement of the public in disaster risk reduction initiatives is an important complement to government actions and coordination. Efforts are also needed to engage the business community, to draw on private sector expertise and to build their commitment to cooperative private and public actions to reduce risk.

The increases in disaster risk that may arise from economic activities should be treated not as externalities, but incorporated into the evaluation and costing of policies and projects concerned, perhaps by incorporating disaster risk as a formal part of the environmental impact assessment process. The chemical industry, as in the case of

Zamdela Township, should be encouraged to invest more in disaster risk reduction initiatives to ensure the safety of the community and also to build better relations. Perhaps the most effective route to take is to incorporate risk considerations in development policy and poverty reduction strategies, including ensuring that development projects themselves are disaster resilient or at least do not exacerbate risks (Commission on Climate Change and Development 2008).

2.11.5 Institutional Framework

The policy development process should be consultative in nature, especially as regards people to be affected by the intended policy. The involvement of key disaster risk management stakeholders is therefore important to ensure successful policy implementation.

The NDMF states that all disaster risk reduction planning, the development of projects and programmes and the allocation of responsibilities must be founded on the needs and priorities of the communities. Disaster risk reduction is a community driven process (NDMF 2005:18). Therefore participation of major stakeholders, including personnel from departments, public health, mass media, transportation, disaster relief organisations and the community, is crucial during all stages of disaster management.

With chemical hazard prevalence, it would be critical for the municipality to ensure recognition of key chemical industry stakeholders such as Chemical & Allied Industries Association (CAIA), Responsible Care, SASOL Company, disaster management volunteers and ward committee members. This will promote environmental care and sharing of information with the public for risk reduction purposes.

2.11.6 Application of risk reduction measures

Risk reduction initiatives can be productive when the local community is involved in developing a hazard map since it will promote the spirit of self and mutual help (Institute for Ocean Management 2007:58). Community based hazard mapping is one of the projects which can be used to emphasize disaster risk reduction at the community level. It can also be used to promote common understanding of risks

among the local community, government officials and experts (Asian Disaster Risk Reduction n.d:11).

Community-based hazard mapping:

- *Field Survey*- residents, local government officials, the private sector and experts, survey the positive and negative features relating to disaster risk by walking through the area.
- *Develop a map* – visualize the observations and findings on the map. Enhance awareness and cooperation through the task.
- *Discussion and Presentation* – What are the problems? Who is responsible? Sharing of information among stakeholders.

The development of the Disaster Risk Management Plan for the Fezile Dabi District Municipality seems not to have followed the community based hazard mapping processes which would have helped to identify chemical hazards as one of the key hazards in the Zamdela

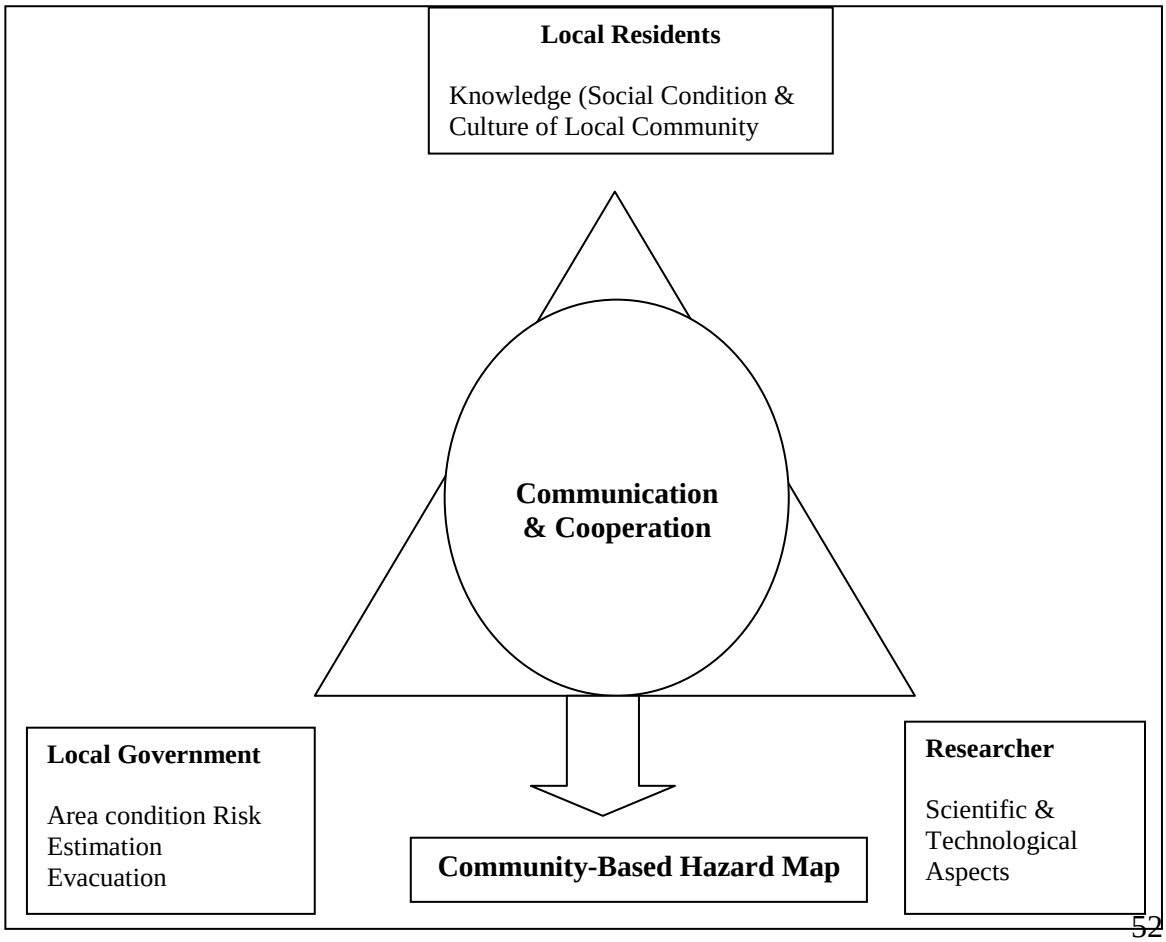


Figure 5: Community-Based Hazard Map *Source: Asian Disaster Risk Reduction (n.d)*

2.11.7 Preparedness and Early Warning System

The goal of disaster preparedness is to reduce the adverse affects of disasters. Disaster preparedness is an ongoing process of assessment, planning and training to prepare for a well coordinated plan of action (Keeney 2004). The technical shortcomings, insufficient preparedness on how best to manage emergencies can potentially increase the impact of an incident. The planning process will produce both effective strategies and systems that are simple and flexible, with understandable designated roles and strong communication and networking between stakeholders, including the community.

In the Kumtor accident in Kirgizstan, for example nearly two tonnes of cyanide and sodium hypochlorite spilled, poisoning the Barskon River and leaving several people dead and hundreds seeking medical treatment. The impact of the incident increased because the spill was not reported for six to eight hours. It was further reported that an ongoing lack of information disclosure, the inadequacy of the government's emergency response and the corruption endemic among state officials all contributed to the public distrust (Bacheva-McGraff 2009:6). This clearly demonstrates that preparedness and early warning systems are important, not only to workers at chemical industries but also to local communities.

The community living close to the chemical industry operational sites should be prepared for hazards, including having clearly documented and communicated early warning systems for possible reduction of vulnerability. The Fezile Dabi Municipality has the responsibility, as an organ of state responsible for disaster risk reduction functions, to ensure that information on early warning systems, evacuation routes, etc is available and communicated to the community. Early warning research has increasingly recognised the need for people-centred warning system (Leonard *et al.* 2008:205). Leonard *et al*. further articulate that effective system require clear, concise

and consistence signals and with simple messages. The research has also indicated that in an effective warning system, messages should:

- Be focused on people at risk
- Be capable of reaching people irrespective of what they are doing
- Be easy to access and use
- Not create added risk
- Be reliable
- Provide appropriate lead time so people can have a chance to protect themselves
- Generate authenticated messages (Leonard *et al*. 2008:205).

2.12 Conclusion

The manufacture of chemicals in South Africa and around the globe provides a wide range of functionality and employment and contributes to improvement of economies and the livelihood of communities. It is, however, important that information on environmental and community safety should be made available to the general public. South Africa has, over the years, managed to develop some of the fundamentally most important legislation, including the National Disaster Management Act 57 of 2002 and the related Framework, as well as others discussed in sections above. The implementation and enforcement of these pieces of legislation have become critical as South Africa is now part of the global economies in all sense of the word.

The website of the Sasol Company was visited, as part of the literature review, to establish whether any reader or member of the general public can obtain any information on early warning, and community safety relating to hazards inherent to Sasol operations, but not much was found. Sasol is, however, a member of the Chemical and Allied Industries' Association and Responsible Care programme. South Africa recorded a number of chemical hazard incidents, which although on small scale, may be an indication that communities are exposed to even greater incidents waiting to happen.

The Fezile Dabi District Municipality and the Sasol Company share a legislative responsibility to ensure that the community is aware of all the risks associated with

the chemical manufacturing operations, including transportation, as demonstrated in the sections above. The analysis of the existing policy framework, documented processes and poor public awareness measures, however, reflect gross negation of the above responsibility relating to chemical hazards.

CHAPTER 3

RESEARCH RESULTS AND PRESENTATION

3.1 Results

The results presented in this chapter are based on the questionnaires completed by the residents of Zamdela Township and interview conducted with Fezile Dabi, disaster management official. The chapter starts with the presentation of results from the questionnaires, followed by analysis of the interview and concludes by interpretation of the results.

3.1.1 Gender

The question of gender was included in the questionnaires to establish the gender ratio of participants and also to understand the perspectives regarding public awareness and disaster management in general from both males and females. The results obtained are presented in Figure 3.

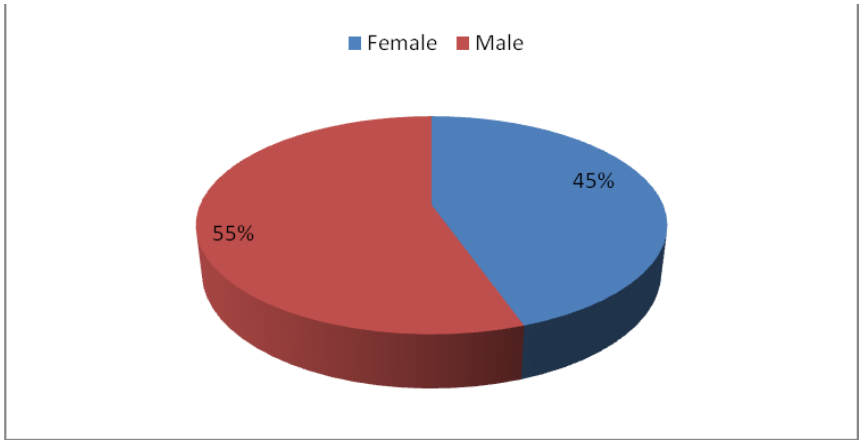


Figure 3: Gender

The results from interviews indicate that 45% of females and 55% of males participated in the study. As indicated in Chapter 1, Zamdela Township started mainly as a residential area for black workers employed by Sasol Company. The area was dominated by hostels which were mainly occupied by males. After the mid-1990s transformation of the South African government, most of those hostels were altered to

accommodate families, which is probably why there was a slight difference in gender representation.

Women are most likely to be at home taking care of young children and this affects their relative vulnerability. Furthermore, men and women's time and place patterns of daily and seasonal activities differ which may produce inequalities in their exposure to disaster (Wisner *et al.* 2006:239). Awareness programmes should be scheduled to accommodate these inequalities between men and women. The study is a proponent of the view that disaster preparedness and mitigation should ensure more inclusive and comprehensive planning with engagement of women as partners.

3.1.2 Age

There are studies which show that in some situations the children and the elderly are more vulnerable to the impacts of natural disaster (Wisner *et al*. 2006:68). In the same way that children and elderly are found vulnerable to the impacts of natural disasters, they are vulnerability to impacts of chemical hazards due to physical inability to act swiftly for their own protection. Awareness initiatives should take into account the age factor hence inclusion of age in this questionnaire.

This question was included to establish understanding of public awareness in different age groups. The study targeted people aged 18 and above since it is believed that public awareness can break barriers of age by transferring information from the young to old and vice versa.

TABLE 2: AGE

Age	Frequency	Percentage
18 – 25	56	37.3%
26 – 35	40	27.0%
36 – 45	25	16.7%
46 – 55	14	9.3%
Above 56	15	10.%
Total	150	100%

The results in Table 2, reflect a widespread age group representation of people who participated in the study. The highest percentage was that of young people in the 18 – 25 age group who contributed 37.3 %; followed by young adults in the 26 – 35 age

group with 27.0%; and the least being 9.3% which represents adults in the 46 – 55 age group. It can be concluded that the results reflect a true representation of people aged 18 and above in the township providing the independent views of different age groups, even those above fifty-six.

3.1.3 Level of education

Participants' level of education is important to indicate their ability to respond satisfactorily to questionnaires and reduce incidents of uncertainty or no opinion responses (Malhotra 2004:177). The levels of education can also influence the extent of public awareness level within Zamdela Township community. The results are presented in Table 3.

TABLE 3: LEVEL OF EDUCATION

Level of education	Frequency	Percentage
Primary	11	7.3%
High School	83	56.3%
Tertiary	39	26%
None	17	11.3%
Total	150	100%

The results show that 56.3% of participants attended high school, while 26% obtained a tertiary qualification. Only 7.3% of participants had a primary qualification and 11.3% did not attend school. The number of participants who received tertiary education may be prepared to contribute their knowledge to new developments taking place in their community. Even though, almost 20% of participants attended primary and some did not attend school at all, public awareness can negate the differences in that the elderly can transfer knowledge which they obtained while living in the same circumstances. The high percentage of participants with high school qualification creates a need for disaster management educational programmes which will improve community resilience. An educated person is more likely to take steps to receive warnings, recognise potentially threatening events, and respond appropriately to those events according to the National Oceanic and Atmospheric Administration (US Department of Commerce 2010:7-7).

3.1.4 Length of stay in Zamdela Township

The question regarding the length of stay was included to establish if the participants were familiar with the dynamics of the area, including historical public awareness programmes employed in the area.

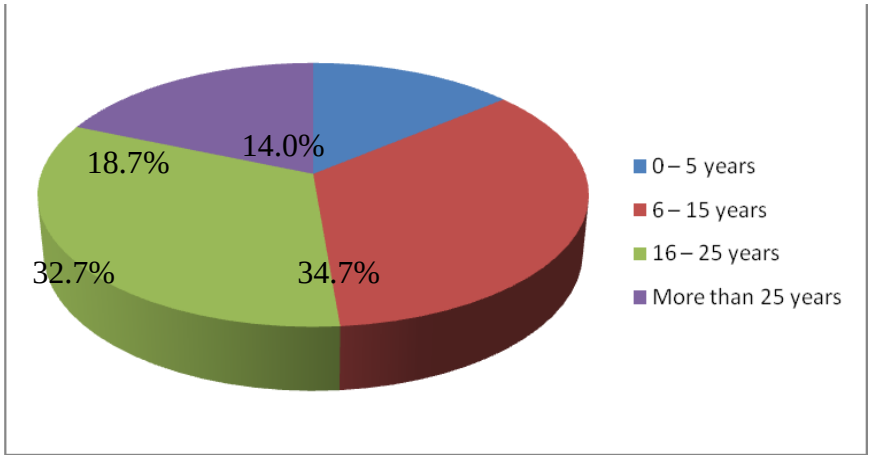


Figure 4: Length of stay

The results in Figure 4 indicate that only 14% of participants have lived in Zamdela for less than five years while 86% have resided in the area for more than six years. This question probes how the Zamdela Township residents with longer and shorter periods of residence may contribute to the study based on their different experiences of incidents which occurred, and also their involvement in disaster risk reduction programmes. Some of community members are involved with the Sasolburg Environmental Committee which facilitates dialogue between the Sasol Company and the community, mainly on air pollution. It can therefore be concluded that majority of participants due to their length of stay are familiar with the dynamics of the area and may relate with the study topic.

3.1.5 Employment Status

According to Wisner *et al* (2006:12), vulnerability and poverty are very highly correlated. They add that vulnerable groups are those that also find it hardest to reconstruct their livelihoods following a disaster, and this in turn makes them more vulnerable to the effects of subsequent hazard events. This question was included to establish the employment status of participants.

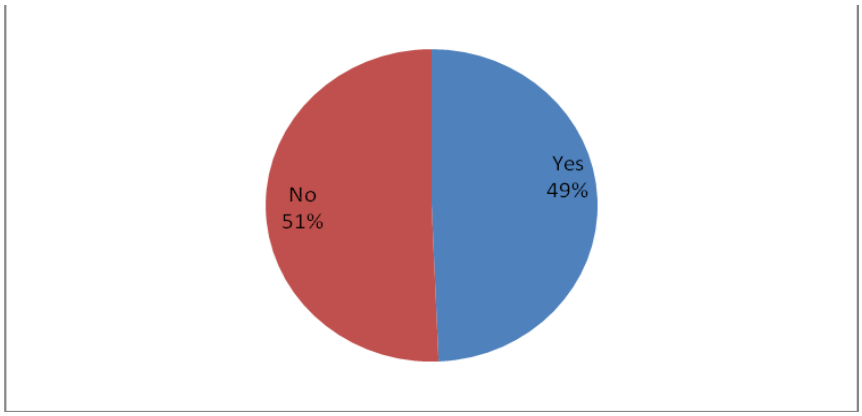


Figure 5: Employment status

The results in Figure 5 indicate that 51% of participants are unemployed and 49% are employed. Existing literature indicates that unemployment increases the vulnerability of communities by exposing them to hazards (Paton & Johnston 2001:272). Vulnerable groups have typically been defined in association with high unemployment, which causes the economic resource limitation and limited social network access.

In the view of the researcher, most of the people moved to Zamdela Township in search for job opportunities since the Sasol Company is the main local employer. High unemployment may have been caused by loss of jobs in the recent economic meltdown which increased the overall unemployment status in South Africa. The increase in unemployment renders Zamdela Township residents vulnerable to chemical hazards and other disasters. This therefore becomes significant to the study in that awareness programmes should be structured to increase preparedness and capacitate the residents at all levels of vulnerability.

3.1.6 Knowledge of risk relating to disaster events

Knowledge is defined as "the fact or condition of knowing something with a considerable degree of familiarity through experience, association or contact" (Ministry of Home Affairs India n.d:1). The question was included to evaluate whether the participants in the study have knowledge of disasters of, or were familiar with the term "disaster" which is basically the core issue in understanding the need for public awareness. It was also used to distinguish the purpose of the study which focuses more on public awareness in relation to chemical hazards than on pollution,

which most community organisations, including the local authorities, seem to concentrate on.

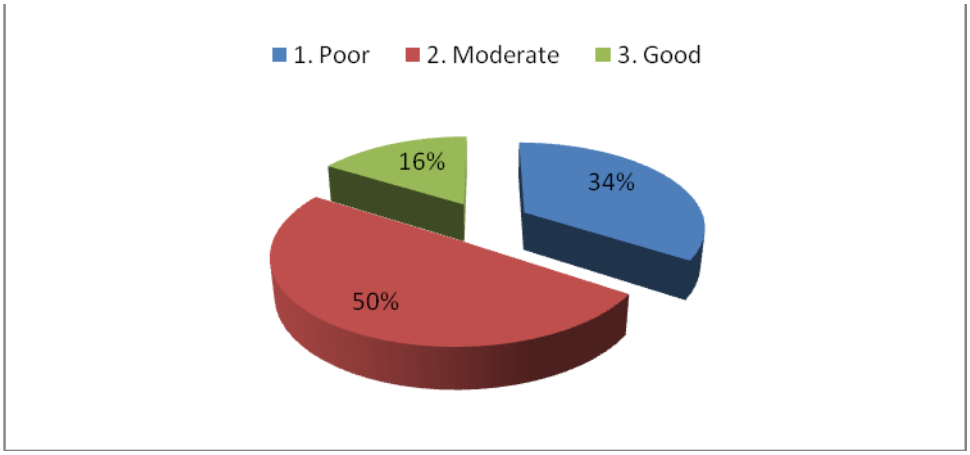


Figure 6: Knowledge of risk relating to events

The responses to the question show in Figure 6 that 34% of participants have poor knowledge of risk relating to disaster events, while 50% have moderate and only 16% percent have good knowledge. These responses suggest that a considerable amount of people have poor to moderate knowledge or experience of disasters. The responses also suggest that participants know more about pollution than other chemical hazards, creates a need for more education.

3.1.7 Hazards prevalence

According to the Pressure and Release Model (PAR Model), disaster is the intersection between socio-economic pressure and physical exposure. In other words, disaster is the result of Hazard x Vulnerability (H x V). The Model also directs attention to the conditions that make the exposure unsafe, leading to vulnerability and to causes creating these conditions (Wisner *et al.* 2006:50). This question was included to establish all the types of hazards that prevail in Zamdela Township according to the participants. The question allowed the participants to raise their views rather than listing hazards for them to choose from. The results are presented in Figure 7.

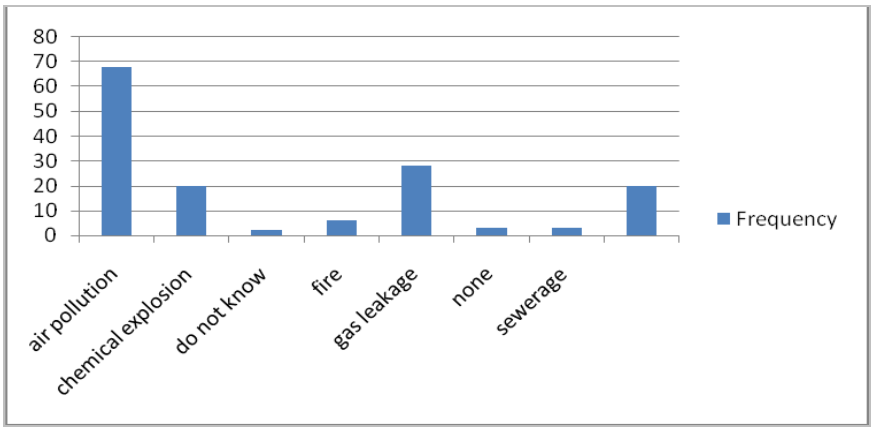


Figure 7: Hazard prevalence

The responses from the participants indicate that 46% believe that air pollution is the major prevailing hazard, while gas leakage constitutes 19%, and chemical explosion and unprotected dumping sites are rated at 13%. According to the responses from the participants, the three major hazards prevailing in the area are: air pollution, chemical explosion and gas leakage, which all result from the operation and production of the Sasol Company plants. Conversely, chemical hazards are not identified as major hazards in the Fezile Dabi Disaster Risk Plan (2009). The disaster risk assessment process should be consultative to allow infiltration of indigenous knowledge such as that of the hazards identified by participants. Such information then flows into the awareness programmes to ensure that all residents are not only aware of the hazards, but are better prepared to deal with the impact of such hazards.

3.1.8 Awareness of hazards

This question was aimed at establishing how the participants came to know about the hazard prevailing in their area. It was also aimed at determining the interest of participants in matters that affect them and their community and also if they pay attention to them. The results are presented in Table 5:

TABLE 4: KNOWLEDGE OF HAZARDS

How did you get to know about the hazards?	Frequency	Percentage
1. Training	18	12. %
2. Media Awareness	46	30.66%
3. Community Meetings	51	34. %
4. Other	35	23.33%
5. Total	150	100%

The results show that 34% of participants heard about the prevailing hazards through community meetings, 30.66% via the media and only 12% through training. Twenty-three per cent of participants heard from other sources such as by word of mouth and some heard while working for the Sasol Company. The results indicate that participants are concerned about their safety and well-being and they also actively participate in community engagements. This also indicates that future data collection during risk assessment should involve community participation taking into account indigenous knowledge and historical records.

3.1.9 Community Involvement

The National Disaster Management Act (South Africa 2002) requires that emphasis should be placed on community participation in disaster management. Organization for Economic Co-operation and Development (2003:79) states that to the extent that public is informed about the risks in their community, they are more likely to participate in decision-making processes and take steps to help reduce the risks. This part of the questionnaire sought to establish what the participants have done to address disaster management issues in their area. It also probed as to which programmes the participants were involved in to address the hazards. The results are presented in Table 6.

TABLE 5: COMMUNITY INVOLVEMENT

How did you get involved in these issues?	Frequency	Percentage
1. Awareness	44	29.33%
2. Education and Training	34	22.66%
3. Volunteer work	26	17.33%
4. Other	46	30.66%
Total	150	100%

The results from participants indicate that 29.33% were involved in raising awareness; 22.66% in education and training, and 17.33% in volunteer work such as the Sasolburg Environmental Committee which was established in 2001. The committee coordinates the community air monitoring programs in the Zamdela Township. They take air samples, measure toxic chemicals with a bucket system and report to the community (Groundwork, 2002). However, 30.66% of participants reported that they did nothing about the information. The positive factor is an indication from the results that almost 70% of participants had at some point in their lives been involved in

community awareness programmes. Furthermore vulnerable groups like women, children and the elderly should be encouraged to participate in order to improve the quality and increase the likelihood of community ownership in disaster risk reduction initiatives.

3.1.10 Knowledge what to do during chemical incidents

Levine (1989:142) in the discussion on the methods of assessing and reducing injury from chemical accidents, states that chemical accidents are complex and often not well understood. She states that it is not only the local emergency personnel that do not understand chemical accidents but also the general public because chemical materials are relatively unstable and capable of changing. The residents of Zamdela Township should be prepared through awareness and information programs relating to chemical hazards associated with Sasol operations. The question was included to determine if the participants, as part of the community, are aware of the procedures to follow during chemical incidents.

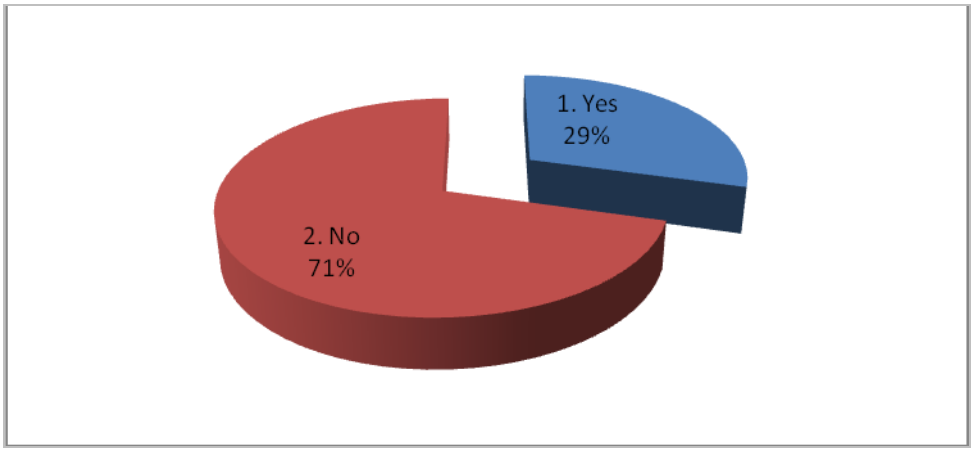


Figure 8: Knowledge of what to do in case of chemical explosion

The results from questionnaires indicate in Figure 8 that 71% of participants are not aware of what to do in the event of chemical incidents, while only 29% are aware. The percentage of participants who are not aware is too high and indicates that much can be done to educate the Zamdela Township community on emergency procedures.

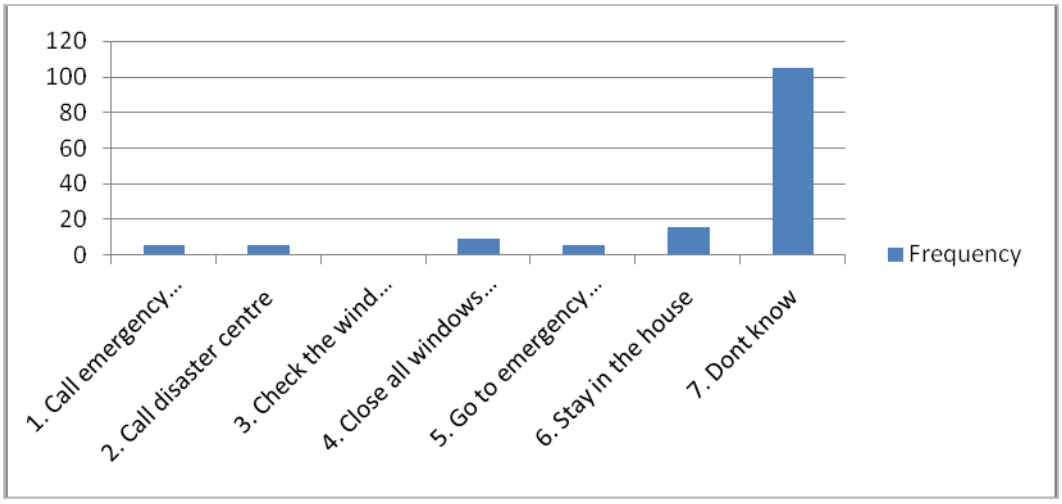


Figure 9: Knowledge of what to do in case of chemical explosion

The results in Figure 9 indicate that regarding the 29% of participants who know what to do in case of a chemical explosion, answers varied from: dialling the emergency number, calling the disaster centre, checking the wind direction, closing all windows and doors, and also staying in their house or in another safe place. The appropriate procedure should be communicated during the preparedness phase to all community members. Major Hazards Installation Regulations (MHI) promulgated under the Occupational Health and Safety Act (South Africa 1993) places the responsibility on local government emergency services to prepare emergency procedures outside chemical plants with major hazards installation. These procedures should be communicated to the public for support and consent and also to encourage active participation (Vogel *et al.* 2007:355). The communication will help clear the correct procedures to be followed during chemical emergency.

3.1.11 Knowledge of awareness programmes

Wisner *et al.* (2006:331) define public awareness as often little more than a description of a rag-bag of this or that item of information that is directed to the public. However what is needed is genuine learning to the point where individuals will be prepared to take actions to promote safety which may not always be in their own interest. They further quote (Handmer & Penning-Roswell 1990) that public awareness followed by informed action is the bedrock requirement to reduce vulnerability and developed resilient households, localities and societies. This question on awareness programmes was included to establish whether there were

other means to raise awareness within the Zamdela Township. The results are presented in Figure 10.

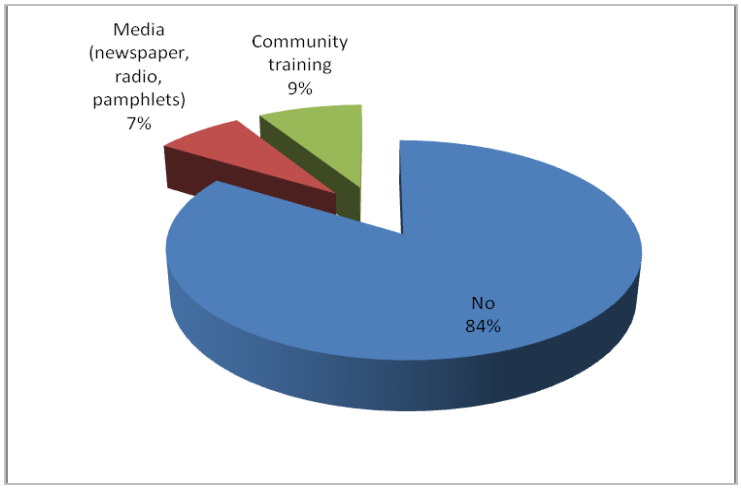


Figure 10: Other awareness programmes

The responses from the participants indicate that 84% were not aware of any awareness programmes being implemented in their area while nine per cent had learnt from community training, and seven per cent said that they had been informed by the media. This response is consistent with the greater tendency towards feelings of helplessness reported earlier concerning their knowledge about what to do in case of a chemical explosion. Studies have shown that people are intelligent, therefore they should be told the risks that the community faces even if the information is of a problematic nature. In addition, people should be told about the status of community resources for dealing with the hazards, how and where they should seek help (Levine 1989:153).

The Disaster Management Act (South Africa 2002) states that the local disaster management centre may give advice and guidance by disseminating information regarding disaster management in the municipal area, especially to communities that are vulnerable to disasters. According to Levine *et al.* (1989:80) programmes of community education through the schools, religious education, religious education and the media should be considered. The goals of such programmes should be to make the public aware of the necessity for preparedness, and to alert them to the specific ways they must act to protect themselves, as well as the ways that community agencies will respond in the event of chemical disaster. Public awareness will be an

effective tool to communicate information regarding emergency actions should be provided to the community of Zamdela Township.

3.1.12 Chemical accidents

The researcher's view is that information on previous chemical accidents, if made public will help alert the community of the levels of potential risk and a need for active participation in the preparedness and risk reduction initiatives. A question on previous chemical accidents was included to establish if the participants were aware of what had happened in the past. It was also aimed at establishing if the reports on those accidents were true and what the participants did during accidents. The results are presented in Table 7.

TABLE 6: CHEMICAL ACCIDENTS

Accidents at chemical explosion	Frequency	Percentage
Yes	69	46%
No	81	54%
Total	150	100%

Responses from participants indicate that 46% are aware of chemical accidents that occurred at Sasol and 54% are not aware. The Sasol Plants in Sasolburg and Secunda were targeted by Umkhonto we Sizwe during the apartheid era in June 1980 (20th South African History, Umzabalazo the Liberation Struggle). The participants were not aware of these chemical accidents probably because 14% of them had been living in Zamdela for less than five years and 34.7% for less than 15 years since the Sasol plant was bombed in the 1980s. Another reason might be that the information was not disseminated to the local community as shown above in 3.6.12 where 84% of participants indicated that they were not aware of awareness programmes.

3.1.13 Knowledge of early warning systems

Emergency warning alert systems should be put in place to warn the mostly likely to be affected community that a disaster had occurred or that there was an imminent threat of a possible disaster. Levine (1989:149) is of the opinion that individuals when properly warned can take appropriate adaptive measures. Early warning systems which will be used during an emergency should be communicated to the community during the preparedness phase (Poyarkov 2005:4). In addition, the systems should be tested in advance so that their significance is fully understood by the public and the

public knows how to respond appropriately during an emergency. This question was included to establish from the participants whether they are aware of early warning systems. The results are presented as follows in Table 8.

TABLE 7: EARLY WARNING SYSTEMS

Awareness of early warning systems in case of chemical explosion/fire	Frequency	Percentage
Yes	82	54.66%
No	68	45.33%
Total	150	100%

The results show that 54.66% of participants reported that they were aware of early warning systems while 45.33% reported that they were not aware. Early warning systems are very crucial to a community such as Zamdela Township and should be known to all residents. According to Leonard *et al.* (2008:205) effective systems require clear, concise and consistent signals and messages. They added that effective warning messages should be focused on people at risk, be capable of reaching people irrespective of what they were doing, be easy to access and use, not create added risk, be reliable, provide appropriate lead time so that people could have a chance to protect themselves and generate authenticated messages. In order to increase public understanding of early warning systems, such information could be communicated through schools and public meetings. As indicated in question 3.6.9 above, the majority of the participants were involved in community matters, therefore these systems could easily be communicated at community gatherings.

3.1.14 Preparedness/contingency plan for chemical explosions

The disaster preparedness is an ongoing process of assessment, planning and training to prepare for a well coordinated plan of action which will be used to minimise the impact of a hazardous event. The preparedness plan should contain information which ensures that all relevant individuals understand their responsibilities, such as evacuation routes, evacuation procedures, assembly points, etcetera during chemical accidents. Communities which have made disaster preparedness plans well in advance of the actual event can achieve quicker and better organised responses when an emergency arises (Levine *et al.* 1989:75).

Community preparedness can be thought of as the advance capacity of a community to respond to the consequences of an adverse event by having plans in place so that people know what to do and where to go when a warning is issued or a hazard is observed according to the National Oceanic and Atmospheric Administration (US Department of Commerce 2010:7-2). The plans can provide guidance to limit the scope and severity of the effects of chemical exposure. Such plans can also help to ensure that action will be taken during the acute emergency phases to monitor the exposure in order to provide necessary clinical services and to initiate research in the future (Levine *et al.* 1989:75). This question was included to establish if the participants were aware of the preparedness plan for any chemical hazards. The results are presented in Table 9.

TABLE 8: PREPAREDNESS PLAN

Awareness preparedness/ contingency plan	Frequency	Percentage
Yes	25	16.66%
No	125	83.33%
Total	150	100%

The results indicate that only 16.66% of participants are aware of preparedness plans while 83.33% are not aware. Local authorities should take steps to provide such information to the community, which will allow them to understand emergency management systems to develop confidence among the public. The public should be made aware of the information and documents available to them related to possible disasters, and where they could be examined (Poyarkov 2005:2). According to Levine (1989:153) a preparedness plan is well worth while in the case of chemical accidents.

This study seeks to motivate for effective communication of the preparedness plan to the Zamdela Township residents. Such information should be two-way, providing an opportunity for public input to the authorities as well as providing information to the public from authorities. Effective communication with the public during an emergency requires the coordinated involvement of different stakeholders such as disaster management officials, community representatives, technical experts and the media. The duties of these parties should be clearly defined during the preparation of emergency and contingency plans.

3.1.15 Knowledge of emergency services numbers

It is important that the community of Zamdela Township should be aware of the emergency service number to use during chemical incidents as the local emergency personnel are regarded as the first responders to emergencies. According to MHI, the local emergency personnel should be provided with appropriate information on the composition and the toxicological and other relevant properties of chemical products which the industry produces, for example uses, stores, to disposes of or transport. They should therefore be able to respond and also provide guidance to the public on what basic safety procedures to perform. The question regarding knowledge of emergency services numbers was included in order to establish whether the participants were aware of such numbers. The results are provided in Figure 11.

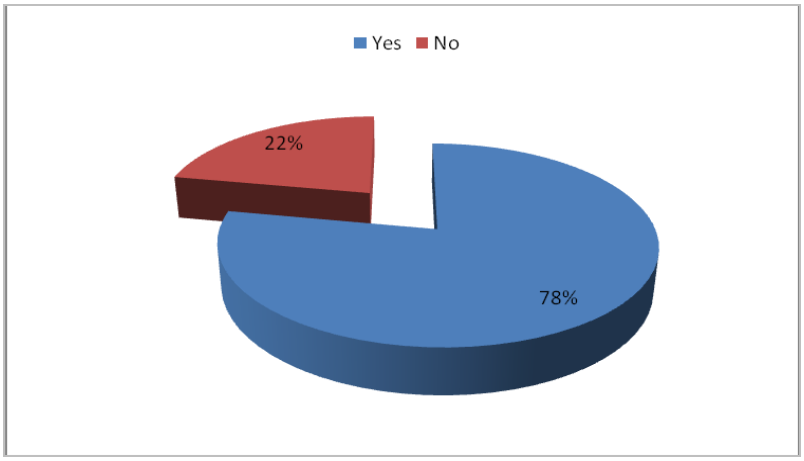


Figure 11: Knowledge of Emergency Services Numbers

The results from questionnaires indicate that 78% of participants are aware of emergency services numbers, while 22% are not aware. As part of emergency preparedness planning, it should be ensured that emergency numbers are known by all community members including children. Such information can be disseminated to the community through awareness programs and school awareness programs.

3.1.16 Knowledge of evacuation procedures

Evacuation procedures will assist in avoiding confusion and facilitate more effective systems during emergency situations. These procedures should be tested in advance so that their significance is fully understood by the public, and the public knows how to respond appropriately in an emergency situation. The question was included to

establish if the participants were familiar with the evacuation procedures in case of chemical explosions. This question is important because the participants live just a few metres away from the chemical industry. The results are presented in Table 10.

TABLE 9: KNOWLEDGE OF EVACUATION PROCEDURE

Awareness of evacuation procedure	Frequency	Percentage
Yes	41	27%
No	109	73%
Total	150	100%

The results indicate that 27% of participants are aware of evacuation procedure while 73% are not. The follow-up question enquires about how they get to know about the evacuation procedures and the results are presented as in Figure 12.

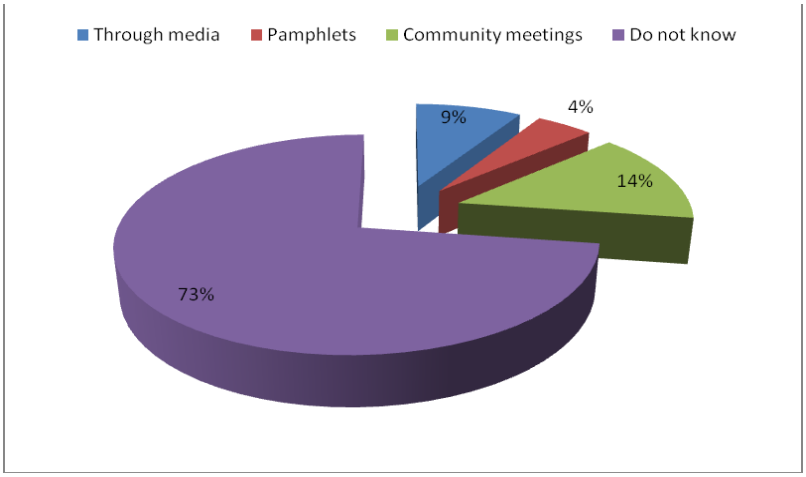


Figure 12: Means of dissemination of information

The results indicate that 9% of the participants had heard about evacuation procedure from the media, while only 4% read about it from the pamphlets and 14% heard of it at community meetings. However, 73% of the participants reported that they had never heard about an evacuation procedure in case of emergency incidents. Information such as that about evacuation procedure can be communicated to the community through media such as local radio, television and postings in public areas like shopping complexes.

The media should be involved during the development of emergency plans and should be given information concerning the emergency procedures in order that they have the necessary background to be an effective and reliable source of information should an

accident occur (Poyarkov 2005:5). Such information can also be communicated to the public through community organisations such as the Sasolburg Environmental Committee, and members of the public who can disseminate this to other community members. In order for all stakeholders to understand their roles during evacuation, they should take part in evacuation exercises to test and identify shortcomings and correct them.

3.1.17 Sasol Refinery efforts to raise awareness

The chemical industry, through the voluntary Responsible Care initiative, is encouraged to form awareness panels and committees to enable relevant information such as safety issues and risk potential to be disseminated to government, labour and the general public [South African National Profile 2002-2005:11-4)]. This question was included to establish the participants' perceptions about Sasol Petrochemical Refinery's efforts to raise awareness among the Zamdela Township residents. The results are presented in Table 11.

TABLE 10: SASOL REFINERY EFFORTS TO RAISE AWARENESS

Sasol's engagement to raise awareness	Frequency	Percentage
Yes	34	22.67%
No	116	77.33%
Total	150	100%

The results indicate that 22.67% of participants think that Sasol refinery is engaging the community to raise awareness of disaster risks while 77.33% think that not enough is done. The follow-up question enquires what the industry is doing to raise awareness. The results are presented in Figure 13.

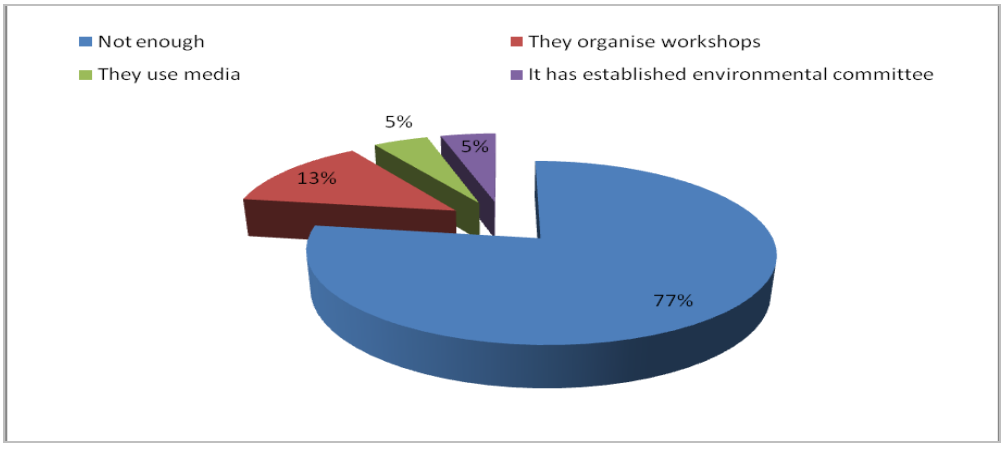


Figure 13: Sasol refinery attempts to raise awareness

Five per cent of the participants indicated that the industry used media, and another five per cent indicated that the industry had established an environmental committee. Thirteen per cent reported that they organised workshops and 77% indicated that they were not doing enough. Although creation of awareness is a collective responsibility of the chemical industry, community and local authorities, the industry is supposed to disseminate information to the general public according to Responsible Care.

According to South African National Profile (2002-2005:11-8), there is currently a lack of information being provided by the chemical industry in the form of MSDS[2] for use by the general public, especially information relating to health and environmental risks. In addition, there must be public places to disseminate information that is made available to the general public by both government and the industrial sector. Information that the industry compiles is often predominantly aimed at the company level and is not geared towards public education (South African National Profile 2002-2005:11-8). The industry has the responsibility which is enforced through South Africa's Constitution that its citizens have the right to transparency and access to any information held by the state, as well as any information that is held by another person and that is required for the exercise or protection of his or her right (South Africa 1996).

3.1.18 Public participation in chemical awareness

In almost all the programmes that are related to chemicals and disasters, Government Departments are supposed to establish monitoring committees that will provide for relevant support expertise. These committees should include representation from the public at large (South African National Profile 2002-2005:11-7). An informed public can provide a stimulus for dialogue among industry, public authorities and the public at large, and a basis for effective participation of the public in decision-making related to hazardous installations (Organization for Economic Co-operation and Development 2003:79). This question was included to establish if the local authorities promoted public participation or sought input on chemical awareness in the area. The results are presented in Table 12.

[22] MSDS are Material Safety Data Sheets specified in the Hazardous Substance Act and the SABS ISO 11014-1:1994

TABLE 11: ADDITIONAL EFFORTS TO ENCOURAGE PUBLIC INPUTS

Efforts necessary to encourage public participation	Frequency	Percentage
Yes	122	81.33%
No	28	18.67%
Total	150	100%

The results indicate that 81.33% of the respondents believe that local authorities should encourage participation or seek public input on chemical awareness in the area, while only 18.67% indicated that community involvement was not significant. The follow-up question enquires about what the local authorities should do to encourage public participation, and Figure 14 indicates the results.

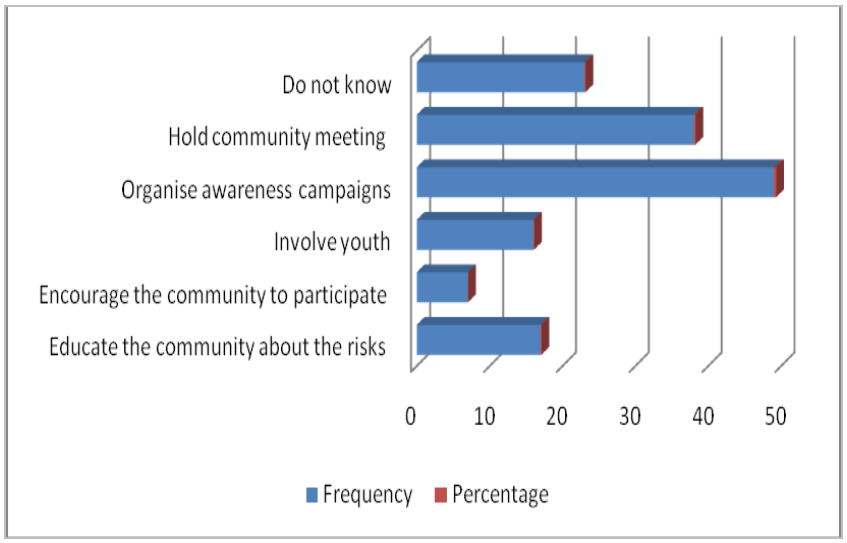


Figure 14: Efforts by authorites to increase public participation

The results indicate that participants suggested that authorities should increase public participation by holding meetings, organising awareness campaigns, by involving youth, by encouraging the community to participate and also by educating the community about the risks.

However, 15.33% of the participants indicated that they did not know what the authorities should do to encourage public participation. More than 30% of the participants indicated that authorities should organise awareness campaigns which could facilitate dialogue between the community and the authorities.

3.1.18 Community decisions influenced by public participation

To the extent that the public is informed about risks in their community, they are more likely to participate in decision-making processes and to take steps to help reduce the risks (Organization for Economic Co-operation and Development 2003:79). This question was included to establish from the participants whether public participation can influence any major decisions in the sphere of disaster risk management. The opportunity to involve community members to provide mutual support through problem-focused coping may also be a good indicator of the level of co-operation between the local authorities and the community. The co-operation may constitute a measure of the likelihood of the success of mitigation strategies that require collective and coordinated action being adopted and implemented (Paton & Johnson 2001:5). The results are presented in Table 13.

TABLE 12: PUBLIC PARTICIPATION

Influence of public participation in major decisions	Frequency	Percentage
Yes	89	59.33%
No	61	40.67%
Total	150	100%

The results indicate that 59% of the participants believe that public participation can influence major decisions in the sphere of disaster risk management while 41% think their involvement will not make a difference.

3.1.19 Advertisement of educational meetings

The more people who are involved in community activities that engender a sense of community, efficacy and problem solving, the greater will be their resilience to adversity (Paton & Johnston 2001:274). Hazard education and disaster risk reduction initiatives should be linked to community development and should be communicated to communities at risk. The question was added to establish from the participants how the meetings concerning education in the community should be advertised and whether they should be open to the public. The results are presented in Table 14.

TABLE 13: COMMUNITY MEETINGS

Meetings should be well advertised and made open to public	Frequency	Percentage
Yes	128	85.33%
No	22	14.67%
Total	150	100%

The results indicate that more than 85% of the participants believe that educational meetings should be well advertised and be open to the public, while 14% indicated that they did not need to be advertised. The follow-up question enquires as to how community meetings should be advertised in order to attract the majority of Zamdela Township residents. The results are presented in Table 15.

TABLE 14: ADVERTISEMENT OF COMMUNITY MEETINGS

How meetings should be advertised	Frequency	Percentages
Though local newspaper	66	44%
Through media, well in time	25	16.67%
Do not know	59	39.33%
Total	150	100%

The results from participants indicate that almost 60% suggested that community meetings should be advertised through media such as newspapers, but should be advertised well in time. That would ensure that the message would reach the majority of community members so that they could attend such meetings. The activities of public authorities related to communication with the public should be co-ordinated to optimise the value of the communication and to build up trust and credibility (Poyarkov 2005:2).

3.1.20 Attendance of community meetings

This question was meant to establish whether the participants in this survey would attend community meetings if the local authorities organised them. Such meetings could be used to provide general information on the nature, extent and potential effects on human health and/or the environment, including property, of possible disasters in the area. Such meetings would facilitate the discussion of emergency plans including roles and responsibilities reducing confusion as part of preparedness. The results are presented in Table 16.

TABLE 15: COMMUNITY MEETING ATTENDANCE

Willingness to attend such meetings	Frequency	Percentage
Yes	119	79.33%
No	31	20.67%
Total	150	100%

Results from participants indicate that 79.33% will attend community meetings while 20.67% indicate that they will not attend. The responses indicate that some of the participants will not attend community meetings may be associated with the tendency towards feelings of helplessness reflected in responses to question 3.6.19 that community decisions may not be influenced by community participation. Again, different segments of the community may not view the threat of chemical accidents as equally important because of value differences. As they might never have experienced a particular kind of disaster, they placed a low priority on preparing therefore (Levine 1989:147). But this is positive in that the majority of the participants are willing to attend meetings since they are representative of the population of Zamdela Township.

3.2 Interpretation and analysis of the results

The interpretation of results is done to better understand of how different questions inter-relate and to understand significant relationship between two items that are selected by using cross tabulation. The findings from data collection through questionnaires are here summarised and discussed in relation to the research objectives:

3.2.1 Knowledge of hazards

To explore the participants' knowledge of hazards which prevail in Zamdela Township, the questionnaire was designed to collect data on participants' level of education, level of disaster awareness and knowledge of hazards which are prevalent in the area. The responses to these questions are here-below discussed and analysed.
Out of a sample of 150 participants, 44.4% of them are females and 55.6% are males. The results indicate that the understanding of disaster between males and females represented by the sample is moderate to good as is clear in Figure 15.

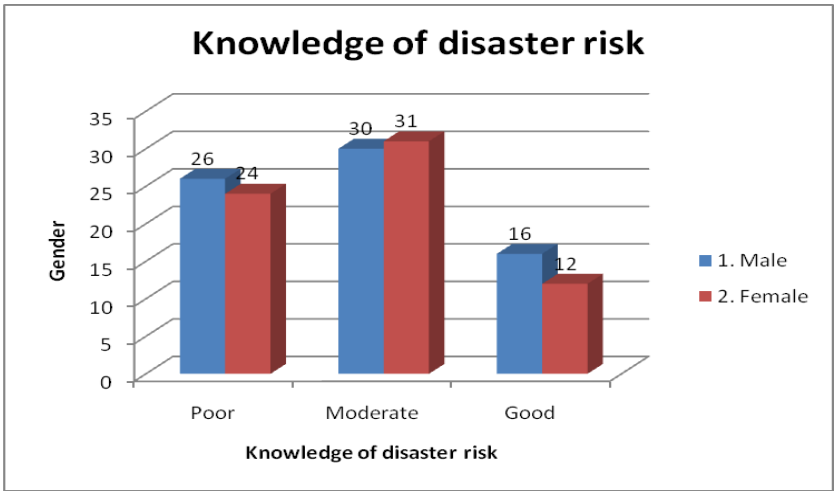


Figure 15: Knowledge of disaster based on gender

The correlation indicate that level of education does influence the knowledge of disaster because from the Figure 16 it is obvious that the participants with high school and tertiary education better knowledge of disaster risk than those with primary and no education at all. Even though nine participants with an education, have moderate knowledge, but the results cannot be based on that since there were only seventeen participants in this group. The results therefore indicate that awareness campaign should also target all community members including those without education. However, those campaigns should be designed to make them understand the concepts of disaster management.

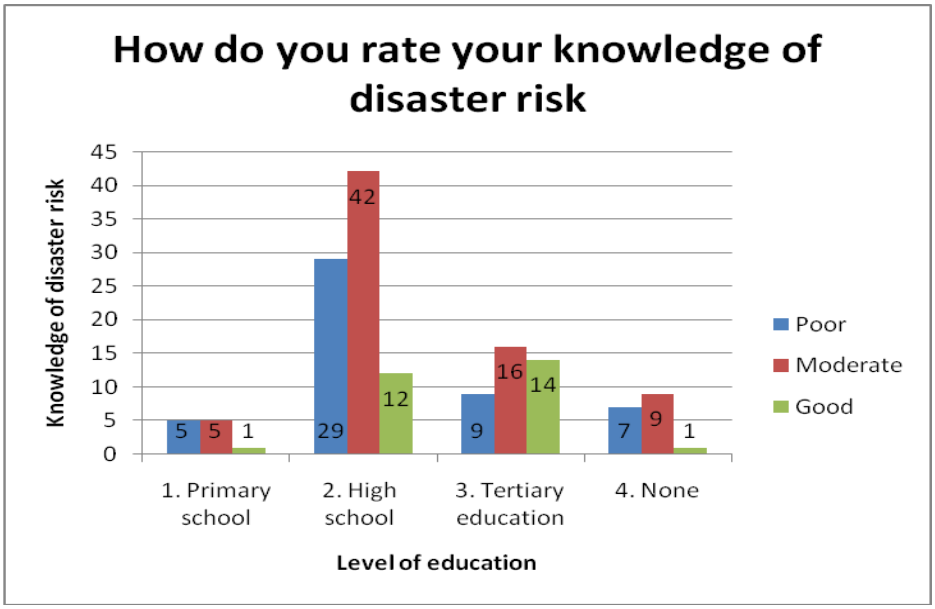


Figure 16: Level of education vs. knowledge of disaster

Knowledge of disaster risk management in different age groups was compared in Figure 17. The results indicate that there is a moderate knowledge of disaster risk across all age groups. There is, however, a low number of participants in the 18-25 age group with a good knowledge of disaster which is not good, since the majority of them are supposed to be still at school and therefore should know.

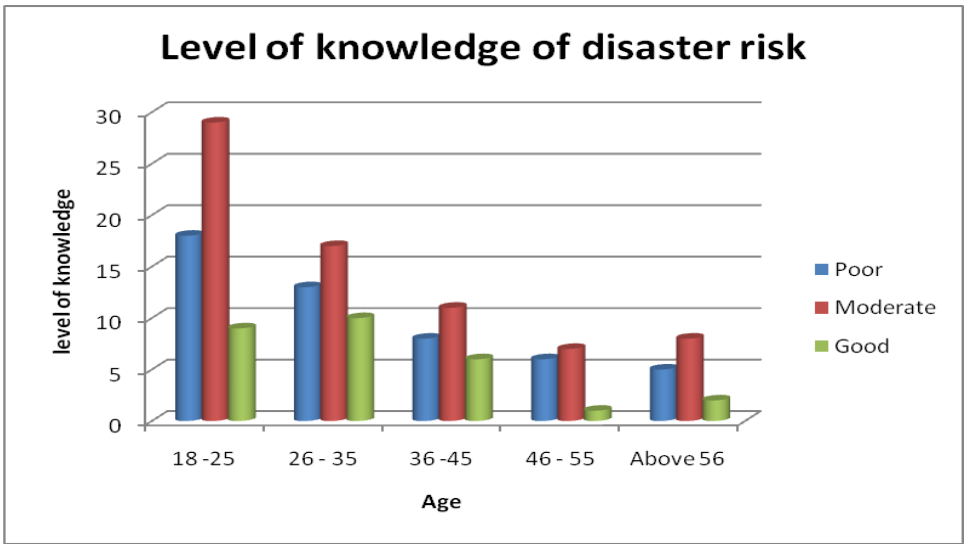


Figure 17: Age vs. knowledge of disaster

The participants identified three major hazards prevailing in the area as air pollution, gas leakage and chemical explosion which includes unprotected dumping sites. This is positive in that respondents are able to identify major hazards which may demonstrate that the community is concerned about their safety and well-being and therefore may respond well to robust awareness programmes.

3.2.2 Early warning systems

To explore participants' knowledge on the existence of early warning systems which are known and employed by the community; their understanding of what to do in case of chemical emergency is compared with their knowledge of early warning systems. Of the 150 participants, 55% indicated that they were aware of the existence of early warning system known to community whilst 45% was not aware.

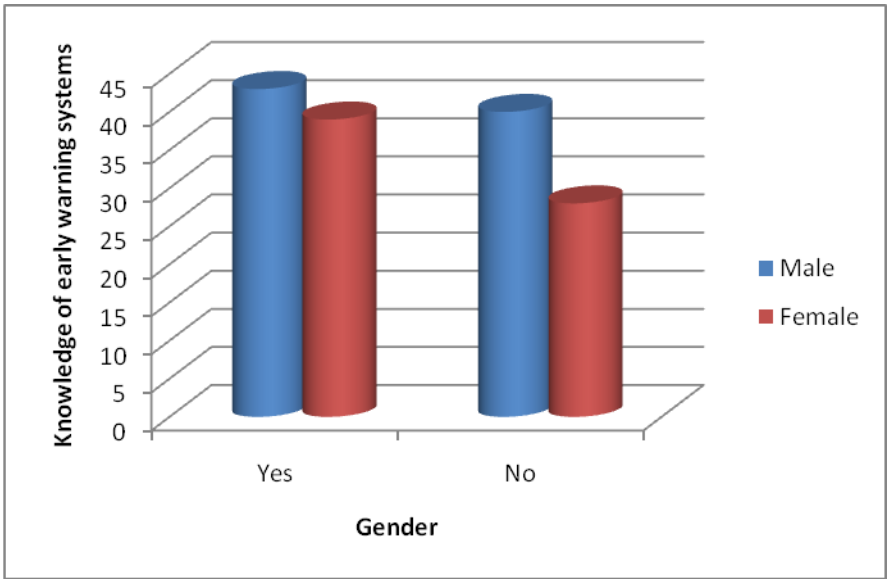


Figure 18: Gender vs. knowledge of early warning systems

In Figure 18 more males (43%) than females (37%) were aware of early warning systems, due to the fact that more males were employed at the company. It is also interesting to note that there is not much difference between the percentages of those who were not aware, males (38%) and females (26%), and those who knew.

The results indicate that high percentage of those who know what to do in case of chemical emergency are employed and only a small number are unemployed. The reason may be that they are employed by the Sasol Company and understand how to respond to chemicals as seen in Figure 19. Therefore, local authorities should target those who are unemployed in the community.

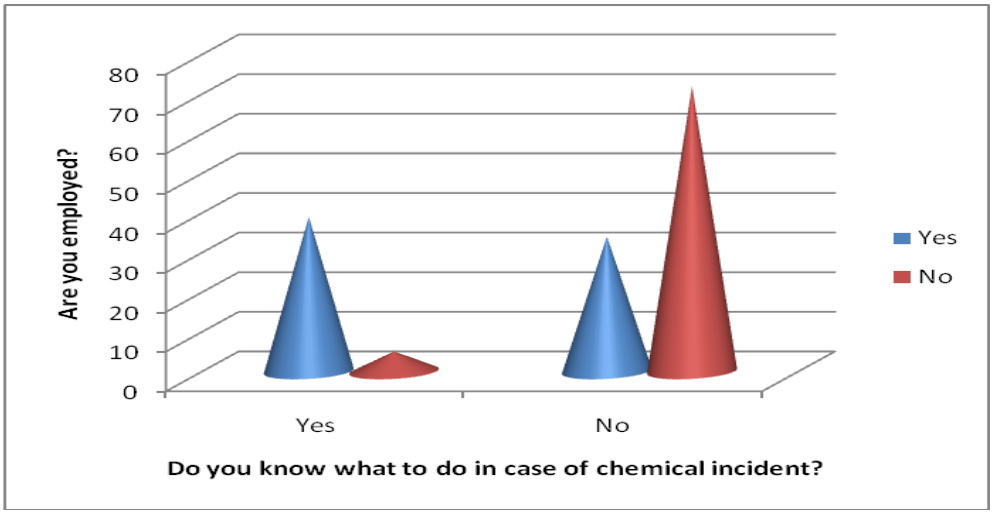


Figure 19: Employment status vs. knowledge of what to do during emergencies

The results are mixed in that if a person is aware of early warning systems, such person should be aware of what to do during chemical explosions. The effectiveness of early warning systems rests on the ability of the community not only to know them, but to be able to execute the entire procedure in emergency situations.

More awareness initiatives are necessary to clear uncertainties in respect of application of early warning systems by Zamdela Township residents. Evacuation exercises will also help the community to understand the use of early warning systems and procedures to be followed during an emergency.

3.2.3 Education in disaster preparedness and response

To evaluate how participants were educated in disaster preparedness and response in relation to chemical hazards, participants were asked about their knowledge of the preparedness plan developed for chemical incidents, and how they knew. Eighty-three per cent said they were not aware whilst 17% said they were aware.

Another question was whether participants knew emergency service numbers which is important in any emergency situation. Level of education of the participants is compared with knowledge of emergency numbers. The results indicate that despite the fact that 82% of participants have high school to tertiary education, there are still participants who do not know the emergency numbers, however small the percentage.

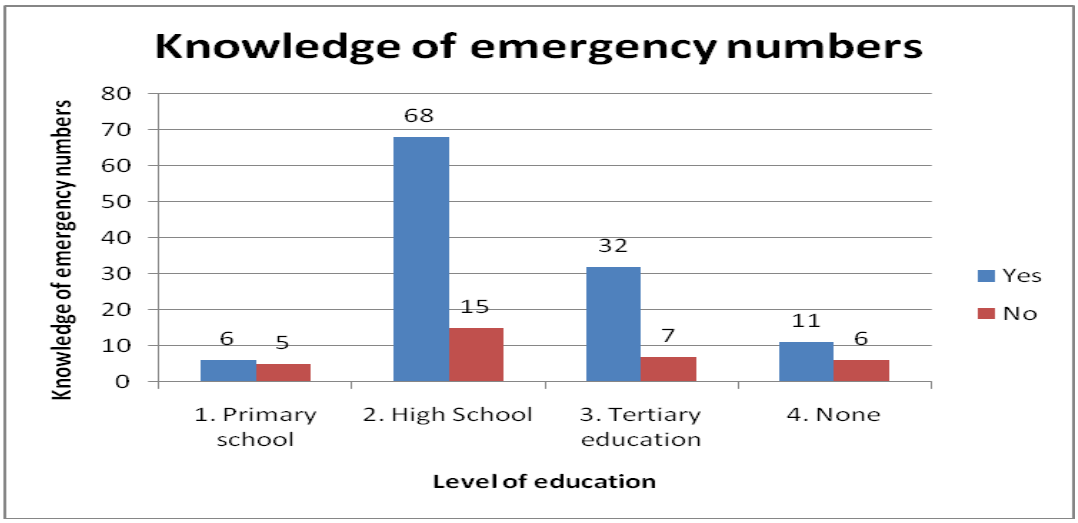


Figure 20: Level of education vs. knowledge of emergency numbers

Again level of education is compared with knowledge of evacuation procedure as shown in Figure 21. The results indicate that only those with tertiary education have knowledge about evacuation while the lower educational levels are not aware.

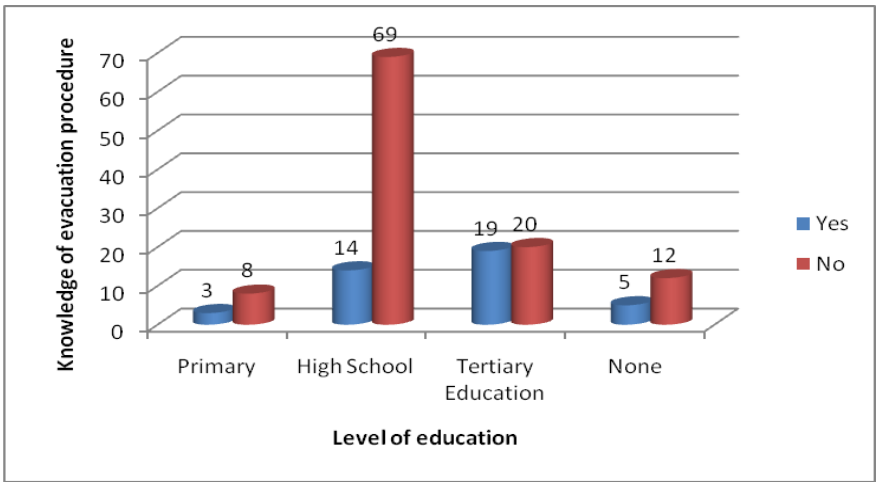


Figure 21: Level of education vs. knowledge of evacuation procedure

Disaster preparedness is an ongoing process of assessment, planning and training to prepare for a well coordinated plan of action which will be used to minimise the impact of a hazardous event. A preparedness plan should contain information such as evacuation routes, evacuation procedures, assembly points, emergency numbers etcetera. Local authorities have the responsibility not only to develop preparedness plans, but to ensure that communities most vulnerable to the chemical hazards are familiarised with these plans. The results indicate that high percentages of participants are not aware of the existence of preparedness plan and the evacuation procedures which is a concern as the sample represents the population of Zamdela Township.

The observation is that there is a need for coordinated awareness programmes to that emergency plans are developed and communicated to the public. Emergency measures are supposed to be reflected on the preparedness plan, which must be made known to the community at large. Information concerning possible disasters, such as emergency responses, should be provided proactively, without request, to the members of the public who might be affected in the event of a disaster. In addition, such information should be provided timeously, be reissued periodically, as appropriate and updated as necessary (Poyarkov 2005:3).

3.2.4 Stakeholder participation

Stakeholder participation in the initiatives to raise community awareness on chemical hazards was explored**.** Participants were asked if they knew of any awareness programmes implemented in Zamdela Township, whether they thought that Sasol Company was doing enough to raise awareness on chemical hazards. Length of stay of participants in Zamdela is compared with their knowledge of awareness programmes. The results in Figure 22 indicate that a small percentage of people who stayed in Zamdela Township for 5-25 years were aware of awareness programmes whilst some who stayed for more than 25 years are not aware of any programme being implemented.

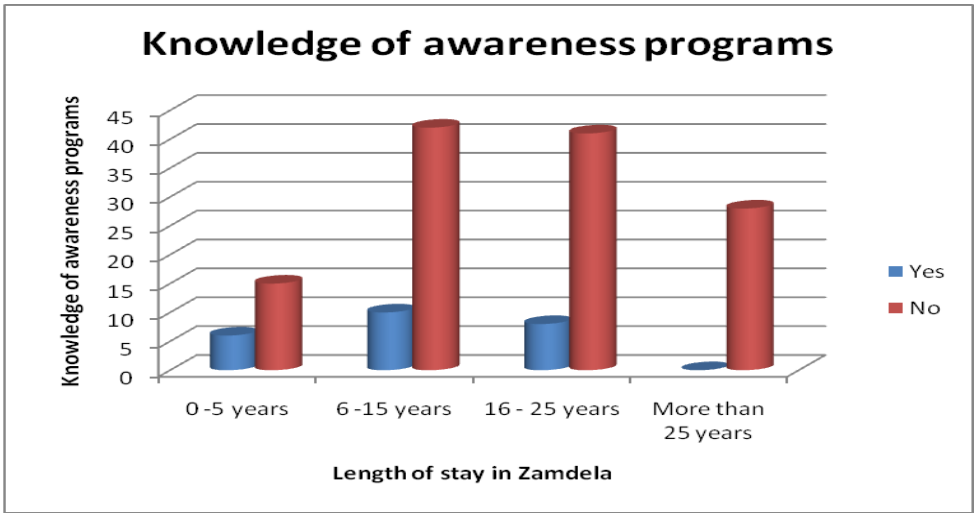


Figure 22: Length of stay vs. knowledge of awareness programmes

In terms of exploring stakeholder participation, gender is compared with opinion on Sasol Company's efforts to raise chemical hazards awareness. The results in Figure 23 indicate that more females believe that the Sasol Company is doing enough to raise awareness while only a few males agree. The majority of participants, irrespective of gender, believe that the company is not doing enough.

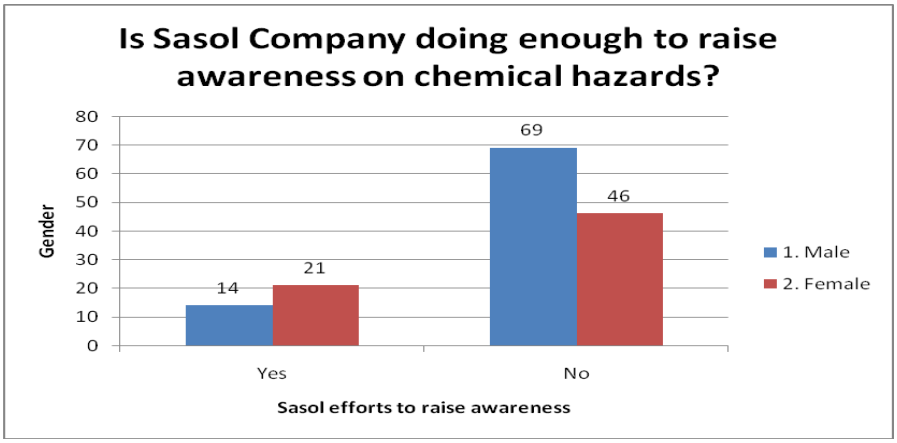


Figure 23: Gender vs. Sasol efforts to raise awareness

The above results suggest that there is more that can be done in relation to stakeholder participation to create awareness on chemical hazards. More consultative awareness programmes driven by the local authorities should be initiated to increase public awareness and minimise risks in case of chemical accidents.

Participants were also asked of their involvement in disaster management issues in the community since stakeholder participation also require community involvement by comparing gender with their involvement in disaster management. The results indicate that more males are involved in awareness and education/training than women, while more women are involved in volunteer work in the community. It is, however, encouraging to notice a balanced participation of both genders in the community initiatives.

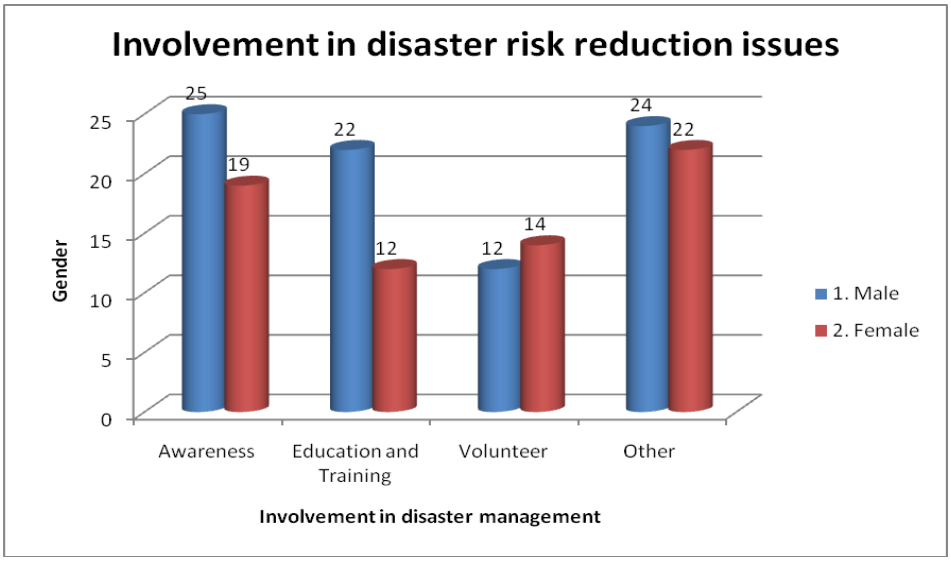


Figure 24: Gender vs. involvement in disaster management

3.2.5 Additional measures for enhancement of initiatives

Participants were asked to suggest additional measures for enhancement of current awareness initiatives including an integrated incident command system for use during chemical incidences. In order to suggest additional measures for awareness, one of the questions asked were whether more can be done to increase public participation, whether public participation is likely to influence major decisions on disaster risk management issues, should such engagements be advertised and whether respondents would attend such meetings.

In terms of whether public participation can influence any major decision in relation to disaster management, public participation is compared based on gender. The results indicate that more women believe that public participation can influence major decisions while a lesser number of men agree as seen in Figure 25.

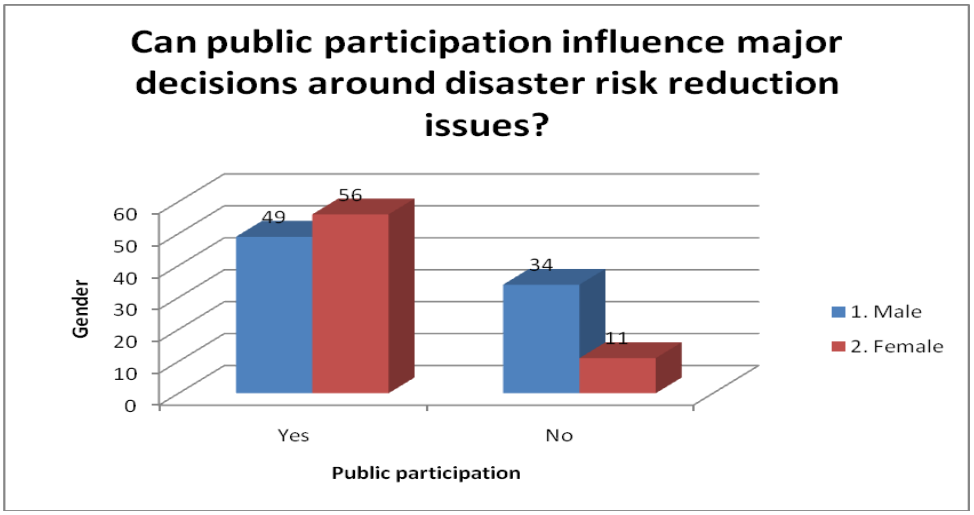


Figure 25: Gender vs. public participation

To suggest further initiatives like advertisement of chemical hazards educational meeting is compared based on the level of education of the participants. The results indicate that a large percentage of participants across all levels of education believe that meetings should be open to the public and adverstised on time as indicated in Figure 26.

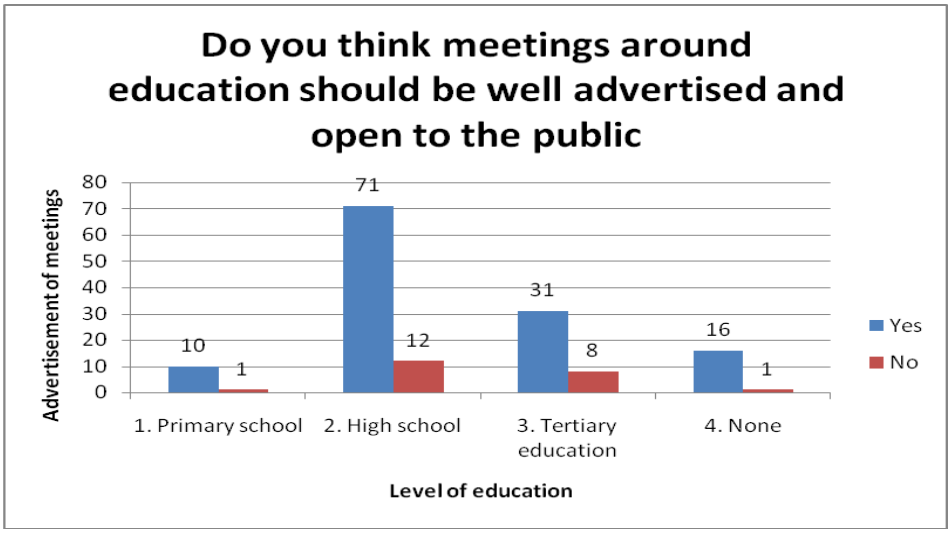


Figure 26: Level of education vs. advertisement of meetings

Employment status is compared with attendance of awareness meetings to determine participants' willingness to get involved in awareness issues. Results show that both employed and unemployed participants are willing to attend public awareness meetings whilst a small percentage of those who are unemployed indicated that they will not attend such meetings as seen in Figure 27. Levine (1989:147) states that the degree to which the community believes it is at risk will affect how much time, money and energy it may be willing to devote to planning for prevention and mitigation of chemical accidents.

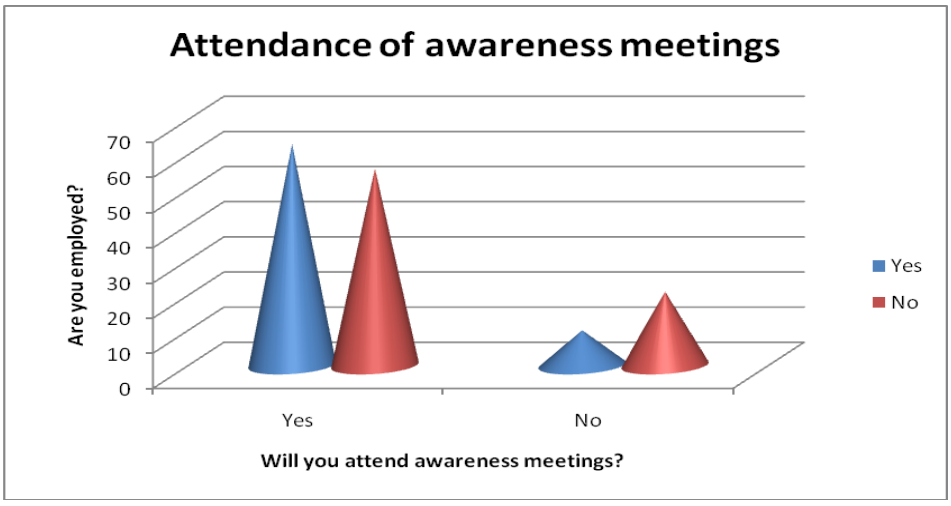


Figure 27: Employment status vs. attendance of awareness meetings

Public participation is important not only from the perspective of information dissemination, but also to strengthen the decision-making process in respect of

chemical hazards risk reduction initiatives. An informed community is able to contribute positively towards their own safety during disasters.

It can also be noted that the participants are willing to be part of the awareness meetings if they are advertised well on time. There is already an entity called Sasolburg Environmental Committee, which facilitates the dialogue between Sasol Company and the community on air pollution. There is an indication from the results that the community is somewhat prepared to participate in structure engagements to handle chemical hazard preparedness matters.

The inclusion of the community during the preparedness phase is important in order to provide safety measures which can be adopted during emergency situations and also to provide the community with information on available documents related to chemical disaster (Poyarkov 2005:3). The study seeks to encourage the local authority target awareness initiatives that are integrated to include public participation.

3.3 Interview with Fezile Dabi District Municipality official

An interview was conducted with Mr Nhlanhla Xaba, who is the Disaster Recovery Officer responsible for response and community awareness programs within Fezile Dabi District Municipality. The following points were established from the interview:

- *What background and awareness programmes were initiated by the district municipality on chemical hazards in Zamdela and its vicinity?*

  The priority of the municipality has been HAZMAT, which they identified as the lead hazard affecting communities alongside the N1 and N3 roads located in the district. The Sasol Company in cooperation with the District Municipality has trained 175 members of the Disaster Management Forum from four local municipalities, Metsimaholo, Moqhaka, Mafube and Ngwathe, on HAZMAT response in the year 2010.

- *Are there any other programmes separately dedicated to chemical hazards within the community?*

Other programmes deal with flooding and wildfire/fire, but none on chemical hazards have been conducted thus far or planned in the near future. Programmes conducted at schools are directed at Grade 11 and 12 students to create interest in disaster management careers only.

- *How do you measure effectiveness of these programmes? Is it via the number of people attending or their ability to respond?*

Questionnaires are distributed for completion by participants to rate satisfaction in respect of training. Promotional material is also issued to support what was discussed in the awareness campaigns. These are issued to the relevant part of the community to ensure effectiveness, for example paraffin safety campaigns are directed at communities living in shacks and RDP houses.

- *How does the community respond to these programmes?*

According to the response of the official, the community is generally concerned with Sasol Company operations and how they affect the health of the people living in the area. The response is therefore good because people want to know more about their safety but to date not much has been done directly linked to chemical hazards.

- *Does the District Municipality have immediate plans relating to creating awareness on chemical hazards whether at schools or in the community?*

The respondent indicated that the municipality is in the process of building capacity for disaster management and there is a budget to be made available for awareness programmes and training. Chemical hazards awareness will be considered.

The interview responses confirmed the results from the questionnaires that the initiatives to create awareness are inadequate and that the community would like to see more being done to improve preparedness in case of chemical accidents. According to the response of the disaster management official, priority of the Fezile Dabi District Municipality is on HAZMAT on N1 and N3 road. He further indicated that there were no other programmes separately focusing on chemical hazard awareness within Zamdela.

3.4 Conclusion

Information on chemical hazard prevalence and how the community should respond during an emergency is imperative for Zamdela Township residents. The results from the questionnaire presented, clearly indicate that not much has been done by the local authorities/municipality to educate the community regarding chemical hazards. In addition, chemical hazards are not even identified as the major hazard in their district disaster plan (Fezile Dabi District Municipality Disaster Risk Plan 2009). This clearly indicates that there are no preparedness plans in place to be activated in case of chemical accidents.

From the interviews conducted with the municipal official regarding development strategies of the municipality, there is no indication of disaster preparedness plans in respect of chemical hazards to be implemented in the future. Another factor which emerged from the interviews was that the Metsimaholo Local Municipality does not have adequate capacity to implement disaster management plans. There was only one official directly responsible for disaster management within the Metsimaholo Local Municipality, in which the Zamdela Township is located. The function of disaster management is dealt with at district level which means that preparedness programmes may not be adequately implemented and monitored at the local level. The study then concludes that Zamdela residents are not ready to respond properly in case of chemical accidents.

CHAPTER 4

RECOMMENDATIONS

4.1 Introduction

Societies have always found ways to cope with natural disasters. Chemical hazards, however, present a different challenge to societies because they are not well understood. They are foreign to the larger communities and relatively few communities have experienced chemical accidents (Levine 1989:141). A variety of accidents is possible, because of a large number of possible combinations of chemical materials. In addition, the materials are relatively unstable and capable of changing, so the dangers of chemical accidents are complex. Despite the increased potential for accidents in chemical plants, transportation, storage, releases and explosions, not much has been done regarding public education and awareness programmes to capacitate at-risk communities. There is a general agreement that chemical accidents still remain much less understood and prepared for than emergencies caused by natural disasters (Levine 1989:142).

The results from the respondents rated chemical accidents as the major hazards in Zamdela Township which could result from operations of Sasol plant. It is crucial for local authorities to implement preparedness measures for chemical emergencies. Owing to the nature of chemical materials, accidents often require specialised protective measures and responses. These responses should be communicated to the emergency personnel, community organisation and the local public, which makes the preparedness stage a crucial one. Therefore, the recommendations in this chapter are informed by the answers from the respondents who participated in the study as well as by the South African legislations on chemical and disaster management.

4.2 Recommendations

It is important to prepare for chemical emergencies in order to withstand them if they occur. Therefore disaster preparedness is an essential phase for chemical emergencies. Disaster preparedness is defined as pre-disaster activities that are undertaken within

the context of disaster risk management, and are based on sound risk analysis. This includes the enhancement of an overall preparedness strategy, policy, institutional structure, warning and forecasting capabilities, and plans that define measures geared to helping at-risk communities safeguard their lives and assets by being alert to hazards and taking appropriate action in the face of imminent threat or an actual disaster (Office for the Coordination of Humanitarian Affairs 2011). Communication underlies the work of the preparedness phase. The following are recommendations:

4.1.1 Awareness Campaigns

Evidence suggests that well-designed public education initiatives increase public hazard knowledge and warning responsiveness (Leornard *et al.* 2008:207) Public education should be done by organising community meetings. The community should be encouraged to gather information and put it to use while they learn to work together. At this stage information should be collected about the resources available to respond to chemical emergencies. Resources include physical objects, equipment, facilities and knowledgeable personnel.

The municipality should carefully plan and use the local media to educate the community about chemical hazards, by defining the issue as important and showing how resources will be used to protect the community. They should use brochures/posters, media releases, internet resources, etcetera to communicate the warning messages and suitable responses. These messages should be in the local languages. The municipality should also make use of the social network to institute dialogue about chemical hazard education because the majority of the youth and young adults use these networks to communicate.

Signage plays a critical role in increasing public awareness of hazards and maximizing effectiveness of early warning systems. Signs and maps showing hazard zones and evacuation routes and safe zones should be used. Agreed and widely distributed evacuation maps are a requirement for public awareness (Leornard *et al.* 2008:207).

Training and education is of the utmost importance. Fezile Dabi District Municipality needs to promote disaster management capacity building by incorporating information

on chemical awareness into school curricula. They should develop educational and training programmes that will focus on preparedness strategies and early warning systems to be employed in the area for chemical hazards. Ways the municipality can use to measure the effectiveness of awareness campaigns:

- Check the population of the community and how many are reached by balancing the representation of different age groups.
- Organise evacuation drills/simulation exercises which will involve different stakeholders in the community.

4.1.2 Involvement of the community and community organisations

The municipality should ensure a broader stakeholder participation in disaster management by involving community organisations such as the Sasolburg Environmental Committee, other NGO's and the general public. Public confidence in a community's emergency plans may increase when the community members are assured that everyone, even the most vulnerable, are being included in a credible planning process and the resulting plans correspond to the community's specific needs (Poyarkov 2005:2). Involvement of an at-risk community in defining learning about and testing appropriate resources for preparedness and response will forge a good relationship between the local authorities, the industry and the community at large.

4.1.3 Emergency/contingency plan

A contingency plan to prepare for and respond to emergencies involving hazardous substances can be considered as a fundamental step for preparedness in Zamdela. According to the Disaster Management (South Africa 2002), each municipality must prepare a disaster management plan setting out contingency strategies and emergency procedures in the event of a disaster, including measures to finance these strategies (DMA 57 OF 2002). The plan should be reviewed, exercised and updated annually. The plan should include procedures for an immediate response to a chemical accident, public notification of evacuation or shelter-in-place procedures and timetables for testing and updating of the plan according to the Environmental Protection Agency (United States 2009). Studies have found that communities with chemical disaster emergency plans, even deficient ones, responded in a more coordinated and effective

way to chemical emergencies than those without plans. These plans sometimes prevented minor threatening incidents from escalating into seriously damaging catastrophes (Levine 1989: 143).

4.1.4 Training of emergency staff

Training of emergency management and response staff must be regular and permanently sustained to overcome ongoing staff turnovers (Leornard *et al.* 2008:207). The municipal fire department is most aware of the possibility of chemical accidents and also knowledgeable on how to deal with them. However, chemical accidents are not solely the responsibility of one state organ and require other departments to be well trained and equipped to handle potentially serious chemical emergencies. For instance, in some cases, the police are the first responders to chemical accidents rather than the fire department. All these departments need to understand one another's mandates, their resources, normal modes of operation and capabilities. Without special training it may be difficult to handle the situation well.

4.1.5 Training of first responders

Disasters of all kinds occur in a local community. With their mandate to attend to the safety and well-being of their families, communities are most likely to be first responders. A municipality can establish a unit of volunteers to participate in disaster management as mentioned in the Disaster Management Act (South Africa 2002). Therefore, Fezile Dabi District municipality should identify volunteers that will be trained in basic fire-fighting and first aid to assist in reducing the impact of an emergency incident. Other members should be trained as evacuation teams that will assist with children, the elderly and physically disabled people. Some volunteer members should be trained to maintain community order and protect the public from continuing threats, for example protect women and children from abuse.

The Sasol industry can be requested to train volunteers about the risks associated with the nature and behaviour of chemicals which are stored in their facilities, those that are transported and those that are being disposed off. They can also educate them on how to handle different emergency situations such as what to do in case of gas leakage.

4.1.6 Funding

According to the Disaster Management (South Africa 2002), the municipality must make recommendations regarding the funding of disaster management, initiate and facilitate efforts to make such funding available. It is therefore recommended that the Fezile Dabi District Municipality together with Metsimaholo Local Municipality should secure funding for awareness campaigns, training of volunteers, research and other disaster management programmes. The municipality can also facilitate funding from the Sasol Company through their Sasol Corporate Social Investment (CSI) programme.

According to Sasol Facts (2010:43) CSI programme focuses on building capacity and providing long-term commitment beyond just financial assistance. They further list principles for community engagement which are: strategic, research-informed interventions, addressing key community priorities and target impacts driven interventions. Fezile Dabi District Municipality needs to, through their Integrated Development Planning process, engage key stakeholders like Sasol Company with regard to chemical risk assessment. This process may require development of joint programs for creation of awareness which may result in Sasol Company availing funds (through their CSI programme) to support these plans to the benefit of the community and the municipality.

4.1.7 Research

A disaster management plan for a municipal area must promote disaster management research which will place emphasis on measures that reduce the vulnerability of disaster-prone areas and communities (DMA 57 of 2002, section 53(2)(g)). It is recommended that the municipality be involved in research to develop early warning systems that are people-centred and communication systems that can be employed during emergency incidents. For early warning messages to be effective, they need to be clear and understandable, accurate, frequent, credible, specific to the situation and give specific advice on what the effects will be, and what to do to reduce the risk from the impending hazardous event (Leornard *et al.* 2008:206; Levine 1989:149).

It is further recommended that research be conducted regarding the educational programmes that will be used for different school levels. Educational materials must

be tailored to the community so that they can be easily incorporated into the school curricula of primary and secondary schools.

Further research on the chemical hazards awareness is necessary to gather additional information for use by all relevant stakeholders. It is the observation of the researcher that very little literature exists in respect of chemical hazards and the threat they pose to communities located in the nearby operational plants. Most of the existing literature is about employee safety focusing within the chemical plant with less in relation to nearby community safety

4.1.8 Incident Command System

Once the emergency plans have been developed, the following questions should be addressed:

- Which agency will take the lead in carrying them out?
- What action can one agency take without overstepping its mandate?
- When working together, what actions can be taken by more than one organisation?
- How will information flow from within and between agencies?
- Who will make decisions?
- Who will call for help within and outside the community?
- How will agencies handle extra personnel and resources?

These questions become particularly important when several organisations have to work together to address an emergency situation. In order to reduce confusion among these agencies, clear coordination and cooperation should be developed. Taking into account that there will be many contingencies which can affect the course of an accident, builds flexibility into preparedness planning which will require changes to be made while coordinating an emergency situation (Levine 1989:146). For many agencies to work together smoothly under one management system, an Incident Command System (ICS) should be developed.

ICS is defined as a standardized, on-scene, all-hazard incident management concept (FEMA 2009). The ICS is responsible for on-scene response activities and must

maintain contact with the Emergency Operations Centre (EOC) which is responsible for community-wide resource management. The EOC staff includes departmental heads, government officials and NGOs. The ICS involves a high degree of coordination and cooperation between different agencies aimed at reducing the severity of the disaster.

As indicated on the ICS diagram below (Figure 28), the Incident Commander should be either the Deputy Fire Chief or the Deputy Police Commander, depending on the situation because for instance, in some cases such as terrorism, police are the first responders to chemical accidents rather than the fire department with the Sasol company fire department representative acting as their assistant. During chemical accidents, specialised knowledge about the nature and behaviour of chemicals and how to contain them in case of releases or spills, is very important. Therefore representation from the Sasol Company is a requirement.

From the ICS diagram in Figure 28, the next level comprises of people who are technical yet mainly decision makers in respect of finance, operations and planning and logistics. Their role is that of ensuring that strategic decisions are thoroughly communicated in time for implementation. They also coordinate feedback from the people involved at the scene to the incident commander. The next level comprises immediate responders, who are people involved at the scene to implement instructions from the incident commander as follows:

- The responsibility of Police Officers include inter alia, law enforcement and maintaining the security of the community members.
- Fire Fighters and Emergency Operation Services (EMS) are responsible for triage and offering treatment to the injured. They are also responsible for search and rescue of casualties, extinguishing of fire and clearing the scene to minimise the effects of an incident.
- The responsibility of Disaster Management officials includes inter alia, situation assessment, documentation of people affected, evacuation of people in imminent danger and liaising with NGO’s for relief resources.

- Traffic Officers will be responsible for traffic control and road closure to allow the free flow of emergency vehicles including quickest routes to hospitals and other critical facilities.
- Public Works Officials and Engineers are responsible for providing technical support in respect of the extent of damage to property and buildings in an effort to minimise casualties.
- The Communication Officer is responsible for appraising the media and the community on the status of the incident.
- The role of finance is to ensure availability and the use of funding in procurement of necessary supplies.

Figure 28 is the Incident Command System which can be used for chemical hazards in Zamdela Township.

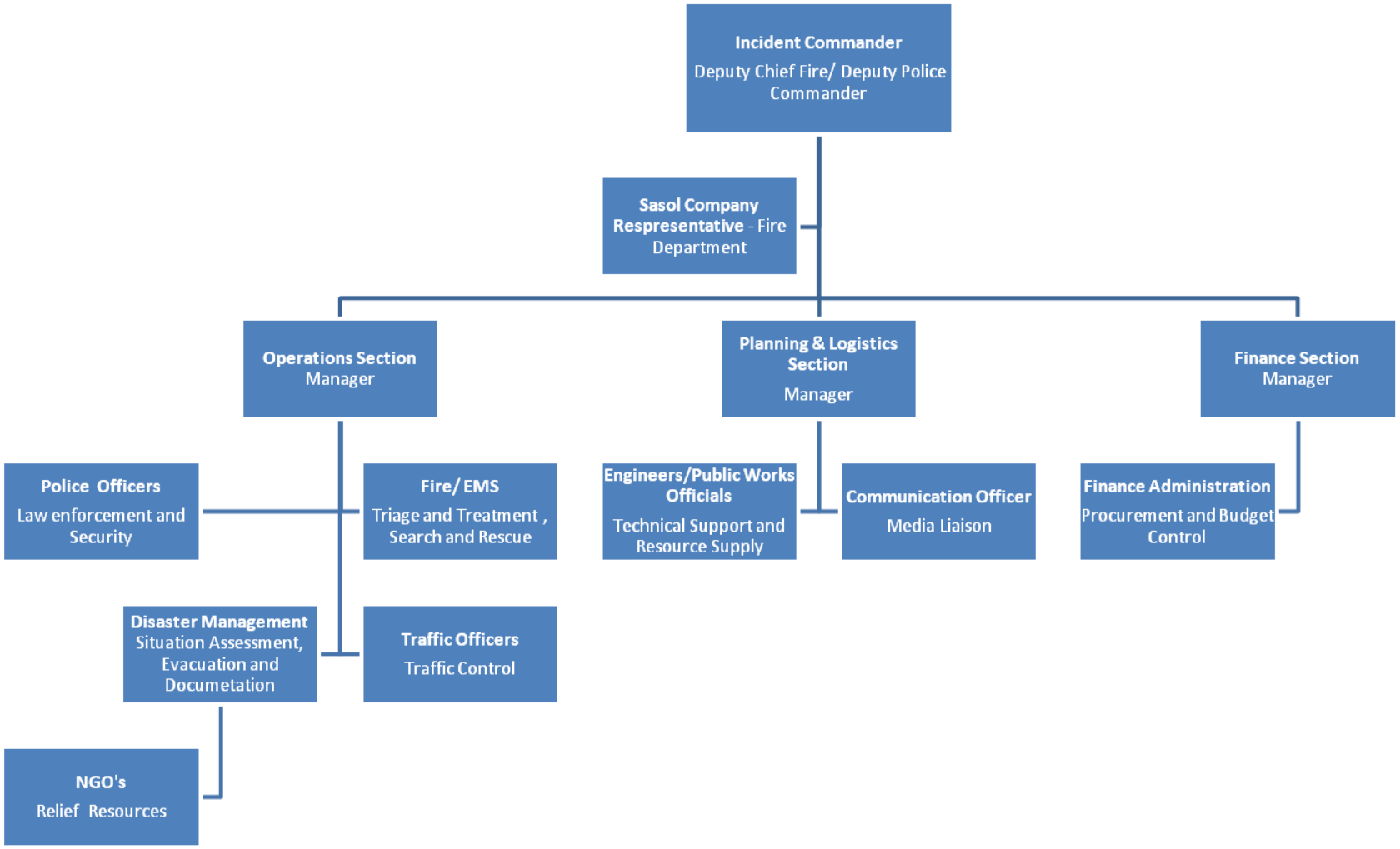


Figure 28: Incident Command System
Source: Compiled by the researcher

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ANNEXURE 1: Research Questionnaire

University of the Free State
PO Box 339
Bloemfontein
9300
March 2010

To whom it may concern

RE: DISSERTATION – MASTERS IN DISASTER MANAGEMENT

I am currently registered for master's degree in disaster management with the University of the Free State in Bloemfontein. In fulfillment of this dissertation I am required to research a topic and produce a mini dissertation. The topic that I have chosen is **Awareness of Chemical Hazards in Zamdela Township – Sasolburg**.

I would be grateful if you could complete attached questionnaire and they will take approximately 20 minutes of your time. Needless to say the information provided will be treated with strict confidence and individual names will not be identified. Equally, a copy of summary report will be available to your institution if so required.

For more information do not hesitate to contact me on this number: 072 753 0259

Yours Sincerely
Puseletso Kolanchu

Supervisor's Signature .....

DEMOGRAPHIC PROFILE

Please indicate answer with X

1. GENDER

Male	
Female	

2. AGE

18 - 25	
26 - 35	
36 - 45	
46 - 55	
Above 56	

3. LEVEL OF EDUCATION

Primary	
High School	
Tertiary education	
None	

4. How long have you been living in Zamdela?

0– 5 yrs	
6 – 15 yrs	
16 – 25 yrs	
More than 25yrs	

5. Are you employed?

Yes	
No	

LEVEL OF AWARENESS

1. How would you rate your knowledge of risk of disaster events? What is your knowledge of disaster? [1]

Poor	
Moderate	
Good	

[1] Disaster is a serious disruption of the functioning of the community or society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community to cope using its own resources (UNISDR, 2009)

2. Which hazards[2]/disaster risk do you think prevail in your area?

3. How did you get to know about them?

Training	
Media awareness	
Community Meeting	
Other	

4. How do you get involvement in these issues?

Awareness	
Education & Training	
Volunteer Work	
Other	

5. Do you know what to do in case of chemical incident? For example; chemical explosion

Yes	
No	
If yes, Specify	

6. Do you know of other awareness programs being implemented in your area? If yes which are those?

Yes	
No	
If yes, Specify	

7. Has there been any incident where there was chemical explosion?

Yes	
No	
If yes, Specify	

8. Are you aware of early warning systems[3] in case of chemical explosion/ fire?

Yes	
No	

9. Are you aware of any preparedness/ contingency plan[4] developed for chemical explosion? If yes, how did you know about it?

Yes	
No	
If yes Specify	

10. Do you know the emergency services numbers?

Yes	
No	

11. Are you aware of any evacuation procedure in case of chemical disasters?

Yes	
No	
If yes Specify	

12. Do you think SASOL refinery is doing enough to engage the community to raise awareness on disaster risk posed by its operations and why so?

Yes	
No	
If yes Specify	

2

[3] Early warning is the set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organisations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss (UNISDR, 2009).

GENERAL PROPOSAL

13. Do you think there should be additional efforts made by the authorities to encourage participation or seek public input on chemical awareness in the area?

Yes	
No	
If yes Specify	

14. Do you think that public participation can influence any major community decisions in the area around disaster risk management issues?

Yes	
No	
If yes Specify	

15. Do you think that meetings around education in the community should be well advertised and made open to the public?

Yes	
No	
If yes Specify	

16. Will you attend such meetings?

Yes	
No	

Thank you for your time and for providing the information.

3

[3] Contingency plan is a management process that analyses specific potential events or emerging situation that might threaten society or the environment and establishes arrangements in advance to enable timely, effective and appropriate response to such events and situation (UNISDR, 2009)

ANNEXURE 2: Personal Interview with Municipal Official.

Interview with the Disaster Response Officer – Fezile Dabi District Municipality 20 / 04/ 2010

Facilitator:

Good morning Mr Xaba. I am Puseletso Kolanchu as I have introduced myself. The idea is err, just to basically interview you on the efforts of the municipality around the chemical issues….err… hazards around Zamdela Region. So, I am going to ask you just to start by asking you just to introduce yourself and then your occupation here in the municipality and thirdly to give us a bit of background on the programmes that you have as municipality to deal with the….err to create awareness on chemical hazards with the Zamdela err, the vicinity.

Respondent 1 (Mr. Xaba):

Ok! Thanks. My Name is Nhlahla Xaba. I am the Disaster Recovery Officer, also dealing with Response. Right now, we are in the Disaster Management Centre, we are responsible for funding this centre. Err, we are still building our capacity, appointing staff very soon and they have already applied. However, with regard to chemicals hazard, we mainly and mostly work with Sasol Firm. There are some NGO organisations in the community, that are somehow about the air spillages, that you may see even the smoke from the Sasol around the location, and as a result there have been protests, even per global warming. So, we organised such with these NGO's and we are assisted somehow by them about information. There are progressive operations including those that are in government, but they only act at a small scale.

With regard to Sasolburg; we have a priority of hazards that affect us in the main of HAZMAT ; you normally see it along our roads towards Parys, towards N3 and N1 roads, because Fezile Dabi District Municipality region has got two highways and two major roads whereby the trucks from travel that side. So we only have this training programme that is being conducted by SASOL Firm, assisted by the District and Centre, by an official called Mme Luki Motaung. So we have so far trained 175 people and those will be members of the disaster management forum or the emergency members that seat in the forum and those who will seat in the forums of

the four municipalities that are …..Metsimaholo, Moqhaka, Mafube and Ngwathe (First sound clip finishes unexpected)

(Second sound clip start)

Facilitator:

Uhmm, sorry about the interruption, we can proceed. You were saying…you were talking about that Hazmart being a priority and saying that the distinct initiative is that of training the provincial stakeholders….

Respondent 1: (Echoing his point of clarity) Training regional stakeholders and prioritising Hazmart as the leading hazard and its dangers.

Facilitator:

(Echoing what the Respondent says in correction) Yes, training regional stakeholders, on the leading hazard which you identified as Hazmart and its dangers with immediate impact on the….

Respondent 1:

Yes, Hazmart which is affecting the communities on our roads. We know that there could be sulphuric acids spillages and other chemical hazards but for now we have prioritised Hazmart. So, that's what we are doing.

Facilitator:

Ok. Mm! Mm! Besides err, besides that campaign or training; are there any other programmes that are separately dedicated for this hazard?

Respondent 1:

Okay…Err, its only awareness workshops and seminars that are run at the schools and within our communities that are run by SASOL, err, we also have one in the municipality one that focuses on fire…on wild fire and also some focus on flooding but your original question was related to chemicals, so these other ones are a replica of our municipal services.

Facilitator:

Okay, and if I may try to dwell on that awareness initiative, for how long have you being conducting it, when did it start and is it ongoing?

Respondent 1:

Okay. We are into sixth month programme now because it was training based on the availability of the experts and the Professors, organised by SASOL, because they are experts in the field and on Hazmart, err, they have more knowledge on Hazmart so we were coordinating as municipality. We completed the first sessions and we are busy with the ceremony of handing certificates to attendants. The second one, as I have already said, will be going on soon. We are currently organising a big certificate handing ceremony where the Executive Mayor and the Head of the Disaster Management Centre in the Province.

Facilitator:

Okay. Thank you Sir. Basically, those were my few questions on the municipal programmes. The second question will be "in your view as the District Municipality, how does the community respond to these programmes". You have just had a major programme. How was the response?

Respondent 1:

You know….the community is at most concerned with SASOL's operations, except for providing employment for the people around here, but with regard to health hazards, they are indeed concerned. Most people have been encouraged to enrol with medical treatment and also make use of the medical and the health facilities and clinics in the municipality here around where there may be problems. It depends also because with some of them, there may be problems, their financial muscles may not be sufficient to cover them. But indeed it is a concern, based on the high rate of unemployment and situations they find themselves in, it is something that they must live with it with a great concern. They hope also that maybe one day something will be done about it. They hope that these chemical emissions will be reduced and controlled at some stage.

Facilitator:

Okay. So you are saying the community is definitely aware, they are participating and they advised on the health issues and they respond positively. Thanks on that one.

Respondent 1:

Yes, yes, Madam

Facilitator:

Okay. Thank you Sir. If I may ask, I hope my question will be well structured. How do you measure the effectiveness of your programmes? Is it by the number of people who attend? Is there another way in which you measure the effectiveness of this programme?

Respondent 1:

You see, err mainly, we are based around Fezile Dabi District Municipality, Metsimaholo Municipality is the immediate people working with communities and they will be able to measure. But using the tools that we using, is through we also measure our campaigns and programmes through the response questionnaires that if their being contented. Lastly we also measure through peoples' ability to ask questions or we make have promotional materials to hand out to peoples to ask them to but conduct questions after them. And we also level of understanding. Our disaster management specific ones, we do not just call all people but we …

(Sound clip 2 ends)

(Sound clip 3)

Respondent 1:

First thing, when we are busy with our own mobilisation tools, we go to the communities that will be keen and interested on the subject. When we talk of paraffin safety, we know that we must go there people living in shacks and RDP houses. So our measuring tool is an impact and understanding of our people using tools that we give, then we do realise that it impact really to them.

Facilitator:

And, I want to make an assumption that we you talk about community you talk about people of all ages, I am talking about a 5 year old to 89 years old, every body who is in that community.

Respondent 1:

You see, with regard to our schools, we only focus on grade 11 & grade 12 because we believe those are the people who will understand the language in the field of disaster management. When we go to schools we have targeted that further so far. Our reason is that they are also exiting school and may consider the opportunities in disaster management.

On the communities we focus on households. People who own houses, who own shacks, people who own because with regard to kids, it might be challenging because we realised that as we have developed the material that relates to primary schools, pre-primary but we especially now, we have partnerships with the scholar patrols on those are 5 to 10 year olds, but with regard to current programmes we only focus on grade 11 and grade 12.

Facilitator:

Please forgive me for vacillating in between my questions but with regard to disaster management at school for grade 1 to 12 and its basically relating to other disaster management areas and not chemical related issues, am I correct?

Respondent 1:

That's correct because the chemical spillages, we are of the opinion that the community knows, they comprise of the majority of women. The people who attend our programmes are women so we believe that our education if focused on those people, they will come.

Facilitator:

Thank you Sir and let me please ask my last question. What I need to know is what other plans do you have in respect of training? You said you had a six month programme, scholar patrol partnerships and awareness for communities. Are you going to broaden your scope in disaster management programmes at school to address chemical issues because this is an area exposed to high chemical hazard? What are your plans in the near or distant future?

Respondent 1:

Yeah, in our service budget and implementation plan, including IDP, our objectives are there that we must rollout these awareness programmes and training. We have even allocated a budget for this function it is just that our time of rolling out will be after the World Cup because we are busy now focusing our energies on the 2010 World Cup. We are of course ready … that is why we are also increasing our capacity for the rolling out of awareness programmes.

Facilitator:

That is all Sir, Thank you very much for your time and sharing information with us.

Respondent 1:

It is my pleasure, Thanks for interest in our business.

Mr Nhlanhla Xaba: Office #: 016 9708850

Email address: nhlanhlax@nfsdc.co.za