

DECLARATION

I, TOBIAS JOHANNES MOKWENA (11621098), hereby declare that the mini-dissertation titled “Health effects of climate change: A Case Study of Ga-Mashamothane village at Fetakgomo Tubatse Municipality, South Africa” submitted for the degree of Master of Public Health (MPH) at the University of Venda is my original work and has not been submitted for any degree at this university or any other institution and that all citations, materials and sources used have been duly acknowledged by complete references.

Signature..... Date.....

T. J Mokwena

DEDICATION

The project is dedicated to my daughter's mother, Ms Mokgadi Mokgehle for being pillar of strength throughout this study. To my mother, Ms Ellah Mokwena, brother, Jimmy Mokwena and sister, Leonard Pako, thank you for your support and encouragement. To my daughter, Tsibishi follow the footstep of your father which has been set before you.

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I would like to thank Almighty for gracing me with courage, understanding and strength to complete this degree. If it had not been for the Lord, I wouldn't have reached this far.

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ABSTRACT

Background: Climate change is a universal public health problem that affects developed and developing countries including South Africa. This environmental hazard causes damage of properties, injuries and death. In most cases, survivors experience psychosocial problems such as depression, anger and isolation after flood because of climate change.

Purpose: The purpose of the study was to determine health effects of climate change at Ga-Mashamothane village, Fetakgomo Tubatse Municipality, South Africa.

Methodology: A quantitative approach using cross-sectional descriptive design was used in this study. A sample of 352 households has been selected from the target population by means of simple random sampling. Self-administered questionnaires with closed-ended questions were administered to respondents between the age of 18 years and above who met the inclusion criteria. Permission to conduct the study was obtained from the Ethics Committee of the University of Venda. Data were analysed using Statistical Package for Social Science (SPSS version 25) and presented in the form of tables, charts and graphs. Chi-square was used to test significant relationship between heavy rainfall and injuries, and between drought and malnutrition.

Results: Three hundred and fifty-two (352) questionnaires were distributed to respondents and 258 questionnaires were satisfactorily completed and returned. The findings of the study showed that 177 (68.6%) of the respondents were male and 81 (31.4%) of the respondents were females. The results indicated that heavy rainfall and injuries statistically are significantly correlated (P -value =0.000). There was positive relationship between heavy rainfall and injuries, as majority of the respondents 242 (93.8%) sustained injuries after experiencing heavy rainfall. The results of the study indicated that drought and malnutrition statistically are significantly correlated (P -value =0.000). There was positive relationship between drought and malnutrition, as majority of respondents 225 (87.2%) suffered from malnutrition during drought.

Conclusions: The study found that there is association between heavy rainfall and injuries and there is association between drought and malnutrition.

Recommendations: There is a need of collaboration of several stakeholders such as local municipality, Department of Health, Department of Agriculture, Department of Labour and department of Basic Education to come up with strategies to protect people's lives.

Keywords: Climate change, Health, Health effects and Case Study.

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LIST OF ACRONYMS AND ABBREVIATIONS

NCCRWP	National Climate Change Response White Paper
SADC	Southern African Development Community
WBPR	World Bank Press Release
WHO	World Health Organization

CHAPTER 1

INTRODUCTION AND BACKGROUND OF THE STUDY

1.1 Introduction

Climate change is a statistical distribution of weather patterns over decades that can lead to drought and flood (National Climate Change Response White Paper, 2011). This is a universal challenge that requires universal action for redress (Bedworth, 2009). Damage of properties, injuries, vector borne diseases and waterborne diseases are recorded every year because of climate change (Ahdoot, 2015; Bukhari and Rizvi, 2015; Abate, 2016; Linsak et al., 2016; Pacheco, 2016). Studies noted that climate change is fuelled by human activities such as deforestation, urbanisation and industrialisation (Myint et al., 2011, Goodman, 2013, WHO, 2015 and Biniyam and Kemel, 2017).

1.2 Background of the study

Climate change is a global public health problem that affects lives of many people in twenty first century (Goodman, 2013). In December 2011, South Africa hosted summit of International Institute for Sustainable Development as an action to address climate change. In the summit, health professionals came up with measures that should be taken to protect human 's health (Goodman, 2013). Flood is a natural disaster that occurs because of prolonged heavy rainfall. This environmental hazard is one of the natural disasters that cause damage of properties, injuries and death. About 20 000 people are dying globally per year because of flood (Adeyeri, Ishola and Okogbue, 2017). In European context, climate change predisposed people to non-communicable diseases (Akin, 2015). People estimated to 30 000 were affected by the flood that occurred in 2013 at the Islands of Saint Vincent, Grenadians and Saint Lucia (World Bank Press Release, 2014).

In addition drought as a result of climate change puts lives of many people in a risk of getting diseases that can result to death. There was drought at Brazil that claimed lives of 100 000 between 1914 and 1915 (Alpino, Sena and Freitas, 2016). In countries such as Bangladesh, Pakistan, Nepal, Ethiopia, Nigeria, Ghana and South Africa, the health effects of climate change have been documented. In Pakistan, about 1985 death and 2946 injuries were recorded because of July-August 2010 flood. There are about 9721 health facilities in Pakistan. Out of 9721 about 515 health facilities that are in the flood affected area were damaged as a result of flood (Bukhari and Rizvi, 2015).

In Angola, 1183 cases of cholera and 21 deaths were reported between 01 October 2008 and 04 January 2009 after a heavy rainfall (United Nation Office for the Coordination of Humanitarian Affairs, 2009). Ghana is one of the developing countries in Africa that has documented the health effects of flood. There was flood in 1995 that claimed lives of 145 people and damaged properties in the country. There was another flood in 2015 that claimed lives of 154 people in Ghana (Ali, Bajracharyar and Raut, 2017).

The major concern after a natural disaster is to ensure that survivors receive necessary resources that will enable them to continue with their lives such as shelter, food and clean water. However, studies indicated that survivors experience psychosocial problems after a natural disaster (Nahay et al., 2014; Bukhari and Rizvi, 2015). South Africa is one of the countries in SADC that is prone to flood (NCCRWP, 2011). In South Africa, 1608 cases of malaria were recorded between 15 November 2008 and 05 January 2009 (United Nation Office for the Coordination of Human Affairs, 2009). About 60% of South African population reside in urban areas, (NCCRWP, 2011). Climate change increased problems caused by poor maintenance at urban municipalities by putting people into the risk of being drowned during flood because of dysfunctional drainage system that is caused by soil erosion and poor maintenance (NCCRWP, 2011). In Gauteng province, 6 people drowned during flood (The Star, 2016) as a result of failure drainage system that was caused by soil erosion. The health effects of climate change have been recorded. There was flood in Kwa-Zulu Natal province around October 2017 that claimed lives of 7 people including a 46-year-old man who drowned while attempting to cross an overflow river. As a result of the flood, properties including health facilities, factories and households were damaged (Eye Witness News, 2017). There was Cholera outbreak in Vhembe district of Limpopo Province whereby 720 cases of Cholera were confirmed in April 2009 (Mudau, Mukhola and Hunter, 2017).

1.3 Problem statement

Even though South African government developed National Climate Change Response Plan such as to reduce ozone and sulphur dioxide concentration by legislative, ensuring that food security and sound nutritional policies form part of an integrated approach to health adaptation strategies, developed and roll out public awareness campaigns on the health risks of high temperatures and appropriate responses and strengthened the awareness programme on malaria and outbreaks (NCCRP, 2011) to mitigate the impact of climate change, the researcher has observed with a great concern that it has an impact on people's health. In 2016, there was heavy rainfall in South Africa that predisposed people to malaria, cholera, injuries and death. Limpopo Province, Gauteng Province and Western Cape Province are

some of the provinces that experienced more damages because of heavy rainfall (SA Government News, 2016). In Gauteng province, 6 people lost their lives as a result of flood including the body of pregnant woman that was discovered at Alexander Township (The Star, 2016). In Waterberg district of Limpopo province, 43 cases of malaria were recorded as result of climate change (Department of Health, 2017). There was heavy rainfall that resulted to the damage of Janefurse hospital at Sekhukhune district of Limpopo province (Pijoos, 2018). Some of the wards were flooded and this resulted patients to be evacuated to St Ritas hospital (Pijoos, 2018). There was a heavy rainfall that occurred in 20 February 2019 in Musina Local Municipality which is situated in the Vhembe district of Limpopo province (Nengovhela, 2019). After the heavy rainfall, dams and rivers were overflowing. Bridges were washed away because of the heavy rainfall (Nengovhela, 2019) and this made it difficult for people to access health facilities. There was heavy rainfall that damaged water pipes at Ga-Mashamothane village and this resulted residents to fetch water from the river, fountain and ponds exposing them to water borne diseases such as typhoid and Cholera. After the rainfall, cases of malaria and cholera were recorded at Dilokong hospital which is located at Sekhukhune district of Limpopo Province. Drought in Limpopo Province resulted to water problems (Mpandeli, Nesamvuni and Maponya, 2015). Since the community of Ga-Mashamothane village rely on subsistence farming, drought and extremely hot temperature resulted to the reduction of crop production.

1.4 Rationale of the study

In the past two decades, several studies were conducted to address health effects of climate change in South Africa (Goodman, 2013; WHO, 2015; Mudau, Mukhola and Hunter, 2017). However, neither of them focused on Ga-Mashamothane village.

1.5 Significance of the study

- Since there are few studies conducted about the health effects of climate change in South Africa, the findings of the study may make policy makers to be aware of the health effects of climate change. When they modify climate change policies they may refer to this study.
- The finding of this study may contribute to the body of public health knowledge on Climate change.
- The findings of this study may help researchers to identify gap so that they can generate other research topics.

1.6 Aim of the study

The aim of the study was to determine health effects of climate change at Ga-Mashamothane village, Limpopo Province, South Africa.

1.7. Objectives of the study

The objectives of this study were to:

- Assess the effects of climate change on the physical health of people at Ga-Mashamothane village.
- Describe effects of climate change on the psychological health of people at Ga-Mashamothane village.

1.8 Theoretical framework

The study was guided by epidemiological triad. Epidemiological triad is an effective triangle shape model used to study diseases and predict future health needs of a community. It includes factors to which individuals are exposed and determine whether the exposure can cause diseases, injuries or death. The triad comprises of agent, environment and host (Accutt and Hattingh, 2016). In this study, host are human beings who are residing in the village. Agents are disease causative organisms such as mosquitoes that can cause malaria, etc. Bacteria such as cholerae and typhi also form part of the agents. Environment is a place where people live, work and attend school particularly Ga-Mashamothane village. Therefore environment, host and agents interrelate in numerous ways to produce diseases, injuries and death. During heavy rainfall, flood or drought people who were living in a flood affected area or drought affected area were predisposed to conditions that exposed them to vector borne diseases, waterborne disease, airborne diseases or injuries.

1.9 Definition of key terms

Climate change: referred to statistical distribution of weather patterns over decades that can result to drought and flood (National Climate Change Response, 2011). In this study climate change means the change in weather pattern that can lead to drought, heavy rain fall, flood and extremely temperature.

Case study: referred to the inquiry that is characterised by organising the data for analysing the problem of people or institution that will lead to the new learning (Maree, 2016). In this study case study means the study will focus only at Ga-Mashamothane village.

Health: refers to a state of complete physical, mental and social wellbeing not merely the absence of diseases (WHO, 2015).

Health effects: referred to the infectious and non-infectious diseases that human being can get after being exposed to hazardous environment (Kampala and Castanas, 2007). In this study, health effects mean diseases, injuries and death because of being exposed to hazardous environment.

1.10 Outline of the dissertation

This dissertation is divided into six chapters as follows:

Chapter 1: Introduces the study, gives the statement of the problem, aim and objectives of the study, significance, rationale and definition of key terms.

Chapter 2: Is based on the literature review which highlights physical effects of climate change, flood, drought, high temperature, psychological effects of climate change and epidemiological triad.

Chapter 3: Summarizes research approaches that were used in data gathering, collection, presentation and analysis.

Chapter 4: Outlines the study findings.

Chapter 5: Discussion based on the results of the study.

Chapter 6: Conclusions and suggested recommendations.

1.11 Summary

Climate change is a universal public health problem that affects developed and developing countries including South Africa. Heavy rainfall and flood as results of climate change cause damage of properties, injuries and death. In most cases, survivors experience psychosocial problems such as depression, anger and isolation after flood because of climate change. Prolonged drought as a result of climate change puts lives of many people in a risk of getting diseases that can result to death. The following chapter presents the literature review of this study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Literature reviewed was based on the objectives of the study and covered the effects of climate change on human being.

2.2 Physical effects of climate change on health

A technical report was released by Ahdoot and Pacheco (2015) about climate change and its effects on children. The report revealed climate change as a major public health problem to children since children are vulnerable to climate change. Diseases estimated to 88% that are related to climate change affected children that were below 5 years in developed and developing countries (Ahdoot and Pacheco, 2015). The report further revealed that some of the effects that children can experience because of climate change include heat stress, decreasing air quality and food insecurity, however extreme heat temperature have been identified as the major cause of death in United States of America (Ahdoot and Pacheco, 2015). Children who spend most of their time outdoors are likely to suffer from respiratory problems during summer (Ahdoot and Pacheco, 2015). Wildfires produce smoke that can travel from a certain area to another and the smoke that is being produced by the wildfire can have dangerous particles. People who are exposed to wildfires can have eyes and respiratory problems (Ahdoot and Pacheco, 2015).

A report that was edited by Cloete (2013) to develop national and sub-national adaptation scenario for South Africa under plausible future climate conditions and development pathway revealed that climate change can result to the distribution of vector borne diseases such as mosquitoes.

Based on the literature reviewed, it can be argued that climate change has direct and indirect effect on people's health. Since children are vulnerable to climate change because of the incomplete development (Ahdoot and Pacheco, 2015). This predisposed them to the effects of climate change than elderly. This has been proved by the report when it reveals that diseases estimated to 88% that are related to climate change affected children. Furthermore, extremely temperature has been identified as a natural condition that exposes people to eyes and respiratory problem (Ahdoot and Pacheco, 2015).

2.2.1 Flood

A study was conducted by Linsak et al. (2016) to highlight the potential heat exposure risks (communicable diseases occurrence and spread) according to which recovery were taken as well as the synoptic analysis of the weather situation which describes the terms and processes that led to a recovery rainfall and flooding of massive proportion. There were floods in Croatia. After the flood, several breeding sides of mosquitoes were formed (Linsak et al., 2016). This resulted people who located from flood affected area to be predisposed to malaria. Some of the people might decide to move from their area to another for employment, education or business purpose. They can act as malaria carrier. Cases of hepatitis were recorded after the flood that occurred in the country (Linsak et al., 2016).

Pakistan is amongst countries that are prone to flood in Asia. Whenever there is flood, it poses threat to the health of people. There was flood in July-August 2010 in Pakistan. During the flood, more than 20% of the land was affected. The disaster left about 10 million of people homeless, destructed health care facilities and causes disruption to the agricultural system. Some of the people who are residing in the affected area were forced to be displaced to the camps. Several pregnant women lost their lives because of the flood. As a result of being displaced to the camps, women and children were raped in the camps. Children estimated to 1000 000 were at risk of losing their lives because of malnutrition. After the flood, cases of waterborne diseases were recorded in the flood affected area (Bukhari and Rizvi, 2015).

Out of 9721 health facilities in the country, 515 health facilities were damaged because of flood (Bukhari and Rizvi, 2015). After the flood, there was disruption of water supplies and sewage system. About 37 million medical consultations related to skin cancer, diarrhoea, pneumonia and malaria were recorded (Bukhari and Rizvi, 2015). Some of the people who were not disable became disable. The cases of dengue fever were also recorded as a result of the flood. However, a province called Punjab recorded many cases of dengue fever compared to other provinces (Bukhari and Rizvi, 2015). The total number of 21 292 cases of dengue fever were documented after 2010 flood and 2011 rainfall. Floods usually affect remote areas in Pakistan. Pakistan is ranked number 8 in terms of infant mortality rate globally. During the 2009-2010, Pakistan infant mortality rate was 86 per 1000 live birth (Bukhari and Rizvi, 2015).

It can be argued that flood has effect on people's health (Bukhari and Rizvi 2015; Linsak et al., 2016). The flood distressed Croatians, Pakistanis and the world. However, Croatians and Pakistanis were mostly affected by the floods that occurred in their countries. Studies revealed that flood damaged infrastructure including health facilities (Bukhari and Rizvi 2015; Linsak et al., 2016). This created more problems to the health system of both countries. People who

were affected by the flood were taken to health facilities that were not damaged by the flood. People that sustained injuries had no choice but to be transported to health facilities that were functioning and located far. This contributed to complications and several cases of death. Disruption of water system and sewage system has been associated with cholera (Linsak et al., 2016).

2.2.2 Drought

A study to evaluate drought hazard at current and future climate conditions in the Boro Paddy cultivated areas of western Bangladesh has been conducted (Reza, Islam, Shen, Hu, and Rahman, 2017). The study used 3 Global Climate models output to evaluate drought hazard (Islam et al, 2017). The result of the study revealed that South western region was severely affected by drought than Northern western region during the period of 1984 to 2013 (Islam et al, 2017). Bangladesh is regarded as one of the countries worldwide that is prone to natural disasters such as flood, drought and tropical cyclone (Islam et al., 2017). There was prolonged drought that resulted to the reduction of crop production in the country. This resulted to food insecurity in the country (Islam et al., 2017).

Climate can influence change in the distribution of rain pattern that can affect crop production negatively (Cloete, 2013). A study was conducted in Ethiopia to explore the communities' perception on climate variability, its effect and adaptation responses in pastoral system (Abate, 2016). The study revealed that drought is common in Ethiopia. It was indicated in the study that some of the effects of drought that occurred in Ethiopia include food insecurity and poverty (Abate, 2016).

2.2.3 High temperature

A report that was compiled by the Department of Environmental Affairs and edited by Cloete (2013) indicated that high temperature can expose outdoor workers particularly construction workers to conditions that can result to dehydration, heat stress, fatigue and skin cancer.

It can be argued that climate change has effect on people' health (Cloete, 2013; Bukhari and Rizvi, 2015; Abate, 2016; Linsak et al., 2016; Islam et al., 2017). Since drought can lead to food insecurity and poverty (Abate, 2016) this can lead to malnutrition. People who are taking medication can be mostly affected by malnutrition because of drought. This will exacerbate their health condition.

2.3 Psychological effects of climate change on health

A study conducted by Alpino, Sena and Freitas (2017) to review a revision of the scientific articles related to droughts and public health, revealed that drought usually affects people who are residing in a drought affected area mentally, causing stress, increasing alcohol consumption and depression and suicide. A technical report was released about climate change and its effects on children. The report revealed that climate change influences vector borne diseases that can threaten the health of people. Extreme weather conditions can result to psychological problems such as trauma and depression to human beings (Ahdoot and Pacheco, 2015).

In Ethiopia, the effects of climate change on human's health have been documented. Abate (2016) revealed that drought has resulted in food insecurity and poverty due to climate change. A study conducted by Biniyam (2017) indicated that in Ethiopia, flood occurs as a result of prolonged heavy rainfall which causes rivers to overflow. People were likely to experience psychological complications if their family members, friend or somebody whom they know sustained injuries or lost his/her life as a result of a natural disaster called flood. Displacement of people can also lead to psychological problems. Signs and symptoms to show that an individual has psychological problem which includes depression, sadness, anger, sleep disturbance and guilty (Acutt & Hattingh, 2016). Several studies indicated that even though climate change can affect physical wellbeing and psychological wellbeing of a person it can also affect social wellbeing of a person. People are likely to isolate themselves and withdraw from friendship if they don't receive counselling after witnessing people getting injuries because of flood (Nahay et al., 2014). It can be argued that drought and flood have negative effect on health. Poverty and food insecurity can cause malnutrition diseases like kwashiorkor and marasmus that can lead to psychosocial problems such as depression, stress, anxiety, isolation and hopelessness

2.4 Conceptual Framework

The study utilizes Epidemiological triad as a conceptual framework. Epidemiology refers to the study of illness and health related issues (Wang, 2002).

2.5 Epidemiological triad

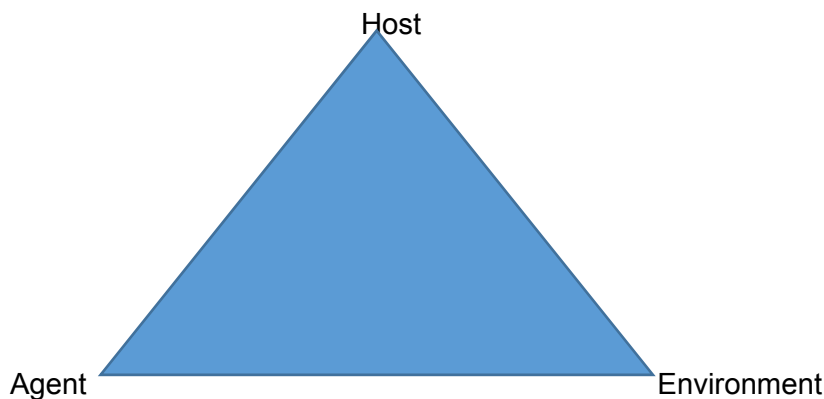


Figure 1: Epidemiological triad Source: (Accutt and Hattingh, 2016)

Epidemiological triad is an effective triangle shape model used to study diseases and predict future health needs of a community. It includes factors to which individuals are exposed and determine whether the exposure can cause diseases, injuries or death. The triad comprises of agent, environment and host. There are different types of agents such chemical agent, mechanical agent, physical agent, psychological agent and biological agent (Accutt & Hattingh, 2016). However, the researcher focused more on physical agents, psychosocial agents and chemical agents.

Host refers to intrinsic factors that influence people's exposure to a causative agent. Factors such as age, gender, socio economic status, immunological status and nutritional status are amongst the host factors that affect individual's probability of being exposed (Wang, 2002)

Agent refers to the organisms that cause diseases. Agent such as cholerae can cause cholera (Wang, 2002). Environment refers to extrinsic factors that affect agent and the opportunity for exposure. It includes climate, geographic status and overcrowding (Wang, 2002). In epidemiological triad the environment influences the agent, host and the route of transmission of the agent from a source to the host. Environment, host and agent interrelate in different ways to produce diseases.

In this study, host are human beings who are residing in the village. Agents are disease causative organisms such as mosquitoes that can cause malaria, etc. Bacteria such as cholerae and typhi also form part of the agents. Environment is a place whereby people live, work and attend school particularly Ga-Mashamothane village. Therefore, environment host and agents interrelate in numerous ways to produce diseases, injuries and death. During heavy rainfall, flood or drought people who are living in a flood affected area or drought

affected area were predisposed to conditions that exposed them into risk of suffering from vector borne diseases, waterborne disease, airborne diseases and injuries.

2.6 Summary

In this chapter, literature review of health effects of climate change was presented. Steps that were followed in reviewing literature include physical effects of climate change on health, flood, drought, high temperature, psychological effects of climate change on health and conceptual framework.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

Research methodology refers to the systematic process of solving research problems (Maree, 2016). Steps that were followed in the research methodology include study design, study setting, sampling procedure, population sampling procedure, sampling size, data collection, data collection instrument, validity and reliability of the study, pre-test, plan for data management and analysis, ethical consideration, plan for dissemination and implementation of results.

3.2. Study design

The study adopted cross sectional descriptive survey design as it attempts to determine health effects of climate change at Ga-Mashamothane village. Cross sectional survey design is suitable in the study that aimed at finding prevalence of certain problem by tacking cross section of the population (Kumar, 2014). Furthermore, cross sectional survey design is used to collect data of a specific population to discuss problems at one point in time (Creswell, 2014) Quantitative is an approach that is used to test objectives by assessing relationship among variables. The approach is applicable when the researcher wants to collect numerical data and generalise the results.

Through description of participant's response, frequencies or percentages this helped to bring out health effects of climate change.

3.3 Study Setting

The study was conducted at Ga-Mashamothane village. Ga-Mashamothane is a village that is situated at Fetakgomo Tubatse municipality in Sekhukhune district, the eastern region of Limpopo Province, South Africa. The village is under the leadership of King Sekhukhune and under the sub leadership Chief Malapane. The village is situated about 150km from Polokwane city and about 65km from Lydenburg town. The area is mountainous and surrounded by rivers. Majority of households depend on boreholes as source of water. The residents of Ga-Mashamothane receive primary health care services from mobile clinic. The village is divided into sections such as B1, Zone 1, zone 2, zone 3, zone 4, zone 5, zone 6,

zone 7, zone 8 and London section. There are 2 hospitals, 3 health centres and 15 clinics at Fetakgomo Tubatse municipality (Department of Health, 2017).

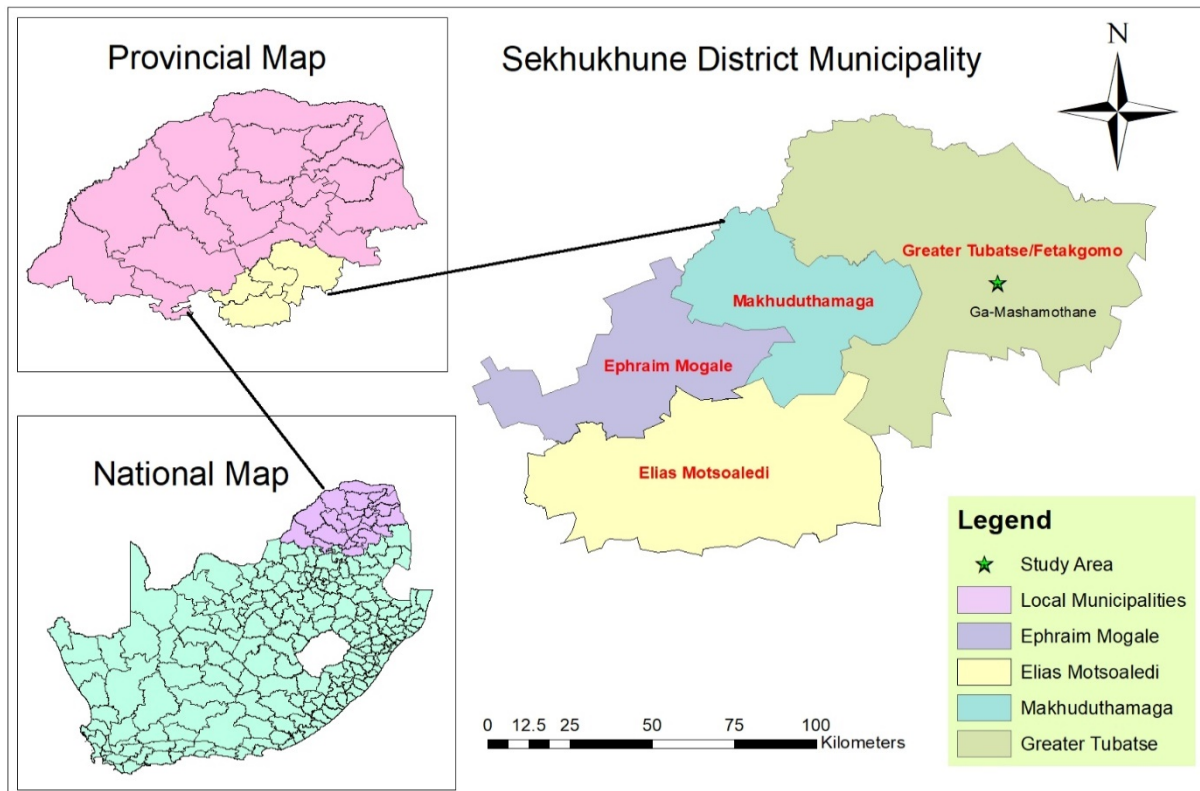


Figure 2: Map of setting Source: (Geography Information System, 2019)

3.4 Study Population

Target population is the group of people who share similar characteristics such as geographical area, norms and values (Creswell, 2014). The population of the study consists of all community members of Ga-Mashamothane village. There are about 2950 households within Ga-Mashamothane village.

3.5 Sampling

Sampling means the process of selecting a portion of the population to represent the entire population. In this study the research used simple random sampling. In simple random

sampling possibility of sample bias is less (Creswell, 2014). The study used simple random sampling to give all participants equal opportunity to be selected in the sample.

3.5.1 Inclusion Criteria

Residents of Ga-Mashamothane village who are 18 years and above, who have stayed in the village for 5 years and above were included in the study.

3.5.2 Sampling size

Slovin's (1960) as cited by Guilford and Frucher (1973) formula was used to calculate the sample size, where N is the total number of population, n is the sample size, and e is the level of error, in this study e is 0.05:

$$n = \frac{N}{1 + (N e^2)}$$

$$n = \frac{2950}{1 + (2950 \times (0.05)^2)}$$

$$n = \frac{2950}{1 + (2950 \times 0.0025)}$$

$$n = \frac{2950}{1 + 7,375}$$

$$n = \frac{2950}{8,375}$$

Sample size (n) = 352

3.5.3 Sampling Procedure

Probability sampling adopting simple random sampling was used in the study. The researcher gave all participants equal opportunity to be selected in the study. The researcher cut small pieces of papers that made 2950. Out of 2950, he took 352 and wrote yes in all 352 pieces of papers and no to the rest. All pieces of papers were folded and kept in a box. The residents of the village who were available during the community meetings where given the opportunity

to pick one small piece of paper from the box. Those who picked yes were provided with the questionnaire to complete.

3.6 Data collection instrument

The study used self-administered questionnaire with closed-ended questions for data collection. The researcher used self-administered questionnaire with closed-ended questions because it helped in safeguarding participants' privacy as participants were told not to enter their personal details in the questionnaire. The instrument was divided into three sections: demographic information of participants, physical health effects of climate change and psychological health effects of climate change. The questionnaire was developed based on different literature reviewed. The questionnaire was translated into Northern Sotho by a language practitioner from the University of Venda to accommodate participants who don't understand English. The questionnaire was translated back in English to ensure that the meaning of the questionnaire was retained.

3.7 Validity and Reliability of the study

Validity refers to the degree to which research measures what is supposed to measure while reliability refers to whether the same instrument if can be used at different times or administered to different participants from same population, will give same findings (Maree, 2016).

3.7.1 Validity

The study used content validity and construct validity in the study. Content validity refers to whether the instrument measures all aspects of the content it supposed to measure (Creswell, 2014). The proposal together with the instrument was presented to the School of Health Science Higher Degree Committee for scrutiny. Therefore, the researcher used comments from health experts to modify the questionnaire.

3.7.1.1 Content Validity

The proposal together with the instrument was presented to the meteorologist prior finalising the study instrument to check whether the instrument cover aspects of climate change. The proposal together with the instrument was presented to the School of Health Science Higher Degree Committee for scrutiny. Therefore, the researcher used comments from health experts and the meteorologist to modify the questionnaire

3.7.1.2 Construct Validity

The researcher ensured construct validity by presenting the proposal together with the questionnaire to the supervisors, one of whom is a meteorologist to be scrutinised prior finalising the instrument. The researcher used the comments to modify the questionnaire.

3.8 Reliability

Reliability means if the same instrument can be used at different times or administered to different participants from same population should give same findings (Maree, 2016). Test and retest method were used to ensure reliability of the instrument. Test and retest is characterised by distribution of questionnaire to the same participants on two or more occasions (Maree, 2010). The questionnaire was pretested on 10 people from Mareseleng village and repeated after two weeks to determine the check-recheck reliability. The reason for administering structured questionnaire to same respondents in different occasions is to check the accuracy and consistency of the questionnaire if it will produce the same results. The Cronbach's alpha coefficient showed= 0.826 was acceptable because the results showed a correlation-coefficient of close to 1.

3.9 Pre-test

Pre-test entails including few individuals who meet the inclusion criteria who will not form part of the sample (De Vos, 2015). The researcher conducted pre-test of the questionnaire at the neighbouring village known as Mareseleng since the population of the village have similar characteristics to the population of Ga-Mashamothane village. Ten people who did not form part of the study were provided with questionnaires to complete to check whether participants would be able to answer the questions. Therefore, before the actual data collection, appropriate corrections and modifications were made. Pretesting helped to check whether participants would be able to complete the questionnaire and how much time they would take to complete questionnaire. Another reason was to check if questions were clear and understandable.

3.10 Procedure for data collection

The researcher attended community meetings to clarify the community about the purpose of the study after getting permission from the chief. Since there are community meetings every Sunday, the researcher provided participants with questionnaires to complete on three consecutive Sundays. Self-administered questionnaires with closed-ended questions were

handed to participants who met inclusion criteria. The data was collected during December 2018. The researcher explained the purpose, procedure and ethical considerations to the participants. Participants were provided with consent forms to sign prior participating in the study to show that they understand the purpose and the process of the study. The respondents were given a period of 45 minutes to 1 hour to complete the questionnaire. Questionnaires were completed in the presence of the researcher to assist participants if there were clarity seeking questions. In the case of participants who couldn't read and write, the researcher assisted participants to complete the questionnaire. Participants who returned complete questionnaire were 258 because they were those who returned incomplete questionnaires and others did not return the questionnaire at all.

3.11 Plan for data management and analysis

Data was entered into Microsoft excel and analysed using a computer program called Statistical Package for Social Science (SPSS version 25. 2017). The researcher started by cleaning the data. The researcher captured the data in an excel spread sheet and exported to the Statistics Package for Social Science. Data was analysed using descriptive and inferential statistics. The Chi square was used to test significant relationship between variables. Statistically significance values for Chi square was set at ($P = 0.05$).

3.12 Ethical consideration

Research ethics involves moral principles of behaviour that is expected to conduct a study and maintains integrity (De Vos, 2015). Ethical issues are set of rules and regulations that govern the way research should be conducted (Maree, 2016). The following ethical issues were adhered to:

3.12.1 Approval to conduct the study

The proposal for this study was presented to the Higher Degree Committee of the School of Health Science of the University of Venda for quality assessment. Thereafter the proposal was submitted to the University of Venda Higher Degree Committee for quality assessment and approval. After obtaining approval from the University Higher Degree Committee, the researcher applied for the Ethical Clearance from the University of Venda Ethics Committee and it was obtained.

3.12.2 Permission to conduct the study

After obtaining ethical clearance from ethical committee, permission to conduct the study was requested from the Batau ba Ga-Mashifane Royal Council and it was received.

3.12.3 Informed consent

The researcher provided participants with information letter that outlines research topic, purpose, the objectives of the study and how the rights of participants were protected. Thereafter the researcher provided participants with consent form to sign whether they are willing to participate in the study. Participants were told that they participate in the study voluntarily and if they want to withdraw from participating in the study they were free to do so.

3.12.4 Confidentiality and anonymity

The researcher explained the purpose of the study and the procedures that were followed while conducting the study. In order to ensure anonymity, the researcher ensured that there is no link of participants and their data. Participants remained anonymous and they were told not to write their names on the questionnaire. The researcher protected participants' confidentiality.

3.12.5 Principle of justice

Participants' selection was based on study requirements not group vulnerability. It is the responsibility of the researcher to treat all participants fairly irrespective of race, ethnicity, belief, religion or political organization affiliation.

3.12.6 Principle of beneficence

The researcher minimised harm but maximised benefits while conducting the study. Regarding the principle of beneficence, the potential risks and benefits were explained to the participants and they were protected from all forms of harm from physical discomfort and emotional stress.

3.12.7 Principle of respect

The researcher respected the dignity of participants, culture, belief and religion. Participants were told that they have the rights not to form part of the study.

3.13 Plan for dissemination and implementation of result

The study results and recommendations will be made available at the University of Venda Library for reference by other fellow students. The findings of the study will be published in peer-reviewed and accredited journals and will be presented at national and international conference.

3.14 Summary

The research methodology provided a clear description of how the data was collected, organized and analysed. This is an integral part of the whole study, given that a poor research design could lead to inappropriate or invalid findings and conclusions. The population and sampling techniques were described in detail in order to clearly show the methods used to select the participants from the study population. Plans for data collection, instrumentation and ethical consideration and data analysis were also explained in detail.

CHAPTER 4

PRESENTATIONS OF RESULTS

4.1 Introduction

This chapter presents findings of the study. As described in Chapter 1, the aim of this study was to determine health effects of climate change at Ga-Mashamothane village, Limpopo Province, South Africa. Responses from respondents were compiled into frequency tables and converted into percentages and presented in tables, charts and bar graphs. Data was analysed based on the study specific objectives and results related to specific study objectives are presented. The chapter is structured in five sections. In the first section, the demographic characteristics of respondents and the relationship of demographic characteristics and physical effects of climate change are described. This is followed by the physical effects of climate change and psychological effects of climate change. Three hundred and fifty-two (352) questionnaires were distributed to respondents and 258 questionnaires were satisfactorily completed and returned, thus the response rate was 73.3%.

4.2 Demographic characteristics of respondents.

Descriptive statistical analyses were performed to obtain frequency distributions of demographic variables, such as age, gender, highest level of education, home language of respondents, marital status, occupation, level of income in the household per month, number of people living in the household, head of the family, section which respondents come from and number of years stayed in the village. Table 1 provides a summary of the demographic characteristics of respondents. Brief descriptions of each of these demographic characteristics are explained

The results of this study showed that only few respondents 7 (2.7%) ranged from 62 and above years. The findings of this study revealed that majority of the respondents 207 (80.2%) passed matric or grade 12. Participants were asked to indicate their home language by placing a tick next to the relevant option provided. The results of this study indicated that majority of the respondents 211 (81.8%) were speaking Northern Sotho. The findings of the study revealed that majority of the respondents 177 (68.6%) were single. It was discovered that majority of the respondents 154 (59.7%) were unemployed. Participants were asked to indicate their level of income household per month by placing a tick next to the relevant option provided. The study findings showed that only few respondents 25 (9.7%) are earning between R4000 to R4999 per month. Participants were asked to indicate the total number of people living in their household by placing a tick next to the relevant option provided. The findings of this study

revealed that majority of the respondents 153 (59.3%) were ranged from 1 to 5 people living in the household. The findings of this study revealed that only few respondents 4 (1.6%) were staying at London section.

TABLE 1: DEMOGRAPHIC PROFILE OF RESPONDENTS (N=258)

Demographic characteristics		Frequency	Per cent
Age (Years)	18-28	89	34.5
	29-39	85	32.9
	40-50	38	14.7
	51-61	39	15.1
	62 and above	7	2.7
Gender	Male	177	68.6
	Female	81	31.4
Highest level of education	Primary school	24	9.3
	Secondary school	207	80.2
	Tertiary	27	10.5
Home language	Northern Sotho	211	81.8
	Southern Sotho	9	3.5
	SiSwati	21	8.1
	Xitsonga	17	6.6
Marital status	Married	72	27.9
	Single	177	6.6
	Separated	3	1.2
	Widow	6	2.3
Occupation	Employed	65	2.2
	Unemployed	154	59.7
	Self employed	25	9.7
	Pensioner	14	5.4
The level of income in the household per month	R100-R1999	123	47.7
	R2000-R2999	30	11.6
	R3000-R3999	32	12.4
	R4000-R4999	25	9.7

	R5000 an above	48	18.6
Head of the family	Yes	106	41.1
	No	152	58.9
The section that That you come from in the village	B 01	7	2.7
	Zone 01	15	5.8
	Zone 02	3	1.2
	Zone 03	23	8.9
	Zone 04	32	12.4
	Zone 05	91	35.3
	Zone 06	43	16.7
	Zone 07	25	9.7
	Zone 08	15	5.8
	London	4	1.6

4.3 Relationship between heavy rainfall and injuries, and relationship between drought and malnutrition.

The results indicated that heavy rainfall and injuries statistically are significantly correlated (P-value =0.000). There was positive relationship between heavy rainfall and injuries, as majority of the study respondents 215 (83.3%) sustained injuries after experiencing heavy rainfall. The results of the study indicated that drought and malnutrition statistically are significantly correlated (P-value =0.000). There was positive relationship between drought and malnutrition, as majority of study respondents 217 (84.1%) suffered from malnutrition during drought. The distribution of heavy rainfall and injuries and drought and malnutrition is shown on table 2.

TABLE 2: RELATIONSHIP OF HEAVY RAINFALL AND INJURIES AND RELATION SHIP OF DROUGHT AND MALNUTRITION

Variables	Sustained injuries						P Value
		Frequency	%		Frequency	%	
Experienced heavy rainfall in the village	Agree	156	60.5	Agree	215	83.3	0.000*
	Strong agree	51	19.8	Strong agree	27	10.5	
	Uncertain	15	5.8	Uncertain	5	1.9	
	Disagree	33	12.8	Disagree	5	1.9	
	Strong disagree	3	1.2	Strong disagree	6	2.3	
Experienced drought in the village	Suffered from malnutrition						
	Agree	60	23.3	Agree	217	84.1	

	Strong agree	131	50.8	Strong agree	8	3.1	0.000*
	Uncertain	9	3.5	Uncertain	6	2.3	
	Disagree	56	21.7	Disagree	22	8.5	
	Strong disagree	2	8	Strong disagree	5	1.9	

*Statistically significant

For analysis, responses for agree and strong agree were combined and the same was done to disagree and strongly disagree.

4.4 Physical effects of climate change on health

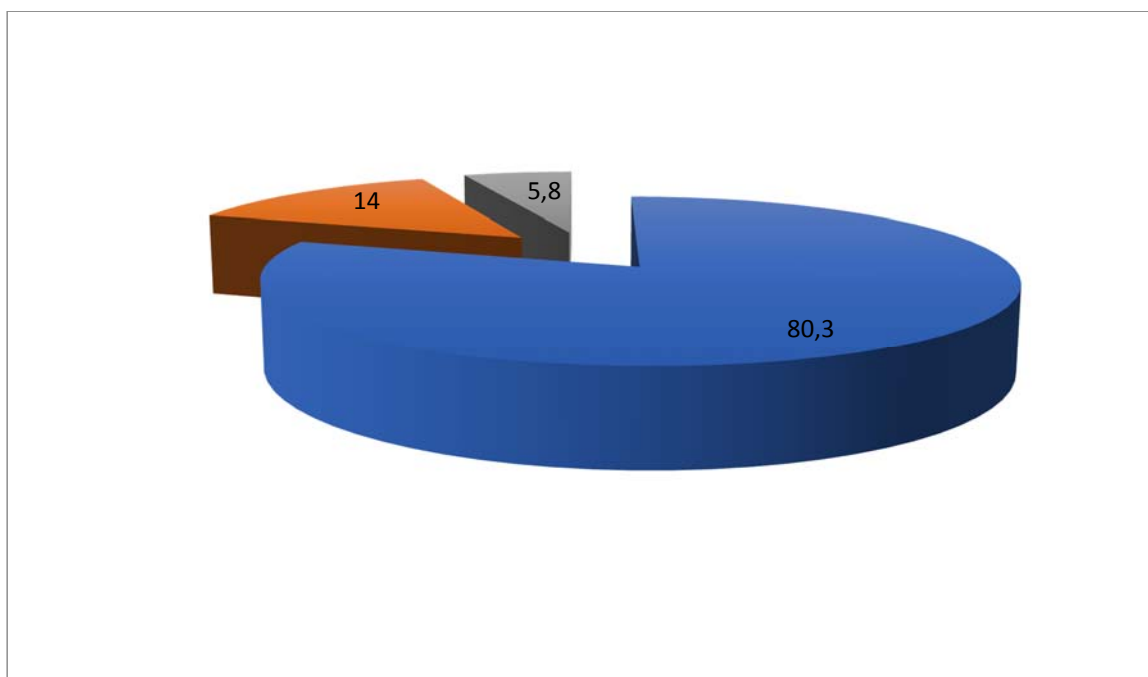


Figure 3: Experienced heavy rainfall (N=258)

The results of this study showed that out of 258 respondents 207 (80.3%) agreed that they have experienced heavy rainfall in the village. The findings of this study showed that 36 (14%) of the respondents disagreed that they have experienced heavy rainfall in the village. The

results of this study revealed that out of 258 respondents 15 (5.8%) were not sure whether they have experienced heavy rainfall in the village.

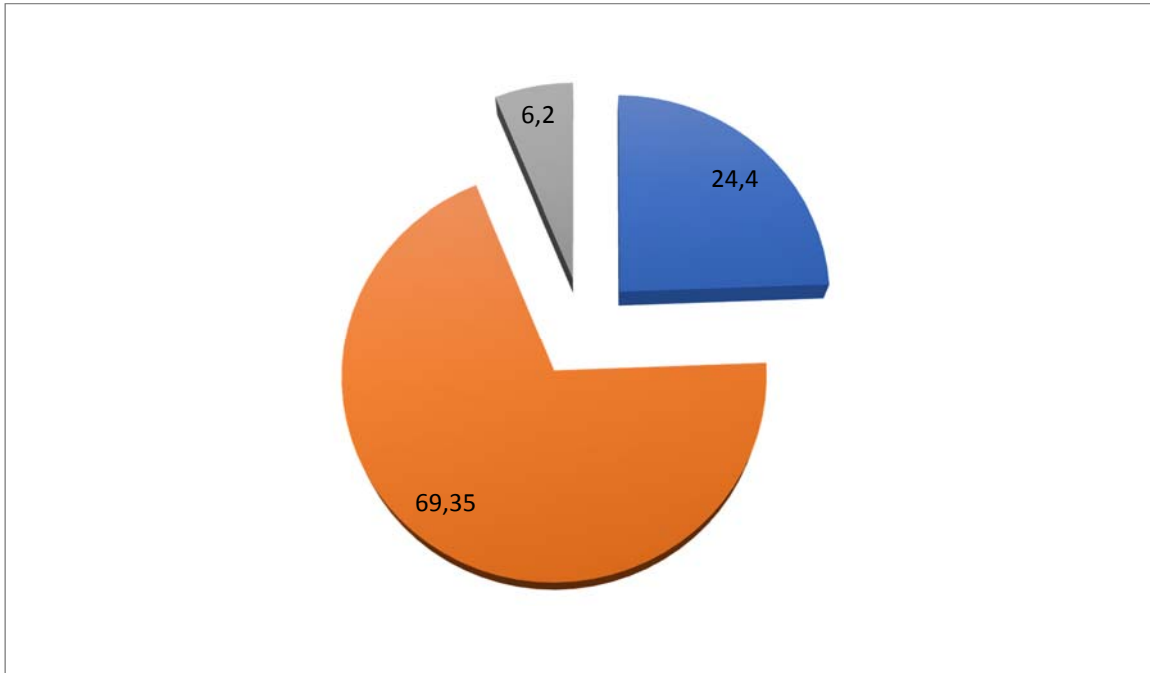


Figure 4: Experienced flood (N=258)

The findings of this study revealed that 171 (69.35%) disagreed that they have experienced flood in the village. The results of this study showed that out of 258 respondents 163 (24.4%) agreed that they have experienced flood in the village. The results of this study showed that 16 (6.2%) of the respondents were not sure whether they have experienced flood in the village.

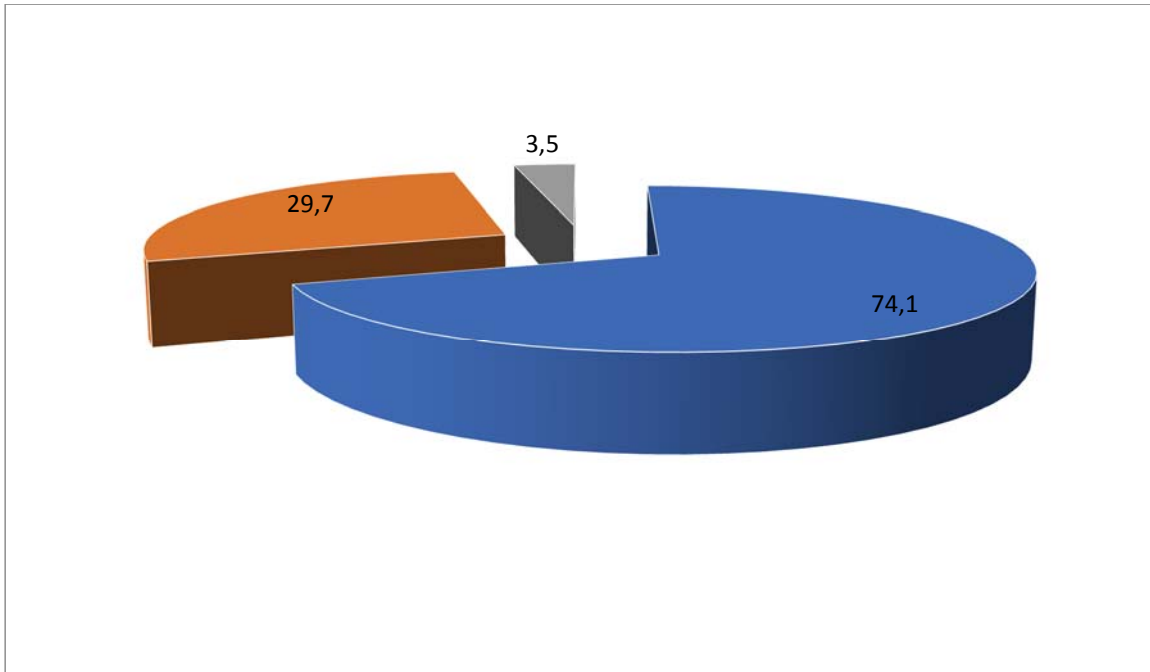


Figure 5: Experienced drought (N=258)

The results of this study showed that out of 258 study respondents 191 (74.1%) agreed that they have experienced drought in the village. The findings of this study revealed that 58 (29.7%) of the respondents disagreed that they have experienced drought in the village. The results of this study showed that 9 (3.5%) of the study respondents were not sure whether they have experienced drought in the village.

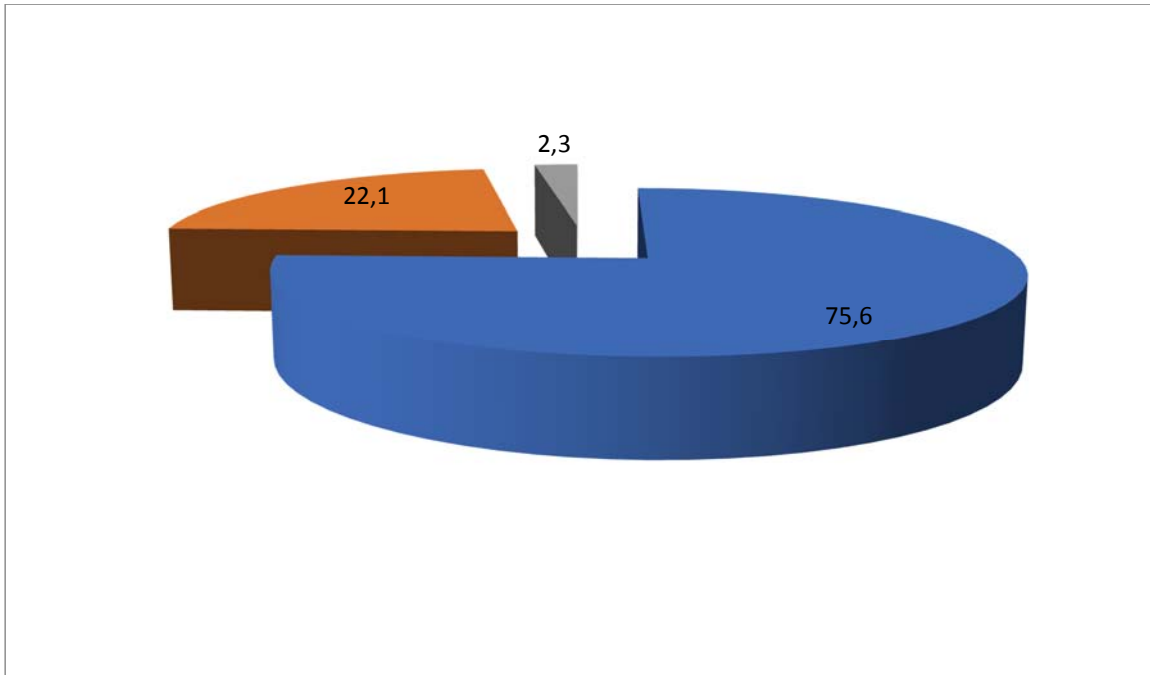


Figure 6: After the heavy rainfall I have been drinking contaminated water (N=258)

The results of this study showed that 195 (75.6%) of the respondents agreed that they have been drinking contaminated water after experiencing heavy rainfall in the village. The findings of this study revealed that 57 (22.1%) of the study respondents disagreed that after experiencing heavy rainfall in the village they were drinking contaminated water. The results of this study showed that 6 (2.3%) of the study respondents were not sure whether they were drinking contaminated water after experiencing heavy rainfall in the village

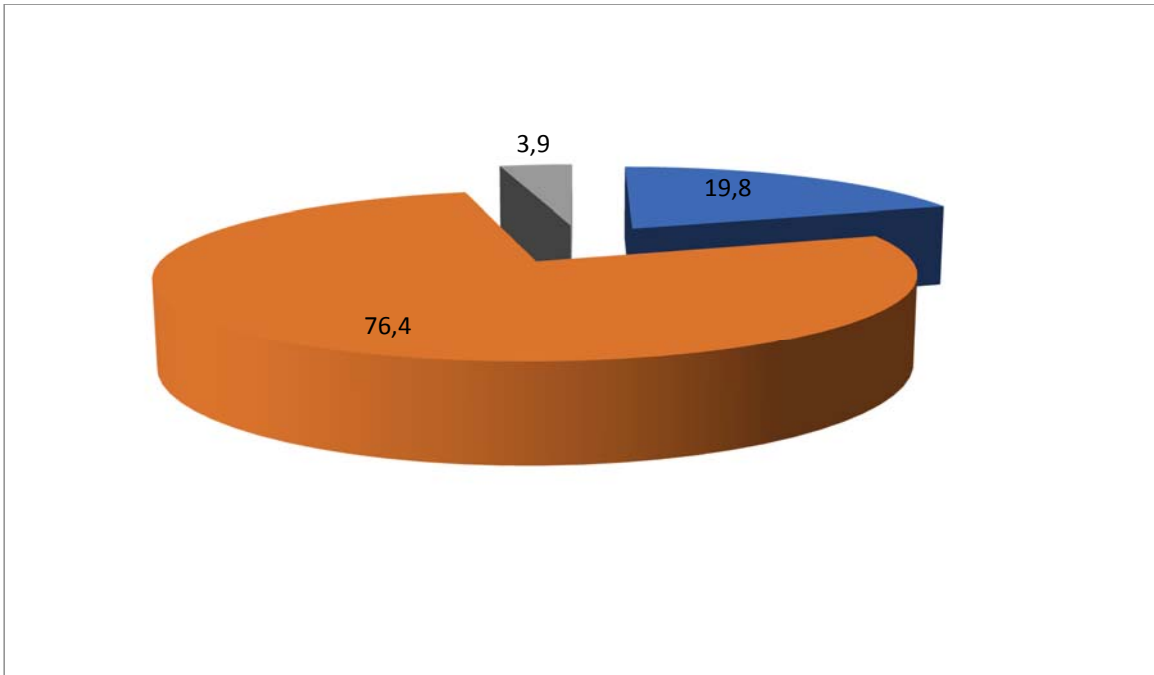


Figure 7: After the flood I have been drinking contaminated water (N=258)

The findings of this study revealed that out of 258 study respondents, 51 (19.8%) respondents agreed that they have been drinking contaminated water after experiencing flood in the village. The results of this study revealed that 197 (76.4%) of the study respondents disagreed that they have been drinking contaminated water after experiencing flood in the village. The findings of this study showed that 10 (3.9%) of the study respondents were not sure whether they have been drinking contaminated water after experiencing flood in the village.

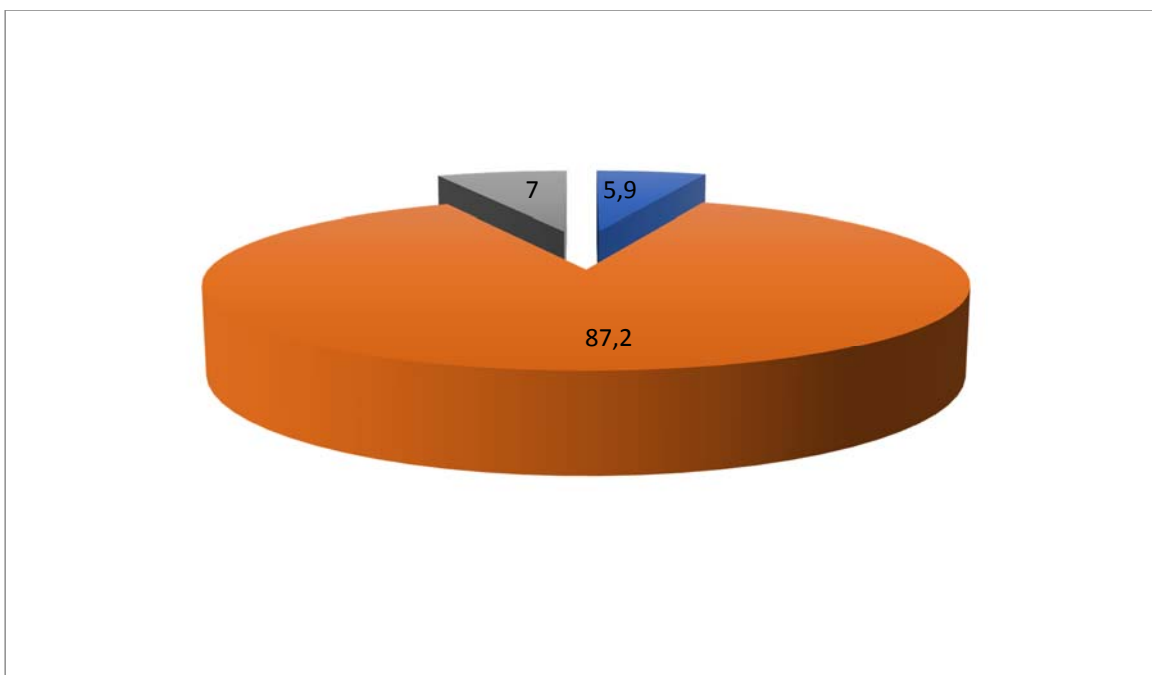


Figure 8: After drinking contaminated water I suffered from cholera (N=258)

The results of this study showed that out of 258 study respondents 15 (5.9%) of the respondents agreed that they have suffered from cholera after drinking contaminated water in the village. The findings of this study revealed that 225 (87.2%) of the study respondents disagreed that they have suffered from cholera after drinking contaminated water in the village. The results of this study revealed that out of 258 study respondents, 18 (7.0%) of the respondents were not sure whether they have suffered from cholera after drinking contaminated water in the village.

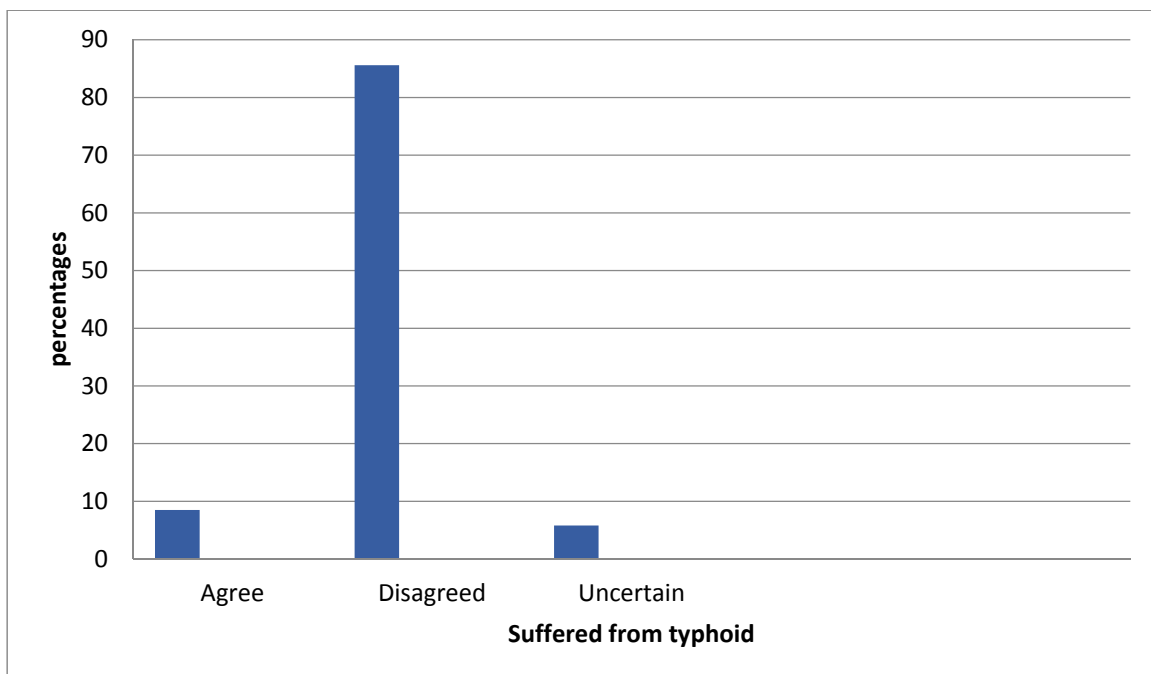


Figure 9: After drinking contaminated water I suffered from typhoid (N=258)

The results of this study showed that out of 258 study respondents 22 (8.5%) of the respondents agreed that they have suffered from typhoid after drinking contaminated water. The findings of this study revealed that 221 (85.6%) of the study respondents disagreed that they have suffered from typhoid after drinking contaminated water. The results of this study revealed that out of 258 study respondents 15 (5.8%) of the respondents were not sure whether they have suffered from typhoid after drinking contaminated water in the village.

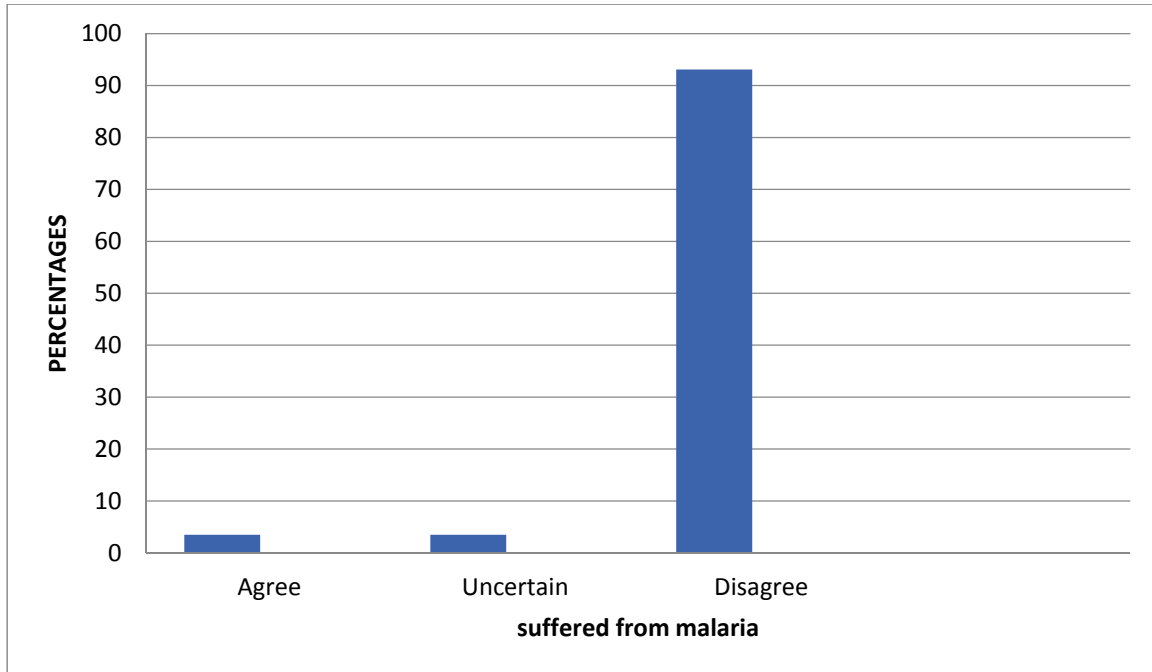


Figure 10: After flood I suffered from malaria (N=258)

The results of this study revealed that out of 258 study respondents, 9 (3.5%) of the respondents agreed that after flood they have suffered from malaria. The findings of this study showed that 240 (93.1%) of the respondents disagreed that after flood they have suffered from malaria. The results of this study revealed that 9 (3.5%) of the study respondents were not sure after flood that occurred in the village they have suffered from malaria.

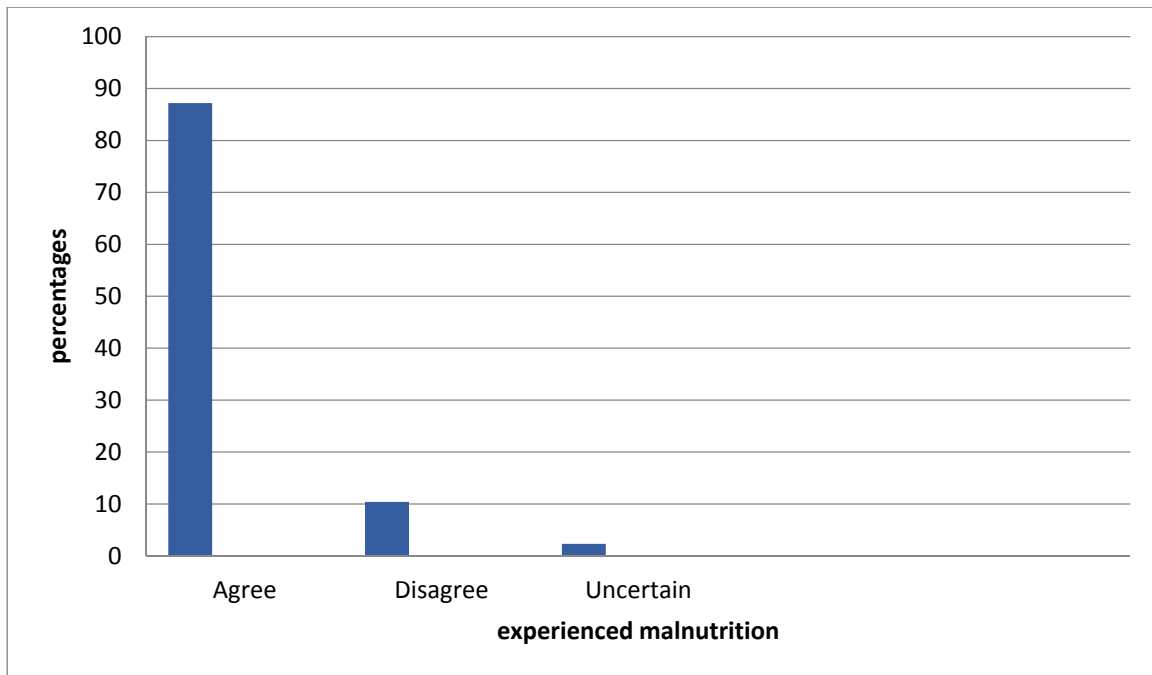


Figure 11: Suffered from malnutrition (N=258)

The findings of this study revealed that out of 258 study respondents, 225 (87.2%) of the respondents agreed that after experiencing drought in the village they have suffered from malnutrition. The results of this study showed that 27 (10.4%) of the study respondents disagreed that after experiencing drought in the village they have suffered from malnutrition. The findings of the study revealed that 6 (2.3%) of the study respondents were not sure that after drought they have suffered from malnutrition.

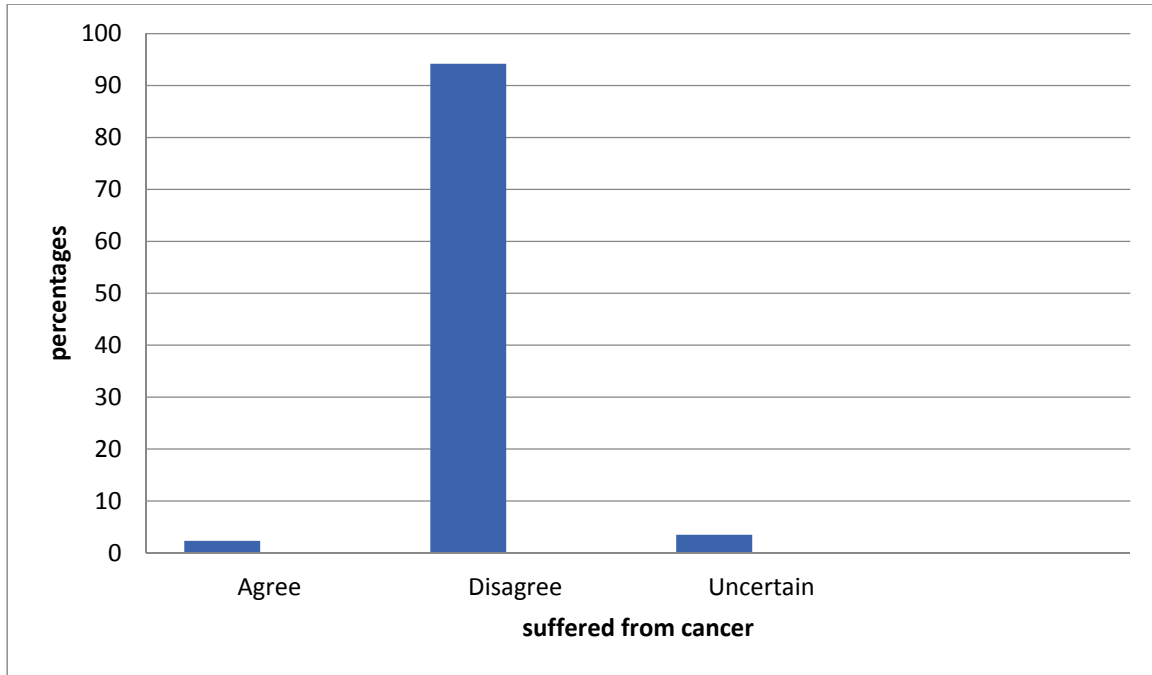


Figure 12: Suffered from Skin cancer (N=258)

The findings of this study revealed that out of 258 study respondents 6 (2.3%) of the respondents agreed that they have suffered from skin cancer. The results of this study showed that 243 (94.2%) of the respondents disagreed that they have suffered from skin cancer. The findings of this study revealed that 9 (3.5%) of the study respondents were not sure whether they have suffered from skin cancer.

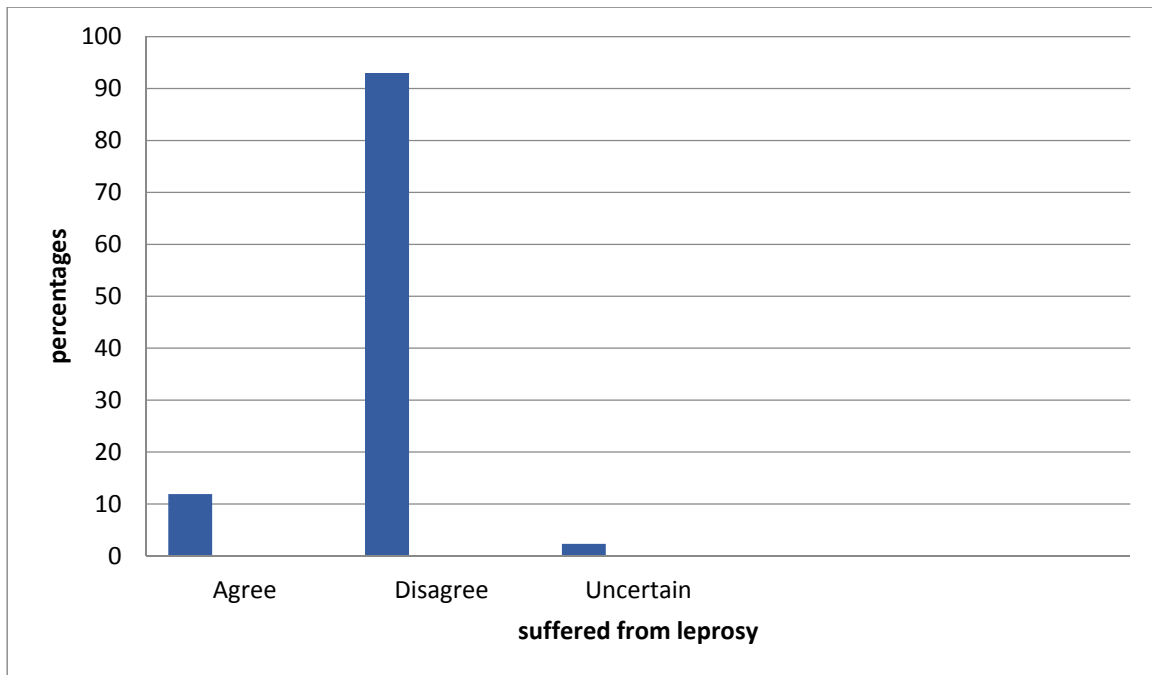


Figure 13: After experiencing drought I suffered from leprosy (N=258)

The findings of this study showed that out of 258 study respondents, 12 (11.9%) of the respondents agreed that after experiencing drought in the village they have suffered from leprosy. The findings of this study revealed that 240 (93%) of the study respondents disagreed that after experiencing drought in the village they have suffered from leprosy. The result of this study showed that 6 (2.3%) of the study respondents were not sure whether they have suffered from leprosy after experiencing drought in the village.

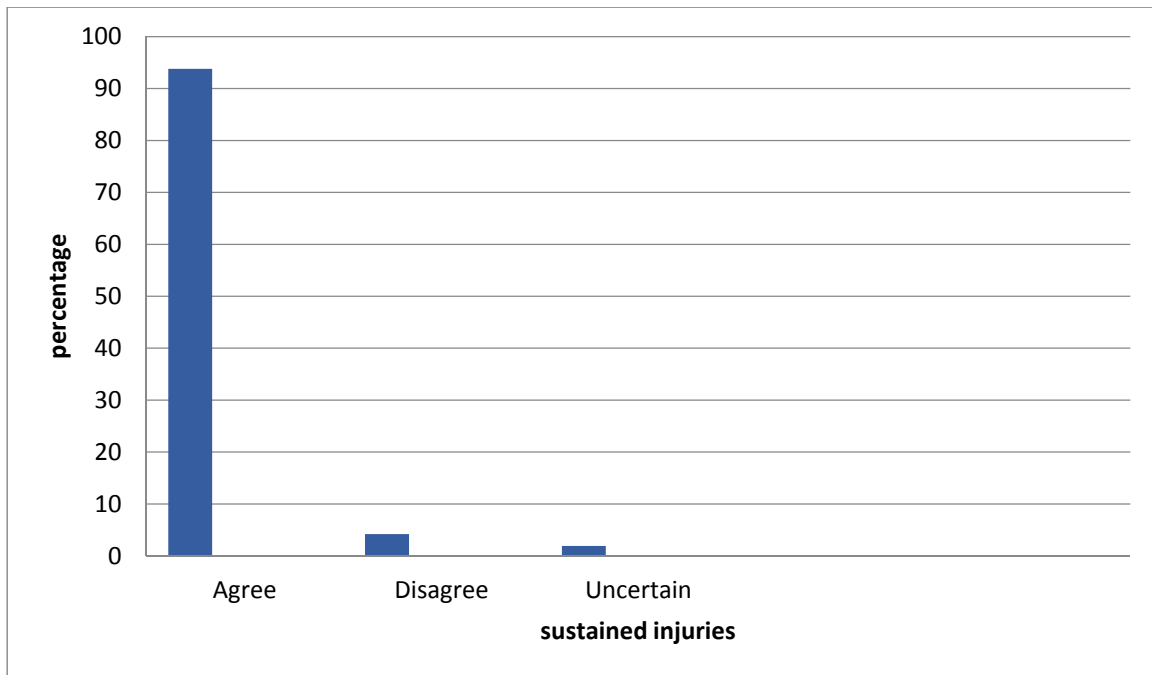


Figure 14: During heavy rainfall I sustained injuries (N=258)

The findings of this study revealed that out of 258 study respondents, 242 (93.8%) respondents agreed that during heavy rainfall they sustained injuries. The results of this study revealed that 11 (4.2%) respondents disagreed that during heavy rainfall they sustained injuries. The findings of this study showed that 5 (1.9%) of the study respondents were not whether they sustained injuries after experiencing heavy rainfall in the village.

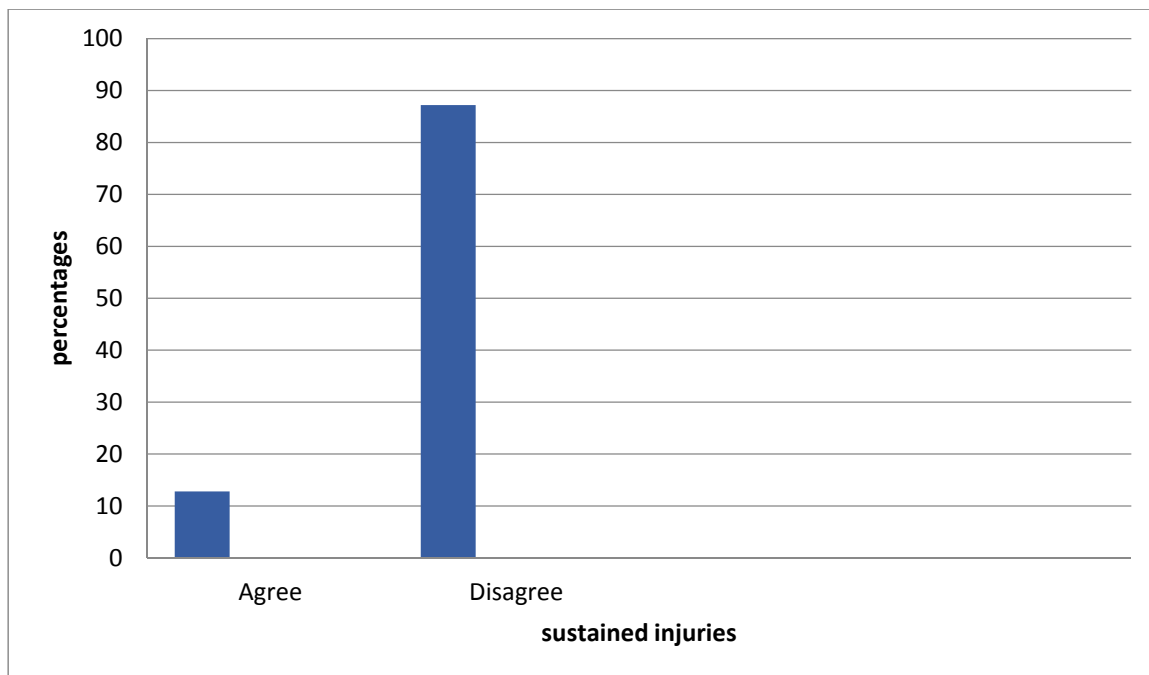


Figure 15: During flood I sustained injuries (N=258)

The findings of this study showed that 33 (12.8%) respondents agreed that during flood in the village they sustained injuries. The results of this study revealed that out of 258 study respondents, 225 (87.2%) respondents disagreed that during flood in the village they sustained injuries.

4.5 Psychological effects of climate change on health

The findings of this study showed that majority of the study respondents 219 (84.9%) disagreed that after witnessing people getting injuries because of flood they developed mood swing. The results of this study revealed that out of 258 study respondents, majority of the respondents 152 (58.9%) agreed that they were traumatised after witnessing people getting injuries because of heavy rainfall in the village. It was revealed that 204 (79%) of the study respondents disagreed that they were traumatised after witnessing people getting injuries because of flood in the village. The findings of this study revealed that only few respondents 21 (8.2%) agreed that after witnessing people getting injuries because of flood in the village, they developed mood swing. Refer to table 3 below.

TABLE 03: PSYCHOLOGICAL EFFECTS OF CLIMATE CHANGE ON HEALTH (N=258).

Variables	Agree		Uncertain		Disagree	
	N	%	N	%	N	%
During flood I witnessed people losing their lives as a result of flood in the village	24	9.3	15	5.8	219	84.9
I was traumatised by witnessing people getting injuries because of heavy rainfall	152	58.9	1	4	105	40.7
I was traumatised by witnessing people getting injuries as a result of flood in the village	45	17.5	9	3.5	204	79
I was traumatised by witnessing people losing lives as a result of flood in the village	24	7.3	9	3.5	225	87.2
After witnessing people getting injuries as a result of flood I developed mood swing	21	8.2	20	7.8	217	84.1

4.6 Summary

In this chapter, the results of the study were presented. The results showed that majority of respondents suffered from malnutrition after experiencing drought in the village. The findings of this study revealed that majority of respondents sustained injuries after experiencing heavy rainfall in the village. The results of this study showed that majority of the respondents were traumatised after experiencing heavy rainfall in the village.

CHAPTER 5

DISCUSSION OF RESULTS

5.1 Introduction

Quantitative data instrument was designed based on the findings from quantitative approach and the instrument was divided into three sections which covered demographic information of respondents, Physical effects of climate change and psychological effects of climate change on health. The objectives of the study were to assess effects of climate change on physical health of people and to describe effects of climate change on the psychological health of people at Ga-Mashamothane village.

5.1.1 Demographic Information

The results of this study showed that out of 258 respondents, 207 (80.2%) passed matric or grade 12 and their ages were ranging from 18 to 61 years. It is evident from the study that majority of the respondents have grade 12 (formal education). Education plays a critical role in understanding climate change and its effects on people's health. A study conducted by Evrendileke (2017) on effects of climate change indicated that some of the findings in the journal of Earth Sciences and Climate Change include provision of environmental education to the people as a strategy to overcome climate change. environmental education is essential to enable people to take actions on issues that will harm the environment and later result to climate change. Since majority of the respondents passed grade 12 or matric, this mean that they are capable of learning about climate change and its effects on people.

The findings of the study revealed that 154 (59.7%) of the study respondents were unemployed and 122 (47.7%) of the study respondents' level of income per month was ranging from R100 to R1999. Employment plays a fundamental role to people, particularly on where they erect buildings. A report compiled by the Department of Environmental Affairs (2013) revealed that poverty can force people to build in a place whereby they will be prone to natural disasters such as heavy rainfall and flood. This can result into injuries and death because of heavy rainfall or flood

5.2 Physical effects of climate change on the health

The results of this study showed that out of 258 study respondents, 242 (93.8%) respondents agreed that during heavy rainfall they sustained injuries. The results of this study are similar to a study conducted by Linsak et al., (2016) at Croatia, which showed that that the flood that

occurred at Croatia in 2014 resulted to 4 injuries. Since some of health care facilities were damaged and bridges were washed away, this resulted to complications and deaths. Those who sustained injuries were forced to be taken to hospitals that were functioning and some were located far from disaster affected area. These resulted to complications.

The results of this study showed that out of 258 study respondents 15 (5.9%) of the respondents agreed that they have suffered from cholera after drinking contaminated water in the village. A study conducted in Croatia by Linsak et al. (2016) indicated that during flood sewage pipes and water pipes were damaged and this resulted to the contamination of water as well as cholera outbreak. The results of this study are similar to a study conducted by Ahdoot (2015) who indicated that diarrhoea as the global leading cause of death estimated to 1.6 million were recorded. This means when drought strikes a particular area this predisposes people who are living in that area to diarrhoea and this could lead to loss of lives. People who don't have knowledge on water purification at household level, when there is a shortage of clean water they are likely to consume contaminated water. This can result to cholera.

The findings of this study revealed that out of 258 study respondents 225 (87.2%) which constitute majority of the study respondents indicated that after experiencing drought in the village they have suffered from malnutrition. The report compiled by the department of Environmental Affairs (2013) to develop national and sub-national adaptation scenario for South Africa under plausible future climate conditions highlighted that malnutrition and natural disasters predisposed people to diseases. Since majority of the study respondents indicated that they have suffered from malnutrition after experiencing drought in the village, this condition exposed them to kwashiorkor. These results are similar to a study conducted by Mpandeli, Nesamvuni and Maponya (2015) to evaluate and analyse how smallholders' farmers in Sekhukhune district have been coping and adapting to impacts of droughts. The results of the study revealed that Limpopo Province experienced severe drought that occurred in 2000. The drought affected all district of Limpopo Province including Sekhukhune district. As a result of the drought this led people to suffer from malnutrition. These results are similar to a study conducted in East Africa by (Abate, 2016) who indicated that prolonged drought resulted into food insecurity in East Africa.

The findings of the study further showed that 6 (2.3%) of the respondents agreed that they have suffered from skin cancer. A report compiled by the Department of Environmental Affairs (2013) indicated that transmission of communicable diseases in South Africa is associated to extremely hot temperature, wind and rainfall. These results are similar to a study conducted at Pakistan by (Bukhari and Rizvi, 2015) who indicated that flood that occurred in July-August 2010 resulted to 37 million consultations related to skin cancer, cholera and malaria.

The findings of this study showed that out of 258 study respondents, 12 (11.9%) of the respondents agreed that after experiencing drought in the village they have suffered from leprosy. The results of this study are supported by a study conducted by Alpino, Sena and Freitas (2017) to present a revision of the scientific articles related to droughts and public health who indicated that there was prolonged drought that occurred at Brazil in the end of 19th century and 20th century. People who relocated from drought affected area to other areas suffered from tuberculosis, malaria and Leprosy.

5.3. Psychological effects of climate change on the health

The results of this study showed that out of 258 respondents, the majority 144 (55.8%) of the study respondents agreed that they were traumatised by witnessing people getting injuries because heavy rainfall. An article written by Nengovhela (2019) indicated that there was flood at Musina municipality that resulted to rivers and dams to overflow. As a result of the flood bridges were washed away. Nengovhela (2019) indicated that people who are residing in the flood affected area were traumatised by the flood. The findings from another study conducted by Ahdoot (2015) on climate change and children health revealed that after hurricane Katrina and Rita, children estimated to 5000 were separated from their families. This resulted to psychological problems such as trauma and sleep disturbance as a result of the flood.

The findings of this study revealed that out of 258 study respondents, majority of the respondents 152 (58.9%) agreed that they were traumatised after witnessing people getting injuries because of heavy rainfall in the village. The results of this study are supported by a study conducted by Alpino, Sena and Freitas (2017) whose findings revealed that there was prolonged drought that occurred at Brazil in the end of 19th century and 20th century. The study indicated that after a prolonged drought that occurred at Brazil people who are residing in the drought affected area were traumatised, depressed and increased alcohol consumption. Some of the heads of families committed suicide since they were unable to cope with the consequences of the drought.

The results indicated that heavy rainfall and injuries statistically are significantly correlated (P-value =0.000). There was positive relationship between heavy rainfall and injuries, as majority of the study respondents 242 (93.8%) sustained injuries after experiencing heavy rainfall. The results of the study indicated that drought and malnutrition statistically are significantly correlated (P-value =0.000). There was positive relationship between drought and malnutrition, as majority of study respondents 225 (87.2%) suffered from malnutrition during drought.

5.4 Summary

Education is essential to enable people to take actions on issues that will harm the environment and later result to climate change. Since majority of the respondents passed grade 12 or matric, this mean they are capable of learning about climate change and its effects on people. Employment plays a fundamental role to people, particularly on where they erect buildings. When drought strikes an area, this predisposes people who are living in that area to diarrhoea which could lead to the loss of lives. People who don't have knowledge on water purification at household level when there is a shortage of clean water they are likely to consume contaminated water, and this can result to cholera. Majority of the study respondents indicated that they suffered from malnutrition after experiencing drought in the village.

CHAPTER 6

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents the summary, conclusions and recommendations based on the study findings. This is based on the study findings that is presented and discussed in the previous chapter.

6.2 Summary of the study

The aim of the study was to determine health effects of climate change: A case study of Ga-Mashamothane village at Fetakgomo Tubatse municipality, Limpopo Province, South Africa. A self-administered questionnaire was formulated in line with study objectives to collect data. The data was captured in a Microsoft excel spread sheet and transferred to Statistics for Social Sciences. Recommendations have been drafted in line with the study objectives. The study reviewed previous studies with a view to establish academic gap which the present study sought to bridge. This was done through literature review.

6.2.1 Physical effects of climate change on health

One of the study objectives was to assess effects of climate change on physical health (injuries, cholera, typhoid, malaria, skin cancer, leprosy and malnutrition) of individuals after experiencing heavy rainfall, flood and drought at Ga-Mashamothane village, Limpopo province, South Africa. The study findings revealed that majority of respondents agreed that they experienced heavy rainfall and drought in the village. The study further revealed that majority of the study respondents disagreed that they have experienced flood in the village. The study findings revealed that majority of respondents agreed that they sustained injuries during heavy rainfall and suffered from malnutrition during drought period.

6.2.2 Psychological effects of climate change on health

The second objective of the study was to describe effects of climate change on psychological health (trauma and Bipolar mood disorder) after experiencing heavy rainfall, flood and drought in the village. The study findings revealed that majority of respondents agreed that they were

traumatised after witnessing people getting injuries because of heavy rainfall. The study further revealed that majority of the study respondents disagreed that they were traumatised after witnessing people getting injuries because of flood, while majority of the study respondents disagreed that they were traumatised after witnessing people lose lives because of flood in the village. The study findings further revealed that majority of the study respondents disagreed that they developed mood swing after witnessing people getting injuries in the village

6.3 Limitations of the study

The scope of the study was restricted to Sekhukhune district and therefore findings might not be generalised to other rural areas in South Africa or beyond- to the rest of Africa and/or developing countries/ emerging economies.

6.4 Conclusions of the study

The study found that there is association between heavy rainfall and injuries and there is association between drought and malnutrition. The aim of the study was to determine health effects of climate change: A case study of Ga-Mashamothane village at Fetakgomo Tubatse municipality, Limpopo Province, South Africa. The study revealed that majority of the study respondents disagreed that they have experienced flood in the village.

6.5 Recommendations of the study

On the basis of the above conclusions, the following recommendations were made about physical health effects and psychological health effects of climate change:

- There is therefore a need of collaboration of several stakeholders such as local municipality, Department of Health, Department of Agriculture, Department of Labour and Department of Basic Education to come up with strategies to protect people's health.
- Local municipalities should implement policies that will restrict people to erect buildings in areas that will expose them to heavy rainfall and floods.
- There should be consistence guidelines for people working outdoors. People should avoid direct sunlight where possible. Those who are working in outdoors should be rehydrated and wear long sleeve.

- The Department of Agriculture should equip communities with knowledge on how to plant fruits and vegetables that can survive during drought period.
- People who are affected by heavy rainfall, flood and drought should receive professional counselling so that they can continue with their lives without experiencing flashback.
- The Department of Health working together with the department of Basic Education should implement effective health promotion programme that will educate people on basic water purification at household hold level.

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APPENDIX A

Letter of Information

Title of the Research Study : Health Effects of Climate change: A Case Study of Ga-Mashamothane village at Fetakgomo Tubatse Municipality, Limpopo Province, South Africa.

Principal Investigator/s/ researcher : Mr T.J Mokwena, (Bsc in Recreation and Leisure and Post -Graduate Diploma in Primary Health Care and District Health Management)

Supervisor : Dr N.S Mashau, (BA Cur, Hons, M. Cur, PhD)

Co-supervisors : Dr H. Chikoore, (BSc, MSc, Phd)
Dr T Malwela, (Bcur, M. Cur, Phd)

Brief Introduction and Purpose of the Study:

Climate change is a global public health problem that affects lives of many people in twenty first century (Goodman, 2013). In December 2011 South Africa hosted summit of International Institute for Sustainable development as an action to address climate change. In the summit health professionals came up with measures that should be taken to protect human's health (Goodman, 2013). Aim of the study is to determine health effects of climate change at Ga-Mashamothane village, Limpopo Province, South Africa.

Outline of the Procedures : Probability sampling adopting simple random sampling will be used in the study. The study will use this sampling to give all participants equal opportunity to be selected in the study. The study will use self-administered questionnaire with closed ended questions for data collection.

Risks or Discomforts to the Participant: There are no foreseen risks and discomforts in this study.

Benefits : The researcher will ensure that the study is available at University of Venda library. The department of health will receive the copy of the findings to take actions on issues that affect health of the community. The researcher might present to international conference and submit the study to peer reviewed journal for publication.

Reason/s why the Participant May Be Withdrawn from the Study: There will be no

Consequences for the participant should they choose to withdraw from participating in the study, they are free to do so.

Remuneration : There will be no remuneration for participating in this study. Participation is voluntary. There will be no expected payments from the participants either.

Costs of the Study : Participants will not be expected to cover any costs towards the study.

Research-related Injury : There will be no compensation if participants sustain injury while participating in the study
Persons to Contact in the Event of Any Problems or Queries: (Dr Mashau N.S) Please contact the researcher (076 30400 14.), my supervisor (015 962 8828) or the University Research Ethics Committee Secretariat on 015 962 9058. Complaints can be reported to the Director: Research and Innovation, Prof GE Ekosse on 015 962 8313 or Georges Ivo.Ekosse@univen.ac.za

I'm Tobias Johannes Mokwena a registered master student for the program Public Health at the University of Venda. I request you to participate in the study entitled as "health effects of climate change: A survey at Ga-Mashamothane village, Fetakgomo Tubatse municipality, Limpopo province, South Africa. As part of assessment by the University of Venda students are expected to conduct research and identify health problems that the community is facing and come up with strategies of addressing the identified problems. The purpose of the study is to determine health effects of climate change at Ga-Mashamothane village. The study will respect culture, belief and religion of participants and the researcher will minimise harm while conducting the study. Prospective participants will be told that they participate in the study voluntarily and if they are willing to withdraw from participating in the study they are free to do so. The study will ensure that there is no link between participants and their data.

APPENDIX B

Informed Consent

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, (*Mokwena T.J*), about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____,
- I have also received, read and understood the above written information (*Participant Letter of Information*) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

Full Name of Participant	Date	Time	Signature
I,

(*Mokwena T.J*) herewith confirm that the above participant has been fully Informed about the nature, conduct and risks of the above study.

Full Name of Researcher

..... Date..... Signature.....

Full Name of Witness (If applicable)

..... Date Signature.....

Full Name of Legal Guardian (If applicable)

..... Date..... Signature.....

APPENDIX C: QUESTIONNAIRE

Instruction:

This questionnaire seeks to determine Health Effects of Climate Change: A Case Study of Ga-Mashamothane village at Fetakgomo Tubatse Municipality South Africa. The study is part of the research Master of Public Health at the University of Venda and it will contribute to the public health knowledge. The study will make policy makers to be aware of the health effects of climate change so that when they modify climate change policies they may refer on my study. Participants do not need to write their names and no respondent will be identified or traced from this investigation whatsoever as confidentiality and anonymity are guaranteed. All data and information provided by you will be treated as strictly private and confidential. There are no 'right' and 'wrong' answers. The researcher is only interested in your response. You are therefore kindly requested to complete the questionnaire as honestly as you can. Thank you for participating in the current survey.

Section A: Bibliographical information

Kindly indicate your response by placing a tick X in the appropriate box at each statement or question.

Serial number

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1.Age				
18-28 years	29-39 years	40-50 years	51-61 years	62 and above
1	2	3	4	5

2. Gender	
Male	Female
1	2

3. Highest level of education			
Never attended school	Primary school	Secondary school	Tertiary qualification
1	2	3	4

4. Home languages										
Northern Sotho	Southern Sotho	Setswana	Tshivenda	Xitsonga	SiSwati	IsiNdebele	IsiZulu	IsiXhosa	English	Afrikaans
1	2	3	4	5	6	7	8	9	10	11

5. Marital Status				
Married	Single	Divorced	Separated	Widowed
1	2	3	4	5

6. Occupation			
Employed	Unemployed	Self employed	Pensioner
1	2	3	4

7. Level of Income household per month				
R100-R1999	R2000-R2999	R3000-R3999	R4000-R4999	R5000 and above
1	2	3	4	5

8. Number of people living in the household				
1-5	6-10	11-15	16-20	21 and above
1	2	3	4	5

9. Are you the head of the household?	
Yes	No
1	2

10. Which section do you come from in the village?									
B 01	Zone 01	Zone 02	Zone 03	Zone 04	Zone 05	Zone 06	Zone 07	Zone 08	London
1	2	3	4	5	06	07	08	09	10

11. Number of years stayed in the village				
0-5 years	6-10 years	11-15 years	16-20 years	21 and above
1	2	3	4	5

Kindly use the rating scale below to indicate your response by placing a tick **X** in the appropriate box at each statement or question.

A-agree	SA-Strong agree	U-Uncertain	D-Disagree	SD-Strong disagree
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	Section B: Physical effects of climate change	Rating				
		A	SA	U	D	SD
1	I experienced heavy rainfall in the village					
2	I experienced flood in the village					
3	I experienced drought in the village					
4	After the heavy rainfall I have been drinking contaminated water					
5	After the flood I have been drinking contaminated water					
6	After drinking contaminated I suffered from cholera					
7	After drinking contaminated water I suffered from typhoid					
8	After flood I suffered from malaria					
9	After experiencing drought in the village I suffered from malnutrition					
10	I suffered from skin cancer					
11	After experiencing drought I suffered from leprosy					
12	During heavy rainfall in the village I sustained injuries					

13	During flood I sustained injuries					
Section C: Psychological effects of climate change		Rating				
		A	SA	U	D	SD
14	I was traumatized by witnessing people getting injuries because of heavy rainfall in the village					
15	I was traumatized by witnessing people getting injuries because of flood in the village					
16	I was traumatized by witnessing people losing their lives because of flood in the village					
17	After witnessing people getting injuries because of flood I developed mood swing.					

Thank you