IMPACT OF MINING ON AGRICULTURE AND SOCIO-ECONOMIC ASPECTS IN THE RURAL COMMUNITIES OF GREATER TUBATSE LOCAL MUNICIPALITY

by

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Submitted in accordance with the requirements
for the degree of

MASTER OF SCIENCE

in the subject

AGRICULTURE
at the

UNIVERSITY OF SOUTH AFRICA (UNISA)

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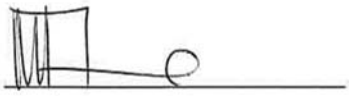
SEPTEMBER 2018

DECLARATION

I Mapuru Rachel Tsebe hereby make a declaration that the study “IMPACT OF MINING ON AGRICULTURE AND SOCIO-ECONOMIC ASPECTS IN THE RURAL COMMUNITIES OF GREATER TUBATSE LOCAL MUNICIPALITY” is my work and is original. All the sources that I have used in this dissertation were cited accordingly. I confirm that this dissertation has not been submitted at any other university.

Signed: 

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ACKNOWLEDGEMENTS

First, I would like to convey my sincere gratitude to the almighty God who has been my strength in all the happiest moments upon completion of my dissertation, **YOU REMAIN A LOYAL FATHER.**

Second, I would like to thank the leaders and the community members of Greater Tubatse Local Municipality for the warm welcome when I knocked at their doors. The kindness, love and the respect I received was amazing. I say thank you to my Supervisor Professor M.A. Antwi and my Co-supervisor Mr M.M.S. Maake for the endless support that went beyond sleepless nights in helping me gain the strength and the courage to believe in myself and to continue with my studies even under difficult circumstances. **MAY GOD BLESS YOU**.

Third, I would like to thank Ms Molatelo Mokgolo for assisting me with data collection. My gratitude goes to my family for supporting me throughout my studies and my loving husband (Mr Themba Godfrey Miya) for being a loyal and a consistent support system. To everyone who contributed to the success of this study, your support did not go unnoticed.

Finally, my gratitude also goes to the University of South Africa (UNISA) for awarding me a bursary which paid for my tuition fees and funded my research activities. Without your financial support it would have been impossible to complete my studies.

DEDICATION

I dedicate this study to my late father Mr Maropeng Jacob Tsebe, for the good upbringing and encouraging me to pursue an Agricultural Science degree. I consider myself a better person today because you existed in my life and taught me to stand my ground and run the race with no fear. ***ROBALA KA KHUTŠO NKWE.***

ABSTRACT

The majority of people in the mining areas in Limpopo, South Africa, depend on agriculture to sustain their livelihoods; however, the mines have also become important because they create better employment opportunities. The purpose of the study was to analyse the impact of mining on agriculture and socio-economic aspects in the rural communities of the Greater Tubatse Local Municipality. The objectives were to profile the socio-demographic characteristics of the community members surrounding a chrome mine; to determine the impact of mining activities on agricultural production (crop and livestock production); to determine factors influencing farmers' perceived impact of mining activities on agricultural production; and to ascertain the socio-economic (natural capital, financial capital, social capital, human capital, physical capital) impact of mining activities on the local communities. A quantitative research approach was used to conduct the study using a survey design. Six villages surrounding a chrome mine in the Greater Tubatse Local Municipality in Limpopo participated in the study. Stratified and random sampling approaches were used to select participants from each village to constitute a sample of 347. A total of 347 survey questionnaires were administered through face-to-face interviews but only 309 were correctly and fully completed. SPSS version 24 was used to analyse the data. The data were analysed using descriptive statistics, the ordered logistic regression model, Wilcoxon signed ranks test and binomial test. The majority (50.8%) of the respondents were male. Sepedi was the most spoken language (97.7%). Most (63.3%) of the respondents were in the age range of 18-30, and 76.4% were single in terms of marital status. A large proportion of the respondents (70.6%) could read and write because they had secondary education. Land ownership findings show that more than half (58.1%) of the respondents had farm plot sizes between 4.6 and 10.5 ha. Average farm plot size was 4.1 ha, and only a few (1.3%) of the plots were above 9 ha. The average family size was about 7 people (actual 6.7). A large proportion (77.7%) of the respondents were dependent on government social grants (pensioners, disability and orphans) as the main source of income. Regarding the impact of mines on agriculture, the study found that in general, the mines did not have a negative impact on the production of livestock and crops, except for donkeys and groundnuts, which were negatively

affected. In addition, the findings also show that a large proportion (92.6%) of the respondents lost their agricultural land (mainly grazing land) because of increased mining activities, although the loss of land did not affect production. With regard to the socio-economic impact of mining activities on the surrounding communities, the study found that the mines had a negative impact on natural capital, physical capital, financial capital and social capital. However, the impact on human capital was positive. It is recommended that mining companies in the study area provide the necessary support to improve the socio-economic status of the rural communities surrounding the mines in Greater Tubatse Local Municipality.

Keywords: Agriculture, mining, Greater Tubatse Local Municipality, socio-economic impact.

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ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
CSR	Corporate Social Responsibility
GDP	Gross Domestic Product
HIV	Human Immune Deficiency Virus
LPGDS	Limpopo Province Government Development Strategies
NRF	Natural Resource Forum
RADAR	Research Alliance for Disaster and Risk Reduction
SANRAL	South African National Roads Agency Limited
STATS SA	Statistics South Africa

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CHAPTER 1: INTRODUCTION OF THE STUDY

1.1 Background and Introduction

In comparison to other countries in the Southern Africa region, the economy of South Africa has been dependent on minerals since the late 19th century (Field *et al*., 2008). The discovery of the first mineral (diamond) in South Africa was in Hopetown, Kimberly in 1867 (Coovadia *et al.,* 2009). The discovery of diamond was perceived as a turning point for South African economy which was highly dependent on agriculture. The emergence of mining changed the country's agricultural economy to a capitalistic and industrialized economy (Allhood & Hambly, 2013). To many South African citizens, the discovery of diamond was known as a mineral revolution because diamond had high value. As a result, South Africans were forced to compromise agricultural land for mining activities. The mining of diamond also attracted people from as far as Britain to move into South Africa to explore the minerals. Because of colonization, the British officers took ownership of most land in South Africa from indigenous people (Allhood & Hambly, 2013). The loss of agricultural land was further perpetuated by the discovery of gold in the Witwatersrand in Johannesburg in 1886, which made it difficult for farmers in Johannesburg area to retain their farms. As a result, most farmers were resettled elsewhere to avail the land for mining activities (Allhood & Hambly, 2013). Before the discovery of minerals, Johannesburg area was divided into farms such as Bezuidenhout Farmstead, Waterval Farm, Geldenhuys Farm and others (Naidoo *et al.,* 2008*).* Farmers were dissatisfied with the impact of mining on water quality and quantity (Adler *et al., 2007).* Naidoo *et al.* (2008) further reported that some farmers were also concerned about the impact of mines on the cemeteries in the area.

The land that was previously used for agricultural purpose in Limpopo Province was allocated for mining, therefore this may lead to a decrease in agricultural production. Most mining activities started a century ago, an example being Penge mine which started operating in 1914 (Matsabatsa, 2009). Most mining activities in Limpopo Province are in Sekhukhune District Municipality compared to the other districts municipalities. Although majority of people in the mining areas in Limpopo Province depend on agriculture for their

livelihoods; mines have also become important in the livelihoods of communities located within the vicinity of the mines. According to Statistics South Africa (STATS SA, 2011), the economy of the Limpopo Province has become diversified and the mining sector contributed 27% to the economic growth of the province in 2011. Mining also created job opportunities and business developments (Chakwizira *et al*., 2014). Although the livelihoods of the people have improved because of mining activities, agricultural production has declined (Mpandeli *et al.,* 2015). This is mainly because agricultural land is used for mining, which destroys productive land that is suitable for cultivation. For example, during the mining excavation, the top layer of the soil is removed, and some remains from the mine are dumped on fertile soil, therefore, the removal of top layer reduces soil quantity and quality, soil fertility and the quality of ground water (Bench Marks Foundation, 2014).

Sekhukhune District Municipality in Limpopo Province is amongst the areas that are currently experiencing water scarcity because of mining activities, which also affects agricultural production (Ziervogel & Taylor, 2014; Mpandeli *et al.,* 2015). The low quality and quantity of water results in drought which makes it difficult for sustainable agriculture in Sekhukhune District (Mpandeli *et al.,* 2015). The impact of mining activities extends to human livelihoods that depend on agricultural production. For example, some mines closed after operating for a few years and contaminating the environment (McCulloch, 2008). People also became unemployed as their farmlands were converted into mining areas (McCulloch, 2008), and in some instances, community members were relocated (Ocansey, 2013). Ocansey (2013) further reported that communities surrounding mining areas are likely to become food insecure because the quality of clean water and air are reduced because of mining activities. Farmers are mostly left with inadequate land suitable for agriculture especially subsistence farming (Peluso *et al.,* 2015). For example, Penge mine, which operated between 1914 to 1992 in Burgersfort in the Greater Tubatse Local Municipality of Sekhukhune District left the land unsuitable for human settlement and agriculture (Matsabatsa, 2009).It is evident that mining activities have compromised agricultural land and dispossessed farmers of their productive land; thus, the study intends to investigate the impact of mining on agriculture and socio-economic aspects of the rural communities of the Greater Tubatse Local Municipality.

1.2. Problem Statement

Limpopo Province has an arable land suitable for various agricultural practices. Different agricultural products such as maize, citrus, table grapes, vegetables, wheat, cotton and livestock dominate agricultural production in the province (Quinn *et al*., 2011; Chakwizira *et al*., 2014). In recent years, minerals such as platinum, chrome, coal, gold and palladium have been discovered in the province, mostly in Sekhukhune District Municipality. Some of the mines in Limpopo Province include Atok, Twickenham, Morula, Dilokong Maandagshoek, Penge, Steelpoort Smelter, and Polokwane Smelter among others. These mining industries are in rural areas where land was previously used for farming and residential purposes. The expansion of mining activities changes land uses in the surrounding communities (Aird & Archer, 2004). This does not only affect the ownership of communal land *(*Tefera *et al., 2004),* but also has an impact on vegetation (Mucina & Rutherford, 2006). The rights of the people to benefit from the communal land are violated by the emergence of businesses like mining (Phala, 2013). This prevents smallholder farmers from producing agricultural products on fertile soils. For example, mines in Sekhukhune District Municipality operate in areas where most people are unemployed and uneducated (Siebert *et al.*, 2001). Majority of the people in these areas are highly dependent on the government for the provision of opportunities than on mining companies. Although mines provide jobs for communities in the surrounding areas, unemployment rate is still high (Mathipa & Roux, 2009).

According to the Department of Cooperative Governance and Traditional Affairs (2011), about 35% of the population is employed within the Sekhukhune District Municipality, while 60% is employed outside the district. There is also high expectation for job opportunities from communities surrounding the mines, because many people gave away their agricultural land to the mines. Some communities are now demanding that for the return of their lands from the mining companies, because their expectations from the mines have not been met (Farrell *et al.,* 2012). Therefore, the research measured the extent to which mining activities had impacted on agricultural production in the communities surrounding the mines. The question is whether communities can still use their land for agriculture to sustain their

livelihoods if mines were discontinued in Sekhukhune District Municipality or not. This has not been fully explored from the agricultural socio-economic point of view.

1.3 Research questions

In filling this knowledge gap, the study will answer the following questions about mines in Sekhukhune District Municipality:

- What is the impact of a chrome mine in Greater Tubatse Local Municipality on:
    - Agricultural production (crop and livestock)?
    - Socio-economic aspects (natural capital, social capital, human capital, physical capital and financial capital) of the local communities?
- What are the factors influencing the impact of mining activities on agriculture?

1.4 Aim and objectives of the study

1.4.1 Aim of the Study

The aim of the study was to understand the impact of chrome mine on agriculture and socio-economic aspects in the rural communities of Greater Tubatse Local Municipality in order to provide basis for informed policies to address the challenges of the community.

1.4.2 Objectives of the Study

The objectives of the study were to:

- Determine the farmers' perceived impact of mining activities on agricultural production (crop and livestock production);
- Profile the socio-demographic characteristics of the community members surrounding a chrome mine;
- Determine factors influencing the farmers' perceived impact of mining activities on agricultural production; and
- Analyse the socio-economic (natural capital, financial capital, social capital, human capital, physical capital) impact of mining activities on the local communities.

1.5 Hypothesis

The null hypotheses of the study were:

- Mining activities have negative impact on crop and livestock production in the local communities.
- Mining activities have insignificant impact on socio-economic aspects of the local communities. The economic aspects include:
    - natural capital,
    - physical capital,
    - human capital,
    - financial capital, and
    - social capital.

1.6 Significance of the study

The study assessed the impact of mining activities on the livelihoods of the surrounding communities. The findings of the study if adopted by policy makers will serve as basis for informed policy decisions aimed at improving the surrounding communities. It may enable government to make informed decisions in the allocation of mining licenses in the land used for agricultural purposes, and improve land zoning”

1.7 Study outline

The study is divided into five chapters outlined as follows; chapter 1, provides the background and introduction of the study, chapter 2, covers literature review, and chapter 3 is the methodology used to conduct the study. Chapter 3 describes the study area, the population of the study, the sample size and sampling procedures, method of data collection and analysis and ethical consideration. Chapter 4 presents the results and discussion of the study, followed by chapter 5 which outlines the summary of the study, conclusive remarks about major findings and recommendations for intervention purposes.

1.8 Summary of the chapter

This chapter has presented the introduction and background detailed problem statement, the research questions and objectives, hypotheses and the significance of the study.

CHAPTER 2: REVIEW OF RELATED LITERATURE

2.1 Introduction

Literature review plays an important role when conducting a research because it provide an overview of what other scholars have discovered in the discipline or field of study. Chapter 2 includes literature about the overview of mining in South Africa, mining versus agriculture and socio-economic impact of mining on natural capital, physical capital, human capital, financial capital and social capital.

2.2 Overview of mining in South Africa

In South Africa, mining started when the European settlers discovered mineral resources in the late 19th century (Gallagher & Robinson, 1953; Field *et al*., 2008). The first mineral to be discovered in South Africa was diamond in Kimberly in 1867, followed by gold in the Witwatersrand in 1886; and that was the beginning of mining revolution in the country (Coovadia *et al.,* 2009). In addition, the discovery of gold played an important role in the economy, as well as the social economic and political environment of South Africa (Adler *et al.*, 2007). Mining became the cornerstone of the economy with limited access of land by black people. When the European settlers arrived in South Africa in the 17th century, the African people were forced to move out from their lands to give way to white people; as a result black people ended up without enough land for settlement and farming. Consequently, black people were forced to look for jobs on white farms (Aliber, 2003) and in mines especially, after the introduction of the 1913 Native Land Act and 1936 Native Trust and Land Act that designated 87% of Land to white people (Coovadia *et al.*, 2009). The Land Acts also prevented black people from owning land, which led to limited access to land for farming and loss of interest in agriculture. Eventually, agriculture in areas settled by black people was undermined because mining companies and white people; which forced black men to leave their settlements to work in mines to sustain their families (Coovadia *et al*., 2009) occupied the land.

In 2004, the Growth and Development Strategy of the Limpopo Province identified mining sector as one of the active economy enlargement sectors (LPGDS, 2004). Mathabatha (2011) also reported that the Limpopo Province has identified mining as a potential contributor to economic growth, job creation, enterprise development and broad-based economic empowerment. The province has the world's largest reserves of platinum group of metals, which also have rich deposits of chrome, vanadium, nickel, diamonds, coal, chrome, iron ore, copper and titanium (LPGDS, 2004). Large coal reserves occur in most of the western parts of the province and are associated with significant quantities of natural gas or coal bed methane (Peluso *et al*., 2015). A study conducted by Ziervogel and Taylor (2008) found that Sekhukhune District Municipality is amongst the areas that derive their economy from platinum, gold, chrome and palladium mines and irrigated agriculture; all of which require a lot of water, that is currently inadequate in that area.

2.3 Mining versus agriculture

Mining is identified as a potential economic activity in most developing countries (Lockie *et al.*, 2009). This is mainly because it contributes towards the creation of employment opportunities especially for men (Bollinger & Stover, 1999; Alexander *et al.*, 2013). For example, in South Africa mining contributed 9.3 % of the total Gross Domestic Product (GDP) compared to agriculture at 2.6 % in 2012 (Alexander *et al.*, 2013). This shows that mining has contributed highly to the economy than agriculture in the past five years. The contribution of agriculture to the GDP declined from 16.6% in 1951 to 2.6% in 2012 (Alexander *et al.*, 2013). Again, in South Africa mining contributed about 6.6% of the total GDP compared to agriculture at 4.2% in the third quarter of 2017 (Stats, 2017). Regarding employment opportunities, mining created 2.7% jobs compared to agriculture at 4.7% in 2013 (Stats, 2013). This is an indication that the potential for mining industry to create employment opportunities has declined in South Africa. The future of mining industry in South Africa is threatened because the number of active mines has declined in the recent years (Meinjies *et al.,* 2008; Peluso *et al.*, 2015).

Even though mining contributes more to the economy than agriculture, the operation of mining whether in a small or large-scale sector has a negative impact on the environment

(Kitula, 2006; Ocansey, 2013). The mine dumps affect the quality of soil, the availability of land for human settlement, and the availability of land for grazing (Meinjies *et al.,* 2008). For example, Mathabatha (2011) reported that in mining communities, farmers lost their land and experienced a drastic reduction in the farm yield due to a decreased access of land, water or air pollution from the mines. Mining activities have the potential to contaminate underground water (Hilson, 2002; Mayes *et al.*, 2009), because metals in mine effluent flow into rivers, and that is not suitable for human consumption and agricultural production (Mayes *et al*., 2009). This compromises the quality of water for human and livestock consumption and irrigation for agricultural production. It also hinders the development of other potential industries that can add value to strengthen the economy. The establishment of mines can cause the displacement of local people from the land and bring about a drastic change to traditional land uses (Moody & Pannus, 1997; Anderson *et al*., 2008). For example, Sekhukhune District Municipality, access to agricultural land in the areas surrounding the mines declined from 34.7% in 2004 to 25.9% in 2006 (Drimie *et al.*, 2009).

According to Bench Mark Foundation (2014) the negative impact of mining activities on water, land and air often leads to food insecurity because air pollution and effluent from the mines affect drinking water, milk production and quality. Moody and Panos (1997); Behera (2015); Fusseini (1996), noted that mining activities happen in areas that were previously economically oppressed and where people did not have the power and resources to evaluate the feasibility of establishing mines in their areas. This leads to conflicts between the local communities and mining companies towards the land use (Hilson, 2002). Conflict often arises when mining companies do not fulfil their promises to the local communities who gave them access to their land.

National Cultural History Museum (2003), reported that when new developments were planned in Sekhukhune District Municipality, local people were resettled away from their agrarian land for mining operations to commence. This caused a decrease in grazing land and the number of livestock in the area. The resettlement was however controversial as people were forced to relocate again after the discovery of more minerals. Mining activities require a lot of water, and more space to accommodate the extension of roads, shopping centers, and living quarters for mine workers, which reduces the amount of land available

for farming (Anderson *et al.*, 2008). Mining activities also destabilizes the livelihoods of the local people because mining is practised in rural areas where people depend on maize as their staple food (for porridge) and other products that are made from maize. In addition, 'Meinjies *et al*. (2008) analyzed Penge mine in Greater Tubatse Local Municipality and found that mining occupied large tracks of land in the area that was suitable for agricultural purposes and that land was left contaminated when the mine stopped its operations. A study conducted by Drimie *et al*. (2009) in Greater Sekhukhune Municipality found that the establishment of mines did not have a positive impact on the lives of indigenous people even though communities availed their agricultural land for mining activities. This is evident because people in the area still rely on government social grants for a living even though there are a lot of mines in their area, which could provide opportunities for income earning activities (Drimie *et al*., 2009).

2.4 Socio-economic impact of mining

2.4.1 Natural capital

Ellis (2000) and Crossman *et al.* (2011) defined natural capital as the primary resources such as air, soil, water, vegetation and other resources that are found in the environment that are important to people who engage in activities that need natural resources, such as farming, fishing and hunting (Rakodi, 1999). Mining activities depend on natural resources such as land and water, which are the same resources that people need for agricultural purposes (Downing, 2002). This is further supported by Ocansey (2013) who reported that natural resources are very important for development and production processes, but they can never be substituted for agriculture, food and farmlands. In the study conducted by Muntingh (2011) it was found that communities had a positive perception towards mining in general, and in return they sacrificed land for mining, because they were highly hopeful that mines would create a market for their agricultural products. Despite that, there were other people who were worried that mining operations would increase crime in the area, reduce availability of ground water, loss of productive farmland, increase cost of housing and the increase incidence of diseases (Muntingh, 2011; Drimie *et al.*, 2009).

The excavation from mines has a huge impact on natural resources and the livelihoods of people who live near the mines (Kitula, 2006; Patterson & Shappell, 2010). The excavation has the potential to pollute the atmosphere in such a way that mine related diseases like respiratory diseases, asbestosis, tuberculosis and others can affect people living near the mines (Kitula, 2006). The impact of mining on natural resources is a concern for a long term as it is coupled with coal dust in the air, land disturbance, tree clearing and water extraction (Lockie *et al.*, 2009). Muntingh (2011) reported that mining cause environmental and ecological impacts such as acid mine drainage, noise, dust pollution, and landform changes. Deforestation has a major ecological impact on natural resources by changing species composition and decreasing grazing land (Behera, 2015).

The study conducted by David (2005) found that mining companies use large amounts of water and energy. However, it was further reported that the existence of the mining in the communities does not only damage the natural resources, but it also creates job opportunities for the local people and improves their standards of living. Mining activities affect the quality of air because of excessive fumes that pollute the air (Kitula, 2006). Moreover, mining affect trees as they are also uprooted to avail the space for mining activities to take place (Lockie *et al*., 2009). The reduction of trees impacts on the availability of browse, therefore, this has a negative impact on the production of livestock. Not only trees are negatively impacted, the environment is also disturbed e.g. mining causes soil erosion, contamination of the soil with heavy metals, which in turn degrade the use of land; it causes damage to groundwater with chemicals that lead to the scarcity of clean water and causes conflicts between the communities and mining companies (Nuss & Eckelman, 2014). Drimie *et al*. (2009) reported that in Greater Tubatse Local Municipality there is a problem with access to clean water for human consumption and agricultural production because of pollution by heavy metals.

Unwanted chemicals from mines flow into rivers and are often absorbed by the vegetation absorbing water from the rivers (Lockie *et al*., 2009). This is harmful because the chemicals from mining effluents are mostly not suitable for the growth of crops and vegetation. Therefore, mining activities has a negative impact on the environment. Sengupta (1993); Earle & Robert (1996); McKinnon (2002); Bian *et.al.* (2006) noted that coal mining has

severe environmental impacts on ground water, flow of rivers and consequential impacts on land-uses, mining waste disposal, damage on infrastructure and potential ecological changes.

2.4.2 Physical capital

Physical capital are the inputs in the factors of production, and are also defined as tangible fabricated assets used during production. These are infrastructures, which are basic and are producer goods that support livelihoods (Ellis, 2000; Ungar, 2011). According to Drimie *et al.* (2009), most people who live near mining areas are unemployed and poor. Some of the people are unable to build decent houses, drill water boreholes, or buy new cars and furniture. This is perceived as a negative impact because people who live near mines expect jobs from mining companies that could improve their socio-capital (Ziervolgel & Taylor, 2008). Working in the mines could enable individuals to afford basic needs such as housing, buying their own cars and acquire other assets. People who live near mining areas are mostly stricken by food insecurity and lack of money (Anderson *et al*., 2008), although it is expected that mines should influence the level of affordability to the local communities. The lack of better housing in mining areas drew the attention of the researchers but also the lack of important facilities such as libraries, clinics, schools and other facilities (Peluso *et al*., 2015; Mwakwambirwa, 2015).

There are many challenges related to socio-capital in the communities in mining areas across the African continent. For example, in Tanzania, Mkuzi *et al*. (2013) identified poor infrastructure such as roads and transport. They also found that lack of hospitals, schools and market for agricultural products were some of the major challenges in the areas surrounding mines in Tanzania. They further noted that lack of transport affects the access to farm inputs and transportation of farm produce to the market, since mining does not contribute much to building and maintaining infrastructures in mining areas (Mkuzi *et al*., 2013). Ocansey (2013) reported that in Ghana, mining companies were able to develop rural communities by improving clinics, schools and other infrastructure such as building workshops for workers, and also provided farming assistant services to the communities. However, in areas where mining companies do not provide infrastructure to the local

communities, conflicts often occur. Drimie *et al*. (2009) reported that tensions in mining areas are mostly caused by the lack of infrastructure; mainly because mining companies often promise local people better and improved infrastructure before operations start. In Greater Tubatse Local Municipality, Dilokong chrome mine near Steelpoort shut down its operations in 2016 due to lack of better access to infrastructure (De Lange, 2016). The closing of the mines in such areas often happens because community members are angry that they are unable to afford basic needs even though there are mining activities in their area (Claasen *et al*., 2007). In Dilokong and Ga-Pila, Mathabata (2011) found that communities surrounding the mines were not hired by the mining companies and therefore, they were unable to build better houses, buy new cars, access better social services like clinics, schools, police stations and others. This implies that their physical capital was not better because of mines in their area. This is a concern because mining companies promise the local communities that they would improve their infrastructure (Mathabatha, 2011). However, they hardly fulfil their promises of development in areas they operate (Mkuzi *et al*., 2013; Moraka & van Rensburg, 2014; Ledwaba, 2017; Gardiner, 2017). On the other hand, Hilson (2002) argues that mining in Ghana made a difference unlike other African countries by providing local communities with improved infrastructure. This is an indication that mining companies have the potential to improve infrastructure in the areas they operate to change the economic status of the local communities.

2.4.3 Human capital

According to Boli (2005) and Ramezan (2011), human capital refers to “the ability of a human being to acquire certain skills, to gain knowledge and to perform labour”. It is therefore recommended that mining companies offer necessary education and skills training to the local communities (Ziervolgel & Taylor, 2008; Rafiei & Davari, 2015). Education and skills training are the most important investments to be made in an individual’s human capital (Becker, 1993; Moser, 1998). Providing people with education and skills training opportunities could improve their human capital, because human capital increases through work experience, formal education and competence development (Judge *et al*., 1995; Armstrong *et al*., 2011). The former president of the Republic of South Africa Mr. Nelson Mandela once said, “Education is the most powerful weapon which you can use to change the world” (Patterson, 2013). Becker (1993) argues that it is only through investing in

education that individuals and organizations may have returns on the investments. This return on investment may manifest itself in higher wages, when people find jobs in other companies besides mining. Hence, people from mining areas expect mines to provide educational programs that could improve their livelihoods (Meissner, 2015).

Most people from rural areas near mines have basic farming skills and they are interested in agriculture, but they are not well trained and lack necessary knowledge to utilize the available agricultural land for farming activities (Drimie *et al*., 2009). Even though not mandatory, this is where mining companies can intervene by providing training opportunities that could enable the communities to utilize their land for farming, since mining companies are unable to hire most of the people in the communities. However, due to lack of knowledge and farming skills, many people have sacrificed their agricultural land to mining activities (Behera, 2015). Communities are still living in poverty, they are neither educated nor working in the mining companies at Greater Sekhukhune District Municipality (Ziervogel & Taylor, 2014). This is not only a South African issue, in Sierra Leone communities were unhappy when mining companies failed to improve the standards of living for the local people by providing the necessary skills to enable them to be employed in the mines (Maconachie & Binns, 2007). This has also been the case in Tanzania where communities did not perceive mining as an economic contributor, they found it to be a curse as people became poorer, more unskilled and remained unemployed (Kitula, 2006).

2.4.4 Financial capital

Ellis (2000) defined financial capital as money and goods that are easily exchangeable for money, such as gold or livestock. This excludes money that an individual has earned. Access to financial capital makes it possible for people to get access to physical capital, which can be used to build better houses or buy cars. People can acquire credit or loans when their financial capital is stable (Rakodi 1999; Ungar, 2011). Claasen *et al.* (2005) mentioned that most people who live near chrome mines in Sekhukhune District Municipality were unemployed, which lead to low income levels and low standard of service delivery (RADAR, 2002). High unemployment in mining areas is not only a national challenge but also an international concern (Behera, 2015). Kitula (2006) found that in Tanzania there was

mutual benefit for both communities that live near mines and those that live where there are no mines through trade. Communities that live where there are no mines grow crops that find a market from people working in mines. This shows that mining in other countries benefit the local people, which should be the case in South Africa, where mining should interlink with agriculture. Lockie *et al*. (2009) noted that people get training and employment programs that facilitate skills for mining operations but it does not add to economic sustainability, because trained people are not promoted to senior posts.

Farell *et al*. (2012) reported that in Limpopo Province many people who live near mines were unemployed in the mines because they were not educated. Being uneducated provided limited opportunities, because their level of education is low. One of the reasons for high unemployment of local people that is used by mining companies is that in South Africa mining companies prefer to hire migrant labour over local labour because they believe that migrants are more skilled and accept lower wages (Peluso *et al.*, 2015). In Greater Tubatse Local Municipality it was found that the income of local people who live near mines has hardly improved because they were unemployed and depended mainly on social grants for a living (Ziervolgel & Taylor, 2008). According to Kitula (2006) and Behera (2015) this is a common global problem. As a result, people are forced to look for other sources of income because mines do not always provide them with employment opportunities as expected. Siebert *et al.* (2001) reported that majority of the people in Sekhukhune District Municipality had low education, depended on social grants and pension for a living. Therefore, their income level was low since social grants income is usually low. This has a negative impact on the livelihoods of the people who live near mines because they cannot access financial assistance such as loans or credits (Drimie, 2009). It is therefore unlikely for people who live near mines to invest or to save because they are uneducated, unemployed and depend on social grants for a living (Anderson *et al*., 2008).

2.4.5 Social capital

Campbell *et al*. (2007) defines social capital as “the community cohesion that results from positive aspects of community life, especially from high levels of 'civic engagement' as reflected in membership of local voluntary associations”. “Such membership is said to be

associated with the positive community norms of trust and reciprocity between community members and a positive local identity".

According to Cloete *et al*. (2007), people in less developed countries derive their economy from subsistence agriculture, whereby mineral extraction is one of the activities taking place to strengthen the economy. However, it is unfortunate that none of the economic factors provide adequate jobs to give satisfaction to community members. People who live near mines have expectations of improved standards of living with support from mining companies (Hilson, 2002). However, the unemployment rate keeps on rising in mining communities (Maconachie & Binns, 2007; Moraka & Van Rensburg, 2015). In addition, community members working in the mines lose jobs when mines close down or stop operating (Welker, 2009; Peluso *et al*., 2015; Van Heerden, 2016). The closure of mines puts communities in a devastating situation, because they cannot sustain their livelihoods and it becomes difficult for them to get employed outside the mining industry, since most mining skills are limited to mine operations only (Moraka & Van Rensburg, 2015), which makes it difficult for them to be employed in other sectors (Haman, 2004a). In addition, Peluso *et al.* (2015) found that when a mine closes down, the community becomes stranded and frustrated. Economic activities in the communities are negatively affected, because people who were employed in the mines lose their jobs (Welker, 2009). Furthermore, this poses a threat to social capital of people who live near mines.

According to South African National Roads Agency Limited (SANRAL) (2013), poverty mostly affect communities that reside near mines in Greater Sekhukhune District Municipality, coupled with serious inadequacy in skills and service delivery, which leads to high unemployment rate. Although it is an expectation that the social-capital of the communities near mines should improve, this is not always the case. In Greater Tubatse Local Municipality there are communities near mines who still live in poor conditions even though they are surrounded by mining companies (Chenga *et al*., 2006; Van Heerden, 2016), and because of that, the relationship between the municipality, the communities and mining companies is not good (The Local Government Handbook, 2013). This is a great concern since a better relationship between the local communities, the municipal government and the mining companies is vital for rural development engagement (Haman,

2004a). Better relations would also prevent conflicts that may occur between mining companies and the local communities in mining areas (Welker, 2009).

In addition, there is stress and trauma that people experience every time communities have to relocate from their ancestral areas where they have cultural memories. As mines continually emerge in rural areas, indigenous people keep on being resettled involuntarily from their fertile lands that are suitable for agricultural production. Relocation makes people lose their cultural roots and some of their belongings. This leads to lack of access to safe water and sanitation, which exposes them to epidemic diseases that are caused by unclean water and poor sanitation. As might be expected, the health impacts fall disproportionately on infants, young children, expecting mothers and elderly people (Downing, 2002). Furthermore, migration causes the formation of informal settlements in areas next to the mining activities. Service delivery becomes slow and informal settlers occupy the land that could be used for agriculture, which has consequences on sustainable local economic development (Anderson *et al*., 2008). Bench Mark Foundation (2016) reported that some communities are not consulted when changes or development opportunities arise in the mines and they are sometimes harassed for being inquisitive. This often results in conflicts between the mining companies and the local communities.

South African mining companies are referred to as corporal social responsibility and partnerships in terms of business case for a collaboration of all the stakeholders involved in mining, which make a good profit sense; however, stakeholders still have social problems (Natural Resource Forum, 2005). Haman and Kapelus (2004), argued in a study on the Corporate Social Responsibility (CSR) that mining in Southern Africa plays a vital role in communities surrounding mining activities. Mining companies have a potential to improve the livelihoods of communities surrounding mining activities through the provision of skilled and unskilled employment opportunities, infrastructures such as roads, schools and clinics (Ako, 2009). Some communities gain from mining but they remain dissatisfied, because the mines have damaged the environment. In addition, the dust from mining activities has a negative impact on the health of communities (Muntingh, 2011). Some mining companies operate for a certain period, but the excavated land is difficult to rehabilitate, and it becomes unsuitable for settlement and agriculture practices (Downing, 2002; Mathabatha, 2011).

Other risks on social capital are the loss of access to public services, high rate of food insecurity, lack of access to common properties, social disarticulation, and limited practice of civil and human rights (Kibreab, 2000). In Greater Tubatse Local Municipality the impact of mining on socio capital lead to young people dropping out of school before completing Grade 12, which is also common in many other mining areas (Downing, 2002). The author further noted that mining disrupts formal education because young people aspire to work underground in mines, which is usually for a short period of time.

Young people especially girls are more vulnerable to the negative impact caused by mine activities, because they end up having relationships with migrants and get children earlier than expected; as a result, they end up being infected with HIV/AIDS (RADAR, 2002). This discourages young girls from pursuing their educational aspirations. Migrant workers from rural areas in South Africa and other countries take advantage of unemployed women and girls by having intimate relationships with them in exchange for money (Cambel *et al., 2007*). As a result, mining communities are mostly affected by HIV/AIDS (Meeker, 2000; Basu *et al*., 2013); which has a negative impact on the productivity in the mining sector and it affects communities in the following ways:

- infected men are absent from work more frequently which affects their income;
- families become poor when men die early from HIV/AIDS infections;
- medical expenses increase;
- children stay away from school while wives are away from work to take care of the sick persons; and
- children become orphans while wives become widows.

Although mine activities have a negative impact on the social capital of communities near the mines, there are certain services that mining communities enjoy such as access to electricity, construction of good roads and other social and economic amenities (Mathabatha, 2011).

2.5 Summary of the chapter

The literature review presented in chapter 2 has shown that mines have contributed positively to the economy of South Africa since they started in the 19th century. Furthermore, mines have also contributed more to the GDP compared to agriculture in the country. However, job creation in the mining industry has declined in the millennium. The review of the socio-economic impact of mining activities on natural capital has found that people located next to the mines are exposed to respiratory diseases such as asbestosis, tuberculosis and others diseases because of air pollution caused by the mines. From physical capital perspective, the literature has discovered that most of the communities in mining areas do not have adequate housing, school, clinic and other infrastructure even though wealth is created from the mines in their area. The human capital, financial capital and social capital of communities surrounding the mines (located next to the mines) has also not improved because most people are unemployed, dot not have adequate housing and infrastructure, unskilled and trapped in poverty.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research approach and design, the area where the research was conducted, study population and sampling procedure, method of data collection and instruments used to collect data, data analysis methods and ethical consideration.

3.2 Research approach and design

The study used quantitative research approach. The research design that was adopted for the study was descriptive, or precisely survey design.

3.3 Study area

The study was conducted in five villages surrounding a chrome mine in the Greater Tubatse Local Municipality in the Sekhukhune District Municipality of Limpopo Province. The villages are Ga-Maroga, Mooihoek, Driekop, Motlolo and Ga-Selala. Greater Tubatse has about 31 wards and 210 villages. The large portion of the municipality is comprised of rural areas and about six townships in urban settings. The total population of the municipality was about 335 677 with 83 199 households about six years ago (STATS SA, 2011). The municipality is dominated by indigenous people who mostly practised subsistence farming and has several mines (STATS SA, 2011).

Figure 3.1: Map of Sekhukhune District Municipality depicting local municipalities

Source: (www.municipalities.co.za)

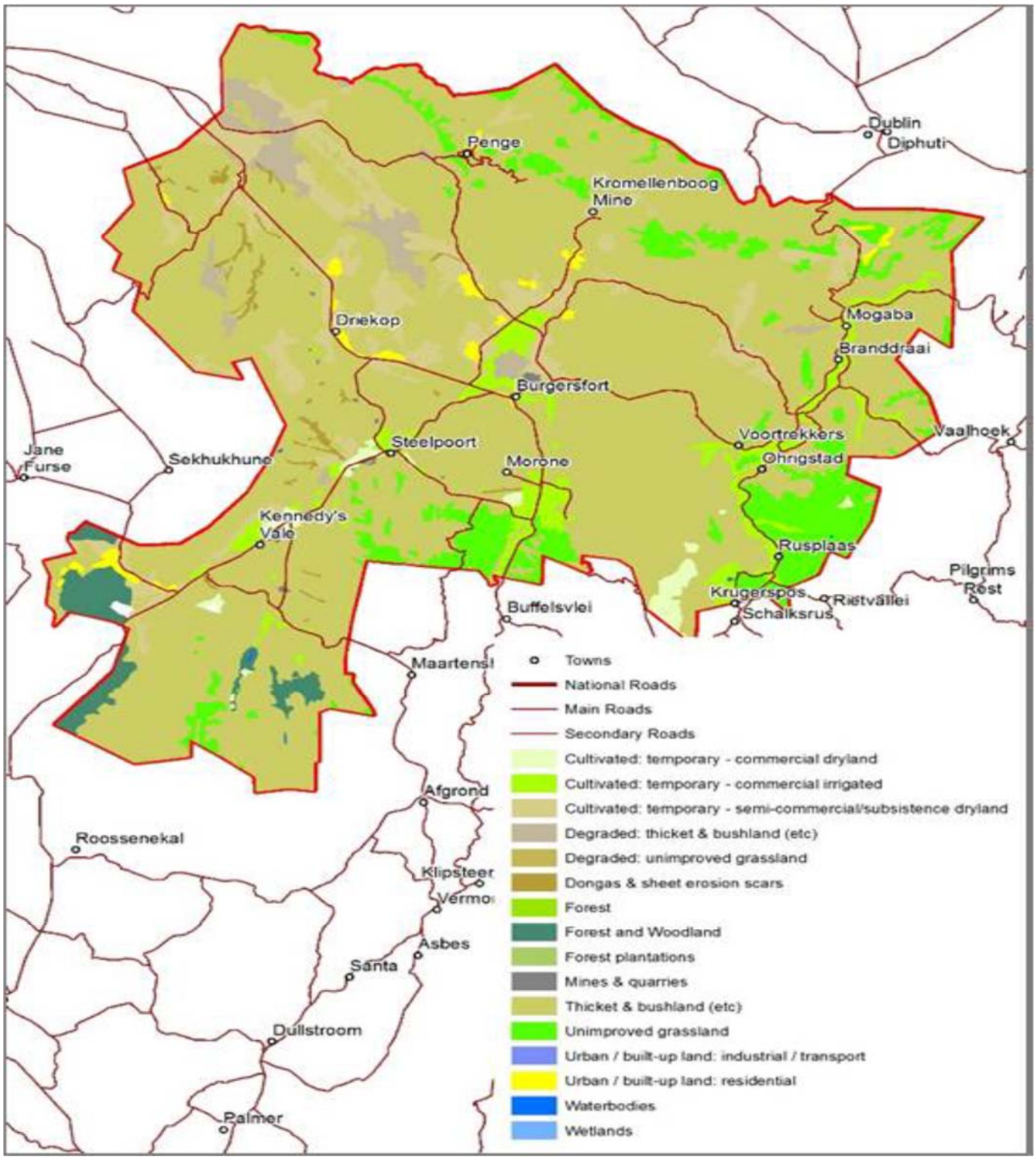

Figure 3.2: Map of Greater Tubatse Local Municipality

Source: http://www.citysolve.co.za/hda/files/pdf/greater-tubatse-local-municipality.pdf

Table 3.1: Name, area and languages spoken by majority of the people in the selected villages

Name of village	Area (km^2)	Language spoken by majority of the people and proportion (%)
Ga-Maroga	3.96	Sepedi (92.59)
Mooihoek	5.75	Sepedi (80.31)
Driekop	4.33	Sepedi (91.25)
Motlolo	4.17	Sepedi (96.59)
Ga-Selala	6.49	Sepedi (94.68)
Total	**19.51**	**91.08**

Source: Stats SA (2011).

3.4 Study population and sampling procedures

Five villages surrounding a chrome mine in Greater Tubatse Local Municipality were selected for inclusion in the study. The villages that were included in the study were Ga-Maroga, Mooihoek, Driekop, Motlolo and Ga-Selala. This is because they are geographically located next to the mines which occupies their agricultural land. The population size of all the six villages was 4 972 households (See **Table 3.1** for more information). The determination of the sample size was based on what The Research Advisors (2006) recommended that to achieve a lower margin error of 5%, a sample size (n) of 347 is recommended from a population (N) of 5 000. However, in the current study, the study population was 4 972 which is close to 5 000. As a result, a sample size of 347 was considered appropriate for the study based on the study population and the recommendations from The Research Advisors (2006). Stratified sampling was used to determine the number of participants from each village, which allowed the researcher to divide the entire population of the villages surrounding the mine into different subgroups. The sample size from different villages was calculated using the following formula adopted from Research Advisors (2006):

$Nj = Nj/N \times n$

Where nj is the sample size for stratum, n is total sample size, Nj is the population size for stratum j, N is the total population for all the selected villages. The application of the formula was as follows:

Ga- Maroga: $n_j = N_j/N \times n = 728/4\ 972 * 347 = 51$
Mooihoek: $n_j = N_j/N \times n = 1051/4\ 972 * 347 = 73$
Driekop: $n_j = N_j/N \times n = 1000/4\ 972 * 347 = 70$
Motlolo: $n_j = N_j/N \times n = 1056/4\ 972 * 347 = 74$
Selala: $n_j = N_j/N \times n = 1137/4\ 972 * 347 = 79$
Total 347

About 347 survey questionnaires were administered through face-to-face interviews and given the participants to complete. However, only 309 survey questionnaires were correctly and fully completed for capturing and analysis. **Table 3.1** below shows the distribution of the study population, target sample size and achieved sample size.

Table 3.2: The distribution of the study population, target sample size and achieved sample size

Name of village	Number of Households	Targeted sample size (n)	Achieved sample size (n)
Ga-Maroga	728	51	53
Mooihoek	1 051	73	75
Driekop	1 000	70	48
Motlolo	1 056	74	53
Ga-Selala	1 137	79	80
Total	**4 972**	**347**	**309**

Source: Stats SA (2011).

3.5 Data collection

A structured survey questionnaire was used for data collection. Survey questionnaires were distributed by the researcher and research assistants. Primary data were collected by interviewing the participants face-to-face and distributing the questionnaires for completion

by the respondents. Face-to-face interviews were used in the instances where the respondents could not read or write in English whereas the respondents who could read and write in English preferred to complete the questionnaires by themselves.

A pilot study was conducted involving 10 participants to determine the validity and reliability of the survey instrument used for data collection. The survey questionnaire was amended accordingly after the pilot study.

3.6 Data analysis

All quantitative data collected were captured in Microsoft Excel sheet and analysed using Statistical Package for Social Sciences (SPSS) version 24. Descriptive statistics was used to summarise and present the data in the form of frequency tables, graphs, percentages and charts. Descriptive statistics included percentage, frequency, mean, standard deviation, standard error of mean, mode, minimum and maximum. Data analysis methods used to achieve different objectives is presented in **Table 3.2** below:

Table 3.3: Data analysis methods used to achieve different objectives

Objective	Data analysis method
To profile the socio-demographic characteristics of the community members surrounding a chrome mine	Descriptive statistics
To determine the farmers' perceived impact of mining activities on agricultural production (crop and livestock production)	Descriptive statistics and Wilcoxon signed ranks test
To determine factors influencing the farmers' perceived impact of mining activities on agricultural production	Ordered Logistic Regression (OLR) model
To ascertain the socio-economic impact of mining activities on the local communities.	Descriptive statistics and Binomial test

The Ordered Logistic Regression (OLR) model

The impact of mining on agricultural production was categorized as 0=No impact; 1=Low impact; 2=High impact; 3=Very high impact. Ordered Logit Regression can predict a polychotomous ranked dependent variables as a function of explanatory variables that describe the characteristics of a unit, individual or economic agent (Gujarati & Porter, 2009). To determine the factors influencing the farmers' perceived impact of mining activities on agricultural production as "No impact", "Low impact", "High impact" or Very high impact". The following OLR model defined regression equation was used:

$$Y^*=X'\beta + \varepsilon \qquad (1)$$

Where *Y*,* the latent variable in equation (1), is not observable. What is observable is the polychotomous Y, defined by the following:

Y=O (No impact) if $Y^* \leq 0$,
=1 (Low impact) if $0<Y^* \leq \mu$,
=2 (High impact) if $\mu_1 < Y^* \leq \mu_2$,
=3 (Very high impact) if $\mu_2 < Y^* < \mu_3$

The μs are unknown parameters to be estimated with β. The ε in equation (1) is normally distributed across observations. With a constant mean and zero variance. The probabilities derived from equation (1) are:

Prob $(y=0 \mid x) = \phi(-x\beta)$,
Prob $(y=1 \mid x) = \phi(\mu_1 - x\beta) - \phi(-x\beta)$,
Prob $(y=2 \mid x) = \phi(\mu_2 - x\beta) - \phi(\mu_1 - x\beta)$,
Prob $(y=3 \mid x) = \phi(\mu_3 - x\beta) - \phi(\mu_2 - x\beta)$,

Marginal effects show the change in probability of being a certain category when the explanatory variable increases by one unit. They are approximations of how much the dependent variable is expected to increase or decrease for a unit change in an explanatory variable. For continuous variables this represents the instantaneous change given for a unit increase and for dichotomous variables, the change is from zero to one. The marginal effects

of the regressors (Xs) on the probabilities are not equal to the coefficients. For the four probabilities, the marginal effects of changes in the explanatory variables are:

$$\delta \frac{Prob(y= 0 \mid x)}{\delta x} = - \phi (x \beta) \beta$$

$$\delta \frac{Prob(y= 1 \mid x)}{\delta x} = [\phi (-x \beta) - \phi (\mu - x \beta)] \beta,$$

$$\delta \frac{Prob(y=2 \mid x)}{\delta x} = \phi (\mu - x \beta) \beta$$

$$\delta \frac{Prob(y= 3 \mid x)}{\delta x} = \phi (\mu - x \beta) \beta.$$

The base group is the "no impact" category. The higher categories are "Low impact", "High impact" and "Very high impact".

The above Ordered Regression Logit will be estimated as follows:

$$Y = f(x_1, x_2, x_3, x_4, x_5, x_6, x_7, - x_8 \ldots . \mu) \ldots \ldots . (xx)$$

Table 3.4: The dependant and independent variables used in OLR model

Dependent variable	**Variable description and value**
Y=Mining impact on agricultural production	0=No impact; 1=Low impact; 2=High impact; 3=Very high impact
Independent variables	
X_1 = Gender	Male=1, Female=0
X_2 = Age of participant	1=18 – 30; 2=31 – 50; 3=51 – 70; 70 and above
X_3 = Level of education	1=Never been to school 2=No formal Education, 3=Primary Education; 4=Secondary Education; 5=College Education; 6=University Education; 7=Other (Specify)
X4 = Plot size	Ha

X5 = Practicing agriculture	0=No; 1=Yes
X6 = Allocated agricultural plot	0=No; 1=Yes
X7 = Lost land for mining activities	0=No; 1=Yes
X8 = Farming experience	Years
X9 = Main source of income	0 = Non-farming activities; 1 = Farming
X10 = Number of livestock decreased	0=No; 1=Yes
X11 = Crop production decreased	0=No; 1=Yes

The Wilcoxon Signed Ranks test

The Wilcoxon signed ranks test was used to determine the impact of the mines on livestock and crop production as perceived by the farmers before and after mining operations started in the study area. The Wilcoxon signed ranks test is a nonparametric test that compares the mean of two related samples or groups. The test compares the difference between the data collected before and after. Each participant was analysed using the score before and after mining operations started. Significant difference was determined at 5% alpha level ($p<0.05$).

Description of Binomial test

The binomial test was used to determine the impact of mining on socio-economic aspects in the study area, by comparing frequencies of the two categories of a dichotomous variable to the frequencies that are expected under a binomial distribution with a specified probability parameter. Statistically, the binomial test is an exact test of the statistical significance of deviations from a theoretically expected distribution of observations into two categories (Slow *et al*., 2014). In the section of the impact of mining on socio-economic aspects of the communities, tables were used to give the significance observation. Significant difference in this case was determined at 5% alpha level ($p<0.05$).

3.7 Ethics

The researcher obtained permission or ethics clearance for the study from the College of Agriculture and Environmental Sciences (CAES) Ethics Committee before data collection. The Ethics reference number is 2016/CAES/116. The Ethics clearance from CAES Ethics Committee was used to apply for permission from commmunity leaders. The participants were required to sign consent form before partaking in the study. Their participation was voluntary and they were allowed to freely withdraw at any time. The researcher abided by

the ethical principles by minimizing the risk and harm of the participants, protecting confidentiality and anonymity, providing the right to withdraw from the study, and avoiding deceptive practice.

3.8 Summary of the chapter

In this chapter, it was shown that quantitative research approach and descriptive research design were adopted to conduct the study. About 309 community members from six villages surrounding a chrome mine participated in the study through face-to-face interviews. Data collection commenced after acquiring ethical clearance from College of Agriculture and Environmental Sciences (CAES) Ethics Committee. SPSS version 24 was used to analyse data whereby descriptive and inferential statistics formed part of the analysis.

CHAPTER 4: RESULTS AND DISCUSSIONS

4.1 Introduction

The chapter presents the results of the study and discussions of the results. The results section is divided into four subsections namely socio-demographic information of the respondents, the farmers' perceived impact of mining activities on agriculture, factors influencing the farmers' perceived impact of mining activities on agriculture, and the socio-economic impact of mining in the surrounding communities. In the last section, the results of the study are discussed in detail.

4.2 Socio-demographic information of the respondents

4.2.1 Demographic information of the respondents

Demographic characteristics such as gender, race, age group, home language, marital status and level of education were included in the study. **Table 4.1** presents demographic information of the respondents.

Table 4.1: Demographic information of the respondents (n=309)

Variable	Frequency	Percent
Gender		
Male	157	50.8
Female	152	49.2
Total	***309***	***100***
Home Language		
Sepedi	302	97.8
Siswati	4	1.3
Tshivenda	1	0.3
English	1	0.3
Other	1	0.3
Total	***309***	***100***

Age group		
18 – 30	209	66.2
31 – 50	90	29.3
51– 70	13	4.2
Above 70	1	0.3
Total	**309**	**100**
Marital Status		
Single	236	76.4
Married	65	21.1
Widowed	4	1.3
Divorced	2	0.6
Other	2	0.6
Total	***309***	***100.0***
Level of Education		
Secondary education	218	70.6
College	38	12.3
Primary	18	5.8
No formal education	15	4.9
University	14	4.5
Never been to school	6	1.9
Total	***309***	***100.0***

Source: survey data (2017)

The results in **Table 4.1** show that majority (50.8%) of the respondents were males, which was contrary to the notion that there are more females than males in rural areas. This was not surprising because unemployment rate is high in South Africa. Being a rural area, Greater Tubatse Local Municipality is no exception. Regarding home language, majority of the respondents (97.7%) were Sepedi speaking people, and the remaining spoke Siswati, Tshivenda, English and other languages. The Pedi speaking people have occupied Sekhukhune region for the past two centuries. Most of the people who spoke other languages were not originally from the villages surrounding Dilokong mine, they came looking for job opportunities and/or worked in the mines.

Regarding age group distribution **Table 4.1** shows that most respondents (66.3%) in the study area were within the age group of 18-30, which was not surprising because Sekhukhune area is dominated by young people who have completed secondary education but unemployed with the anticipation of finding job opportunities in the mines. Less than 5% of the respondents were above 50 years old.

The marital status of the respondents shown in **Table 4.1** indicated that majority (76.4%) of the respondents were single people because youth participation was high in the study area. Less than 25% of the respondents were married, since minority of old people participated in the study. The divorce rate of the respondents was at 0.6% because young people were not yet married and the number of married people was smaller than those who were single. The widowed respondents were at 1.3% and others at 0.6%, which could be those who stayed with their partners but not married.

Most of the respondents (70.6%) have attained secondary education, 17% attained tertiary education (College and University), while 4.9% and 1.9% of the respondents had no formal education or never attended school, respectively. These results showed that most of the respondents had the potential to further their studies because they had completed secondary education. However, the challenge was that there were very few institutions of higher learning in the study area.

4.2.2 Socio-economic information of the respondents

Socio-economic information of the respondents was included in the study. This showed the number of years the respondents were involved in agriculture, the main sources of income, family size, plot size and the area allocated for farming. **Table 4.2** presents some of the socio-economic information of the respondents.

Table 4.2: Socio-economic information of the respondents (n=309)

Item	Years involved in Agriculture	Plot size	Family size
Mean	16.68	4.10	6.74
Std. Error of Mean	0.67	0.18	0.19
Mode	0	6.0	5
Std. Deviation	11.72	3.19	3.33
Minimum	0	0	2
Maximum	60	10.00	26

Source: Survey data (2017)

The results in **Table 4.2** show that the minimum and the maximum number of years that the respondents were involved in agriculture was zero (0) and sixty (60), respectively, with an average of 16.7 years. The respondents who had 0 years farming experience inherited plots from their families but they never cultivated them. The variation of the number of years in which the respondents were involved in agriculture was high as shown by the standard deviation of 11.72, and a low (0.67) standard error of mean was recorded.

The average plot size of the respondents was 4.10 ha which ranged between zero (0) and 10 ha. The respondents with 0 ha plot size lost their land to the mines or they were never allocated farming plots. The result also show that households were not allocated the same size of plots.

The range for family size of the respondents was two (2) and twenty-six (26) with a mean of 6.7 family members. The standard deviation for plot size and family size was 3.19 and 3.33, respectively, which showed that the variation was low for both variables. A low standard error of mean was achieved for both plot size (0.18) and family size (0.19).

The plot sizes were also grouped in different categories ranging from 0 to 10.5 ha. **Figure 4.1** represents plot size categories of the respondents.

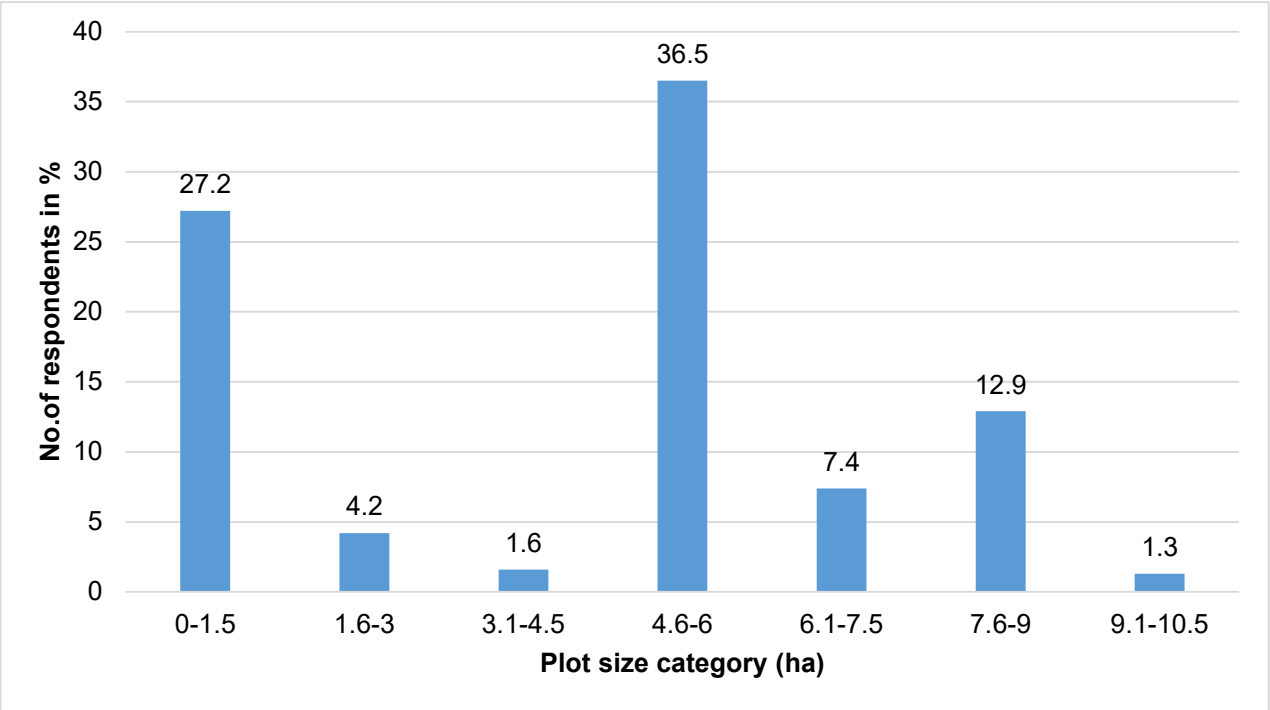

Figure 4.1: Plot size categories of the respondents (n=309); (Source: survey data 2017)

Figure 4.1 indicates that most (58.1%) of the respondents had plot sizes between 4.6 ha and 10.5 ha. However, only a few (1.3%) of the plots were above 9 ha in size. About 36.5% of the respondents were allocated plot size between 4.6 and 6 ha. About one third (33%) of the respondents were allocated plot size of ≤ 4.5 ha.

Figure 4.2 present the family size categories of the respondents.

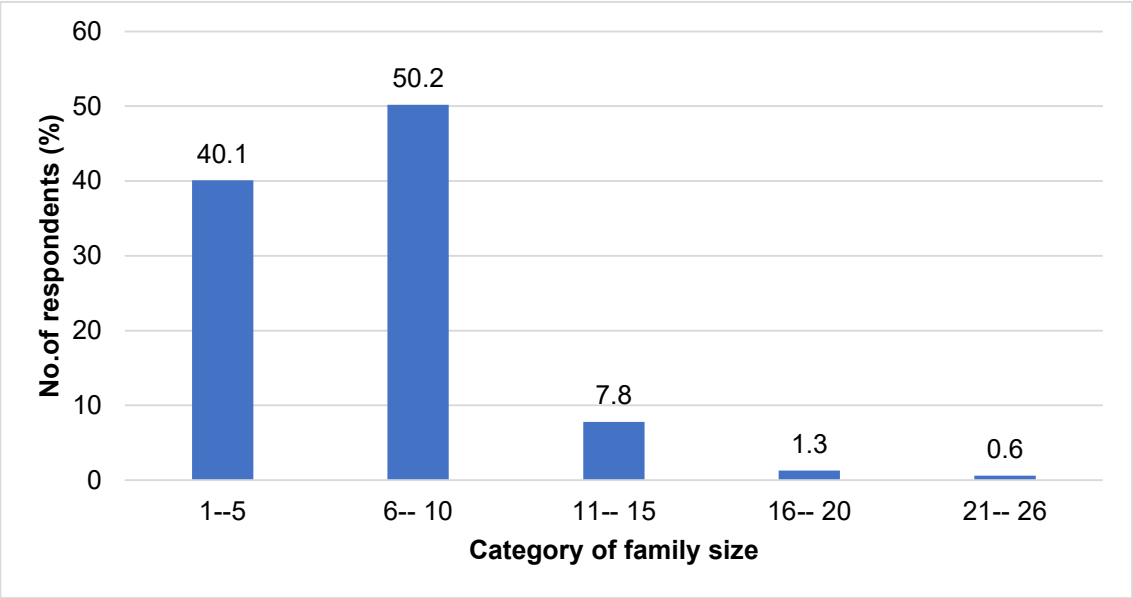

Figure 4.2: Family size categories of the respondents (n=309) (Source: survey data, 2017)

In terms of family size, **Figure 4.2** depicts that most (50.2%) of the respondents had family size of between six (6) and ten (10) people staying in one household. The second largest family size category was 1–5 as indicated by 40.1% of the respondents. Only 1.9% of the respondents had family size above ≥ 16 people.

Figure 4.3 represent main sources of income for the respondents.

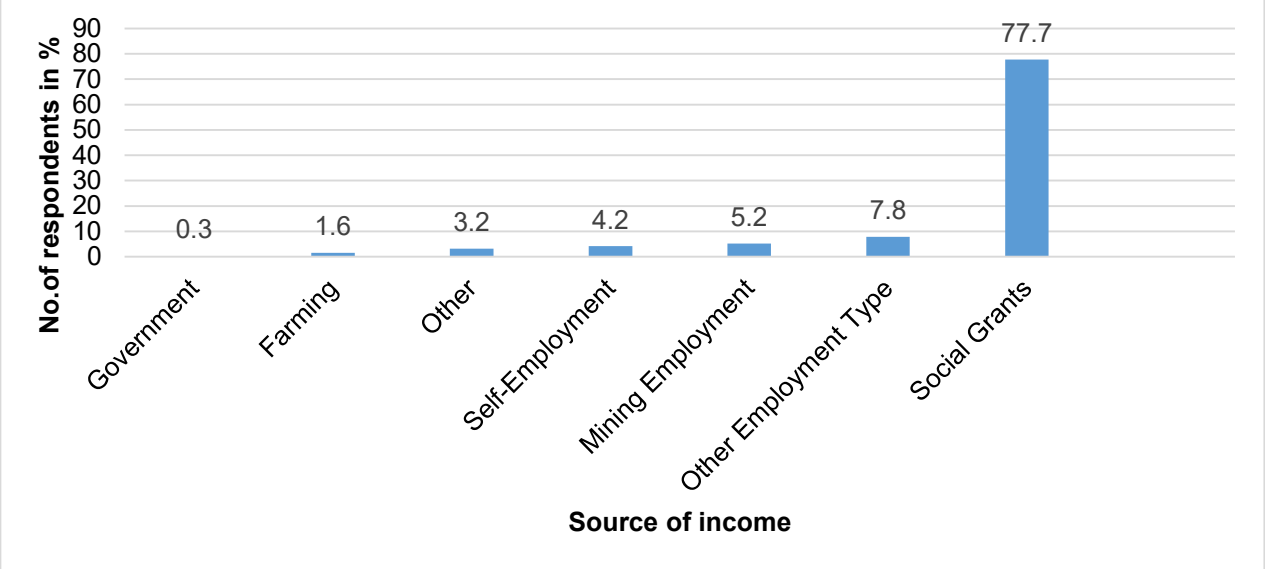

Figure 4.3: Sources of income of the respondents (n=309) (Source: Survey data, 2017)

Figure 4.3 indicates that more than two third (77.7%) of the respondents were dependant on government social grants (pensioners, disable people and orphans) as the main source of income. It is a worrying situation as only 5.2% of the respondents were earning incomes from the mines compared to 7.8% of other employment opportunities. Government employment was the main source of income for only 0.3% of the respondents that was the lowest after farming (1.6%).

4.3 Impact of mining activities on land access and agriculture

The variables of the impact of mining activities on agriculture in the study area included access to land utilisation, farming typology, and livestock and crop production. The outcomes from the respondents are presented in section 4.3.1 to 4.3.2.

4.3.1 Land utilisation and farming typology

This section includes the proportion of the land used for agricultural purposes in the villages surrounding Chrome mine and farming typology. See, **Table 4.3** shows the proportion of the land used or lost to agriculture in the study area.

Table 4.3: Proportion of the plots used, and a portion of agricultural lost by farming in the study area (n=309)

Variable	Frequency	Percent
Plots currently used for faming		
Yes	217	70.2
No	92	29.8
Total	***309***	***100***
Lost portion of agricultural land		
Yes	286	92.6
No	23	7.4
Total	***309***	***100***

Source: Survey data (2017)

Table 4.3 shows that most of the respondents (70.2%) utilised their plots for farming purposes. Only 29.8% of the respondents indicated that they were not using their plots for

farming. The results show that despite the mining activities in the villages surrounding the chrome mine, most of the people cultivated their plots. However, respondents whose land was located next to the mine could not practice farming because of the risks associated with the mining activities. Regarding land access, majority of the respondents (92.6%) indicated that they lost a portion agricultural land to the mine operations. This meant that communities had less access to agricultural land than in the past; therefore, the impact of mining activities on agriculture was negative.

Figure 4.4 present farming typology of the respondents.

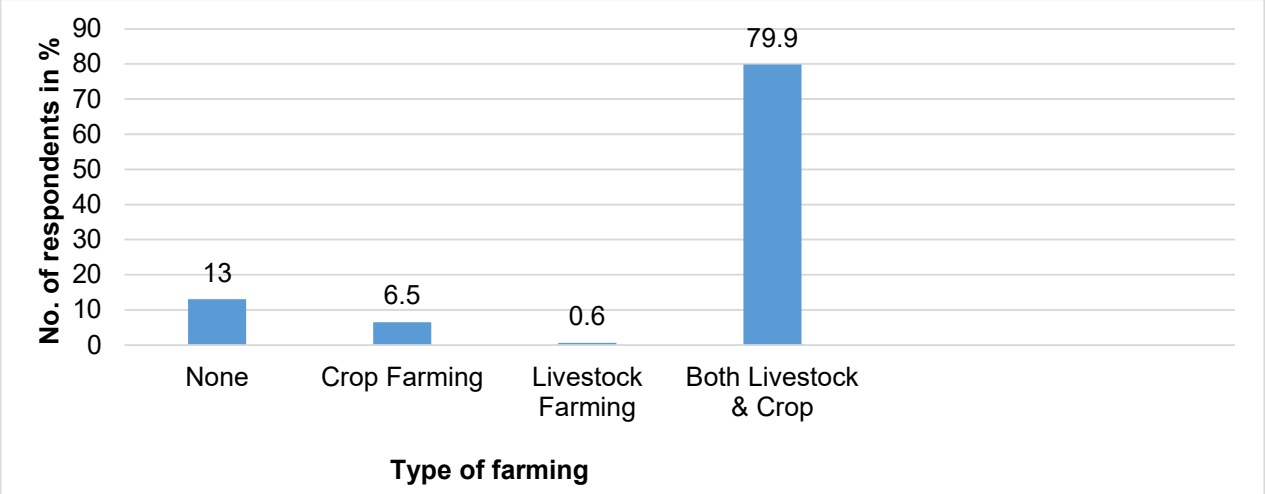

Figure 4.4: Farming typology of the respondents (n=309). Source: Survey data (2017).

Figure 4.4 shows that most (79.9%) of the respondents in the study area farmed both livestock and crops. This showed that mixed farming was popular in the areas surrounding the chrome mine. Few respondents (6.5%) practised crop farming only, with livestock being the lowest at 0.6%. However, 13% of the respondents did not utilise their land for farming purposes.

4.3.2 Livestock and crop production

This section includes the status of livestock and crop production of the respondents. The types of livestock found in the study were cattle, goats, sheep, poultry, donkeys and pigs, while crop types included were maize, groundnuts, pumpkins, butternuts, dry beans, green

beans, soya beans and sorghum. The respondents were asked whether livestock production had decreased or increased because of mining activities in the area.

Table 4.4 presents the result of the number of respondents who kept different livestock before and after mining activities and Wilcoxon signed ranks test.

Table 4.4: The number of respondents who kept livestock before and after mining activities and Wilcoxon signed ranks test (n=309)

Type of livestock kept	No percentage (%)		Yes percentage (%)		Mean		Level of Significance (Wilcoxon signed ranks test)
	Before	After	Before	After	Before	After	
Cattle	46.0	47.9	54.0	52.1	0.54	0.52	0.273
Goats	46.0	46.6	54.0	53.4	0.54	0.53	0.777
Sheep	70.9	74.1	29.1	25.9	0.29	0.26	0.114
Pigs	83.8	87.7	16.2	12.3	0.16	0.12	0.064
Poultry	63.8	67.6	36.2	32.4	0.36	0.32	0.102
Donkeys	68.0	57.6	32.0	42.4	0.32	0.42	0.000
Average	**63.1**	**63.6**	**36.9**	**36.4**	**0.4**	**0.36**	**0.222**

Source: Survey data (2017)

Table 4.4 shows that the number of respondents who kept livestock decreased after mining activities started in the area. The reduction was also supported by a decrease in the mean score of the crops. However, the change was only statistically significant (Sig. = 0.000) for donkeys. This implied that mining activities did not have significant negative impact on the production of cattle, goats, sheep, pigs and poultry. The negative impact of mining operations was only evident in donkey production. Overall, the selected chrome mine that participated in the study did not have a negative impact on livestock because the average statistical significance was 0.222.

The result of the number of respondents who cultivated different crops before and after mining activities and Wilcoxon signed ranks test are presented in **Table 4.5.**

Table 4.5: The number of respondents who cultivated different crop types before and after mining activities and Wilcoxon signed ranks test (n=309)

Type of crop cultivated	No percentage (%)		Yes percentage (%)		Mean		Level of Significance (Wilcoxon signed ranks test)
	Before	After	Before	After	Before	After	
Maize	27.2	28.8	72.8	71.2	0.73	0.71	0.369
Groundnuts	39.2	44.7	60.8	55.3	0.61	0.55	0.004
Pumpkins	65.0	65.0	35.0	35.0	0.35	0.35	1.000
Butternuts	66.0	68.9	34.0	31.1	0.34	0.31	0.139
Sorghum	86.7	87.1	13.3	12.9	0.13	0.13	0.835
Soya beans	78.0	80.6	22.0	19.4	0.22	0.19	0.117
Dry beans	68.0	70.2	32.0	29.8	0.32	0.30	0.194
Green beans	72.2	70.9	27.8	29.1	0.28	0.29	0.555
Average	**62.8**	**64.5**	**37.2**	**35.5**	**0.40**	**0.40**	**0.402**

Source: Survey data (2017)

The number of respondents who cultivated crops decreased by less than 6% after mining activities started in the study area as shown in **Table 4.5**. The reduction was also supported by change (increase and decrease) in the mean of all the crops. However, the change was only statistically significant (Sig. = 0.004) for groundnuts. This implied that mining activities did not have significant negative impact on the production of maize, butternuts, dry beans, soya beans, pumpkins and sorghum. The negative impact of mining operations was only evident in groundnut production. Overall, the selected chrome mine that participated in the study did not have a negative impact on crop production because the average statistical significance was 0.402.

4.4 Factors influencing the impact of mining activities on agriculture

This section is about the impact of mining activities on agricultural production. The focus was on the factors influencing the perceptions of the respondents on the impact of mining activities on agriculture. **Table 4.6** shows model fitting information of the results of Ordered Logistic Regression (OLR) model.

Table 4.6: Model fitting information (n=309)

Model	-2 Log likelihood	Chi-Square	Df	Sig.
Intercept only	260.553			
Final	185.681	74.872	11	0.000

Source: Field data (2017)

Table 4.6 shows that the p-value is statistically significant because it is 0.000. This means that the model can be used to predict the threshold because it is statistically significant.

Table 4.7 presents the results of the Goodness-of-Fit (Pearson and Deviance).

Table 4.7: Goodness-of-Fit for Pearson and Deviance (n=309)

	Chi-Square	Df	Sig.
Pearson	640.814	886	1.000
Deviance	185.658	886	1.000

Source: Field data (2017)

The Pearson chi-square statistics had a p-value of 1.000 from the significant level column, for that reason it was not statistically significant as shown in **Table 4.7**. That means the model used was appropriate for the data. A p-value of 1.000 was achieved for Deviance chi-square statistics, which means it was also not statistically significant at 5% confidence interval. Therefore, the results of both goodness-of-fit measures presented in **Table 4.7** may not produce the same results constantly.

The results of Pseudo R-Square are presented in **Table 4.8**.

Table 4.8: Pseudo R-Square (n=309)

Cox and Snell	0.215
Nagelkerke	0.378
McFadden	0.287

Source: field data (2017)

The results presented in **Table 4.8** indicate three (3) pseudo R-squared values. The results show that the equivalence on logistic regression to the R-squared values in OLS regression was not there. However, because the analysis of Pseudo R-square is of less importance, the values of R-squared have a different meaning from what OLS regression means.

Table 4.9 presents the results of the parameter estimates of the Ordered Logistic Regression (OLR) model of the factors influencing the respondents' perceived impact of mining activities on agricultural production.

Table 4.9: Parameter estimates of the Ordered Logistic Regression (OLR) model (n=309)

		Estimate	Std. Error	Wald	Df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	No Impact = 0	-5.557	1.957	8.061	1	0.005	-9.393	-1.721
	Low impact = 1	-4.593	1.919	5.729	1	0.017	-8.354	-0.832
	High Impact = 2	-3.651	1.897	3.704	1	0.054	-7.369	0.067
Location	Gender	0.751	0.528	2.025	1	0.155	-0.283	1.785
	Age	-0.089	0.024	14.133	1	0.000	-0.136	-0.043
	Family size	-0.145	0.066	4.787	1	0.029	-0.274	-0.015
	Level of education	0.049	0.279	0.030	1	0.862	-0.498	0.595
	Plot allocation	-1.881	0.753	6.242	1	0.012	-3.357	-0.405
	Practicing agriculture	1.310	0.744	3.101	1	0.078	-0.148	2.767
	No. of years involved in agriculture	0.104	0.031	11.593	1	0.001	0.044	0.164
	Type of farming	0.483	0.279	2.993	1	0.084	-0.064	1.030
	Lost land for mining activities	-0.632	0.638	0.983	1	0.321	-1.882	0.618
	Number of livestock decreased	0.813	0.547	2.209	1	0.137	-0.259	1.886
	Crop production increased	0.763	0.589	1.677		0.195	-0.918	0.392

Source: Field data (2017)

The results in **Table 4.9** show that out of 11 variables, seven (7) of them (Gender, level of education, practicing agriculture, number of years involved in agriculture, type of farming, increase in crop production and decrease in the number of livestock) had a positive influence on the respondents' perceived impact of mining activities on agriculture. However, only one variable among the seven was statistically significant at 1% level of significance ($p<0.01$). Increase in the number of years in farming among the respondents increased their higher impact perception of mining activities on agricultural production with other factors remaining constant. This implied that more experienced farmers thought that mining activities had higher impact on agricultural production.

Age, family size, plot allocation and losing land to mining had a negative influence on the impact of mining activities on agriculture as shown in **Table 4.9**. However, only age, family size and plot allocation were statistically significant at 5% level of significance ($p<0.05$). On the other hand, age was also statistically significant at 1% level of significance ($p<0.01$). The results meant that age of the respondents had a negative ($\beta= -0.089$) and statistically significant (sig 0.000) effect on the respondents' perceived impact of mining activities on agriculture. It implied that the impact of mining activities on agriculture decreased with increase in the age of the respondents, with all other factors being constant. The result of family size showed that an increase in family size decreased the respondents' perceived impact of mining activities on agriculture, because it was negative $\beta= -0.145$ and statistically significant at $p=0.029$. With regards to plot allocation (having agricultural plot), it decreases the respondents' perceived impact of mining activities on agriculture because it was negative at $\beta= -1.881$ and statistically significant ($p= 0.012$).

4.5 Socio-economic impact of mining activities

The socio-economic impact of mining activities in the areas surrounding the mines are presented in this section. The socio-economic factors included are natural capital, physical capital, human capital, financial capital and social capital.

4.5.1 Impact on natural capital

This section presents the results of the impact of mining activities on natural capital of the communities surrounding the mines in Greater Tubatse Local Municipality. The variables include the impact on access to water, access to land, air and water quality and others.

Table 4.10 presents the farmers' perceived impact of mining activities on natural capital in the study area.

Table 4.10: The respondents' impact of mining activities on natural capital (n=309)

Natural capital variable	Proportion of responses (%)		Mean	Level of significance (Binomial test)
	No	Yes		
Insufficient land for grazing	3.9	96.1	0.96	0.000
Dissatisfied with air quality	25.6	74.4	0.74	0.000
Poor water quality	3.6	96.4	0.96	0.000
Reduced number of trees	3.9	96.1	0.96	0.000
Reduced water availability	1.6	98.4	0.98	0.000
Poor air quality	2.3	97.7	0.98	0.000
Caused respiratory diseases	1.9	98.1	0.98	0.000
Average	**6.1**	**93.9**	**0.94**	**0.000**

Source: Field data (2017)

In terms of natural capital, **Table 4.10** shows that on average most of the respondents (93.9%) perceived the overall impact of mining on natural capital as negative. The impact was statistically significant (0.000) in all the natural capital variables presented in **Table 4.10**, and the average mean from binomial test analysis of all the variables was 0.94, which implied that the majority agreed with the questions since 0 was No and 1 was Yes in the questionnaire. It implied that the majority were dissatisfied with insufficient land availability for grazing, water access and quality, the number of trees, water availability, air quality and exposure to respiratory diseases because of mining activities in the area. Concerning water, it implied that mines polluted the water and people were forced to share water that was meant for agricultural production and home consumption with the mines. On the other hand,

reduced number of trees and inadequate land for grazing affected livestock production negatively. The quality of air was also perceived as a concern people were exposed to respiratory diseases. It was an indication that mines have a negative impact on natural resources since mines adversely affected environmental factors that are required to sustain agricultural production and human life.

4.5.2 Impact on physical capital

Table 4.11 presents the respondents' impact of mining activities on their physical capital. The variables included whether or not respondents acquired housing, infrastructure, cars, furniture and boreholes.

Table 4.11: The respondents' impact of mining activities on their physical capital (n=309)

Physical capital variable	Proportion of responses (%)		Mean	Level of significance (Binomial test)
	No	Yes		
Received housing from mining company	96.1	3.9	0.04	0.000
Acquired infrastructure	97.4	2.6	0.03	0.000
Built a new house	97.4	2.6	0.03	0.000
Bought a new car	97.7	2.3	0.02	0.000
Bought furniture	97.4	2.6	0.03	0.000
Drilled a borehole	97.4	2.6	0.03	0.000
Other assets	97.7	2.3	0.02	0.000
Average	**97.3**	**2.7**	**0.03**	**0.000**

Source: Field data (2017)

Table 4.11 above shows that in the respondents' opinion, their physical capital did not improve because of the mining activities in the study area, because 97.3% of the respondents gave negative answers to the variables considered. The impact was statistically significant (0.000) in all the physical capital variables presented in Table 4.11, which implied that mines did not enable the respondents to acquire physical capital. The low average means scores of all variables (0.03), implied that most respondents disagreed with

the questions by selecting 0 or No in the questionnaire. The findings meant that the overall impact of mining activities on physical capital was insignificant on all the variables that constitute physical capital. Therefore, mining activities did not help the communities to acquire more assets to improve their livelihoods.

4.5. 3 Impact on human capital

This section presents the results of the respondents' perceived impact of mining activities on human capital of the communities in the mining areas. The variables included in this section were the provision of skills on financial management, computing, farm management and marketing, these skills were chosen for their need in farming business.

Table 4.12: The respondents' perceived impact of mining activities on their human capital (n=309)

Human capital variable	Proportion of responses (%)		Mean	Level of significance (Binomial test)
	No	Yes		
Financial management	38.5	61.5	0.61	0.000
Computer skills	34.6	65.4	0.65	0.000
Farm management	48.2	51.8	0.52	0.000
Marketing skills	78.6	21.4	0.21	0.000
Farming skills	35.9	64.1	0.64	0.000
Average	**47.2**	**52.8**	**0.53**	**0.000**

Source: Field data (2017)

The respondents believed that mining activities in the area had a positive impact on human capital; that was statistically significant (0.000), as shown in **Table 4.12**. On average, the majority (52.8%) of the respondents mentioned that they have acquired skills such as financial management, computing, farm management and farming from the mines, which gave an average mean score of 0.53 for all the human capital variables. These findings show that the mining companies assisted the communities with the necessary skills that could help them to access employment in other sectors of the economy.

4.5.4 Impact on financial capital

Table 4.13 presents the respondents' impact of mining activities on their financial capital. The financial capital included family members who were previously or currently working in the mines, received compensation for resettlement, or had access to credit and other variables.

Table 4.13: The respondents' impact of mining activities on their financial capital (n=309)

Financial capital variable	Proportion of responses (%)		Mean	Level of significance (Binomial test)
	No	Yes		
Family member previously worked in the mines	77.0	26.0	0.23	0.000
Family member currently working in the mines	86.1	13.9	0.14	0.000
Income improved	96.4	3.6	0.04	0.000
Acquired a job because of mines	93.2	6.8	0.07	0.000
Access to credit	96.1	3.9	0.04	0.000
Linkage to financial institutions	96.1	3.9	0.04	0.000
Received financial support from mines	96.8	3.2	0.03	0.000
Average	**91.7**	**8.8**	**0.08**	**0.000**

Source: Field data (2017)

The results in **Table 4.13** show that most (91.7%) of the respondents thought that mining activities had no positive impact on their financial capital through access to credit, financial support from the mines, linkage to financial institutions, job acquisition in the mine and employment of family members. This was statistically significant (0.000), and the average mean of all variables was 0.08. It means that mining activities had insignificant impact on financial capital of the local communities. It indicated that the mines did not provide adequate job opportunities for the local communities.

4.5.5 Impact on social capital

The perception of the respondents of the impact of mining activities on their social capital is shown in **Table 4.14**. The variables considered were the standard of living, established network, better relationship with stakeholders, better access to food and education, and others.

Table 4.14: The respondents' impact of mining activities on their social capital (n=309)

Socio capital variable	Proportion of responses (%)		Mean	Level of significance (Binomial test)
	No	Yes		
Standard of living improved	92.2	7.8	0.08	0.000
Established network	90.0	10.0	0.10	0.000
Have better relationship with stakeholder	96.8	3.2	0.03	0.000
Better access to food	96.4	3.6	0.04	0.000
Better access to education	97.1	2.9	0.03	0.000
Mine encourages youth participation in agriculture	99.0	1.0	0.01	0.000
Average	**95.3**	**4.8**	**0.05**	**0.000**

Source: Field data (2017)

Most (95.3%) of the respondents believed that mining activities had insignificant impact on their social capital as shown in **Table 4.14**. The respondents indicated that their standards of living have not improved, they were unable to establish networks to form better relationships with stakeholders; and neither did they have better access to food and education since mining operations started in their area. The negative impact was statistically significant (0.000) in all the social capital variables, and the average mean of all the variables was 0.05; which implied that most respondents disagreed with the questions by responding with 0 or No in the questionnaire.

4.6 Discussions

4.6.1 Demographic Information of the respondents

The socio-demographic information indicated that majority (50.8%) of the respondents were males, may be due to high unemployment rate in South Africa as a whole, and in the rural areas near mines in particular. Because more males than females are looking for employment opportunities in the mines. Peluso *et al.* (2015) found that there was high unemployment in communities near the mines in South Africa.

Most (97.7%) of the respondents near the mines spoke Sepedi (Northern Sotho), which is the dominant group in Sekhukhune District Municipality, and those who spoke Siswati and Tshivenda were in the minority. These findings agreed with the results of the last census done in 2011 (Stats SA, 2011), which reported that the dominant language group in Sekhukhune District Municipality was Sepedi and the minority made up the remaining 4.38% of the population. The Pedi have lived in Sekhukhune District Municipality for over two centuries, while the minority groups were recent migrants to the area in search for employment opportunities in the mines. The fact that there were migrants in the study areas was not new in mining industries the South Africa, it has been reported that mining companies prefer to hire migrant workers more than the local people (Bollinger & Stover, 1999; Coovadia *et al*., 2009; Bench Mark Foundation, 2016).

Majority (66.3%) of the respondents in the study area were young people between the age of 18 and 30 years. This was consistent with the findings of Drimie *et al*. (2009), who reported that young people who have completed secondary education dominate Sekhukhune area where the current study was conducted. However, although most of the young people were unemployed and without having completed formal education, they still hoped to find jobs in the mines.

Single people were the majority (76.4%) among the respondents, mostly because more young people participated in the current study. Less than 25% of the respondents were married, since fewer old people participated in the study. The divorce rate of the respondents was low (0.6%) for the same reason that young people were not married. The widowed

respondents were at 1.3% and others at 0.6%, which could be those who lived with partners but they were not married. These results were anticipated since Statistics South Africa reported that the majority (69.0%) of the people in Greater Tubatse Local Municipality never got married, which implied low divorce and widowed rates (Stats SA, 2011).

Results showed that majority (70.6%) of the respondents have attained secondary education, and 17% have attained College or University education. This was in contrast with the findings by Drimie *et al.* (2009), who reported that majority of the people in Greater Tubatse Local Municipality were illiterate. In the current study 6.8% of the respondents had no formal education or they never went to school. There is a possibility that the number of illiterate people in Greater Tubatse Local Municipality has declined since the previous study was done in 2009; or the previous study had much older respondents who never had formal education, than the current study, which had much younger respondents who were more educated. These results show that majority of the respondents had the potential to further their studies since they have attained secondary education. However, the challenge was that there were very few institutions of higher learning in the study area. This challenge was reported by previous researchers, who noted that lack of tertiary institutions in mining areas is common in South Africa (Becker, 1993; Moraka & van Rensburg, 2014; Ledwaba, 2017; Gardiner, 2017; Hilson, 2002).

4.6.2 Factors influencing the farmers' perceived impact of mining activities on agricultural production in the study area

Generally, the mining activities in the study area did not have a negative impact on agricultural production (crops and livestock) because the change in the number of respondents who cultivated crops and kept livestock was not statistically significant (0.402), for most of the cultivated crops, except groundnuts. This may be due to the loss of agricultural land, therefore they would rather grow other crops than groundnuts. It implied that the change that occurred because of mining activities in the study area was not statistically significant. The production of groundnuts was negatively affected because the number of farmers who cultivated groundnuts declined significantly (0.004) due to loss of

productive land to mines in the area, as previously reported by Meinjies *et al*. (2008), when they studied Penge mine in Greater Tubatse Local Municipality.

The impact on livestock production was positive as envisaged and the average statistical significance for all types of livestock was 0.222, except for donkeys, which were affected negatively by mining activities. The lower number of donkeys might have been due to fewer respondents keeping donkeys in the area. The findings were in contrast with those reported by Kitula (2006), who found that mining activities had a history of decreasing livestock production in areas surrounding the mines, most probably because of reduced grazing land. This was also in contrast with the findings by Anderson *et al.* (2008) and Meinjies *et al.* (2008), who found that as the land for agricultural production gets contaminated by fossil fuels that are used in mining activities, which affected grazing land. However, the results showed that a decrease in grazing land did not reduce the number of livestock and crop production.

Furthermore, the current study found that most of the respondents (92.6%) lost a portion of agricultural land to mining operations in the study area, as reported by Meissner (2015) who conducted a study at Ga-Sekhukhune, which found that mining activities were performed on the land that was suitable for agricultural production. However, although the impact of mining did not significantly affect crops in the study area, there are other areas near mines where farmers found it difficult to cultivate their land because of the adverse effects of heavy metals from mines, which were dumped on agricultural land. Similar findings were reported by Mayes *et al*. (2009), who reported that mining activities contaminated water in England and Wales. Dust resulting from mining activities in Ga-Sekhukhune also made it difficult for land to be used productively by community. This has also been the case in mining areas as mentioned by Lockie *et al.* (2009), who reported that dust from mines polluted the environment and caused respiratory diseases, and sick people were not productive on the land. The hazardous fumes from mining excavation affected people working on the available land.

4.6.3 Socio-economic impact of mining activities

Impact on natural capital

Most of the respondents perceived the overall impact of mining activities on natural capital as negative, which was consistent with the findings by Lockie *et al*. (2009), who reported that Coppabella coal mine in Central Queensland had a negative impact on the environment and land use. Kitula (2006) and Bian (2006) found that mining activities polluted air and contaminated water supply. In the current study, the results showed that more than 95% of the respondents were dissatisfied with access to grazing land because of mining activities. Drimie *et al.* (2009) reported that in Ga-Sekhukhune, only land used for grazing, cemeteries and crop production was allocated for mining operation. Similar findings were reported by Lockie *et al*. (2009), Drimie *et al.* (2009) and Behera (2015), who reported that mining activities reduced the size of grazing land, water availability (access and quality) and number of trees. Mining activities in the study area were perceived as negative, because they affected air quality, which led to the exposure to respiratory diseases as reported by Kitula (2006) in Tanzania. The impact on water access forced communities to share polluted water with mines. Similar findings were reported by Muntingh (2011), who found that mining activities contaminated water sources and communities were to use that water for drinking. Majority of the respondents were also dissatisfied that mining operations reduced the number of trees and other vegetation suitable for browsing and grazing, which affected livestock production. Lockie *et al*. (2009) also found that mining activities were associated with cutting of trees. Therefore, the overall impact of mining activities on natural resources was negative in the Greater Tubatse Local Municipality.

Impact on physical capital

The perceived impact of mining activities on physical capital was insignificant. Most (>96%) of the respondents said that they did not receive housing from mining companies directly or indirectly, did not acquire infrastructure, did not build new houses, did not buy new cars and furniture, and did not drill boreholes or any other assets. Similar findings were reported in other areas surrounding the mines. For example, Peluso *et al*. (2015) reported that communities near the mines in East of Asia could not afford to build decent houses for communities living near the mines. Therefore, the study found that mining companies did

not improve the physical capital of the majority of the people living near the mines in the Greater Tubatse Local Municipality.

Impact on human capital

The current study found that the human capital of >50% of the respondents improved because of the support received from the mining companies in the area. Most of the people acquired skills such as financial management, computing, farm management and farming from the mines. This contrasted with Behera (2015), who found that people from mining areas remained unskilled. Furthermore, Drimie *et al*. (2009) also found that skills training was not provided to the people living near the mines in Greater Tubatse Local Municipality. Similarly, Anderson *et al*. (2008) found that mining companies do not encourage communities to establish their own businesses, hence they remained poor if they were not employed in the mines. The interventions reported in the current study were positive, although marketing skills would also enable communities to venture into businesses rather than remaining poor and unemployed.

Impact on financial capital

Mining activities affected financial capital in the Greater Tubatse Local Municipality negatively, because 75% of the respondents said that they have never worked in the mines. Farell *et al.* (2012) also found that people living in the mining areas did not work in the mines within their vicinity. From an income point of view, it was found that the level of income of most (96.4%) of the respondents in the current study did not improve because of mining operations in their area. Behera (2015) shared the same sentiments that people living near mining companies remained poor and they were unable to access credits and loans from financial institutions because they lacked support from the mining companies operating in their area. This was an indication that if mines do not create enough jobs opportunities, the people would not have the required collateral to acquire loans from financial institutions. One of the things that could contribute to financial capital is when communities are resettled and compensated. However, in the current study it was found that people were not compensated for resettlement because they were never resettled.

Impact on social capital

In terms of social capital, the findings showed that the mining activities had an insignificant impact on the livelihoods of the communities living near the mines. The standard of living, network with stakeholder, access to food and education; and relationship with stakeholders of ≥ 90% of the respondents did not improve because of mining operations within their vicinity. Hilson (2002) reported that people who live near the mines expect their standard of living to improve, but surprisingly that is not always the case. In Kenya, Mwakwambirwa (2015) found that mining activities did not improve the standard of living of the majority (68.6%) of local people, and did not help to build any infrastructure such as schools. Similarly, Downing (2002) also found that mining did not improve the standard of living and education of the communities in Greater Tubatse Local Municipality.

The current study also found that even though the area was surrounded by mines, majority of the local people were unemployed and dependent on social grants for a living. Several studies (Kitula, 2006; Ziervolgel & Taylor, 2008; Behera, 2015) have shown that communities in mining areas remain unemployed and dependent on grants for a living. Hilson (2002) and Bench Mark Foundation (2016) reported that people in mining areas are constantly in conflict with mining companies and community leaders. This could be one of the reasons why people in Greater Tubatse Local Municipality have had conflicts with mining companies and community leaders when they demanded for job opportunities in the mines.

4.7 Summary of the chapter

Chapter four presented the findings of the study and discussions. It was found that majority of the respondents were males, of which most (>90%) spoke Sepedi, whereby the age range of majority participants was 18-30 years old who were mostly single individuals with secondary education at their highest educational level. It was found that mining did not significantly decrease the number of animals kept by the respondents and types of crops cultivated; which implies that mining activities did not have a negative impact on agriculture. The findings of the factors influencing the impact of agricultural activities on agricultural production showed that experienced farmers were of the opinion that mining activities had more impact on agricultural production. The summary of the findings of the socio-economic impact of mining activities showed that in general, the impact of mining activities was

negative because natural capital, social capital, financial capital and physical capital of the respondents did not improve significantly. Only the human capital of the respondents improved significantly.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter consists of conclusions and recommendations of the study. It further includes research aim and objectives that informed the study. The aim of the study was to understand the impact of a chrome mine on agriculture and socio-economic aspects in the rural communities of Greater Tubatse Local Municipality in order to provide basis for informed policies to address the challenges of the community. This study was to assess the socio-economic impact of a chrome mine in Greater Tubatse Local Municipality. The study objectives were to:

- Determine the impact of mining activities on agricultural production (crop and livestock production);
- Profile the socio-demographic characteristics of the community members surrounding a chrome mine;
- Determine factors influencing the farmers' perceived impact of mining activities on agricultural production; and
- Analyse the socio-economic (natural capital, financial capital, social capital, human capital, physical capital) impact of mining activities on the local communities.

5.2 Conclusion

This study revealed that the proportion of males in the rural mining communities was higher (50.8%) than females, of which most (97.7%) of them spoke Sepedi (Northern Sotho). The marital status of the majority (76.4%) was single or not married, this could be attributed to the fact that most of the respondents below 30 years and unemployed.

This study found that most (92.6%) of the people lost a portion of agricultural land that was used for grazing before mining operations started in the area; but the loss of agricultural land did not affect production. The study also found that overall, mining activities did not have a significant impact on the production of livestock and crops, except for donkeys and groundnuts which were negatively affected. Therefore, the null hypothesis that mining

activities have negative impact on crop and livestock production of the local communities was rejected.

With regards to the socio-economic impact of mining activities on the surrounding communities, the study found that mines had an insignificant impact on natural capital, physical capital, financial capital and social capital, and a positive impact on human capital. In terms of natural capital, most (95%) of the respondents were dissatisfied with access to grazing land because of mining activities. Mining activities had a negative impact on the quality of air, which exposed the local communities to respiratory diseases, such as tuberculosis, lung cancer and other airborne diseases. On the other hand, most (96.1%) of the respondents were also dissatisfied with the mining operations because of the reduced number of trees and vegetation for grazing animals, which might affect livestock production in future. Therefore, the null hypothesis that mining activities have an insignificant impact on natural capital of the local communities was accepted.

The results showed that physical capital of the respondents was insignificantly affected by the mining activities in the study area, since most (>95%) of the people did not receive housing, did not acquire infrastructure, never built new houses, never drilled boreholes, and never bought new furniture or cars because of the mining activities in their area. Therefore, mining activities did not help the surrounding communities to acquire more assets to improve their living conditions. The null hypothesis that mining activities have insignificant impact on physical capital of the local communities was accepted.

This research found that human capital of the majority (>50%) of the respondents improved because of the support received form mining companies. For example, most community members acquired skills such as financial management, computing, farm management and farming from the mining companies. However, more than three quarters (78.6%) of the respondents did not acquire marketing skills from the mining companies. These findings showed that mining has the ability to empower communities with the necessary skills that could help them to start their own businesses, and to create employment opportunities for others. The intervention in the current study were positive, although marketing skills should also be provided to enable communities to venture into successful entrepreneurships instead of remaining poor and unemployed. Therefore, the null hypothesis that mining

activities have an insignificant impact on human capital of the local communities was rejected.

The current study found that mining had an insignificant impact on financial capital of the respondents. Majority (>75%) of the respondents have never worked in mine companies before or after the mining activities started, their level of income has not improved, and they were not able to access credits or loans from financial institutions, which could be attributed to the support from mining companies in the study area. The statistical significance (0.000) has proven that mining activities have insignificant impact on the financial capital of the local communities, therefore, the null hypothesis was accepted.

On social capital, the findings showed that mining activities did not improve the standard of living of most (92.2%) of the communities in the surrounding area, since most of the people were unemployed, have never worked in the mines, their income did not improve, they did not have a better relationship with stakeholders; and they had less access to food and education despite their proximity to a chrome mine in Greater Tubatse Local Municipality. Therefore, the social capital of the respondents was insignificantly impacted by mining activities, and the null hypothesis was accepted.

5.3 Recommendations

This part entails the recommendations of the study based on the research findings. The recommendations are presented as follows:

- **Water contamination:** the effluent from the mines should not be drained into water sources used for human and agricultural purposes to avoid contamination.
- **Job opportunities:** chrome mines should develop a model that will give preference to local people in the provision of jobs to improve the standard of living of the local communities.
- **Youth participation in agriculture:** this study recommends that youth participation in agriculture should be prioritised since majority of youth in Greater Tubatse Local Municipality were not working. The mining companies and the government should

intervene by providing the necessary skills that might influence the youth to pursue farming.

- **Human settlements:** mining companies should not operate close to human settlements to avoid health hazards in the dust from mining activities. Alternatively, they should work in partnership with stakeholders to form health care initiatives, to educate the communities about different air-borne diseases and how to prevent them. In addition, mining companies can work with local health authorities to design and provide preventive and treatment programmes against diseases such as tuberculosis and others.
- **Infrastructure:** the provision of infrastructure such as better roads, educational facilities, health facilities, and transport could encourage local communities to improve their livelihoods. Therefore, mining companies should provide the necessary infrastructure.
- **Establishment of stakeholder relationships:** the establishment of relationships between mining companies and stakeholders in the communities is necessary to minimise conflicts and to sustain progress in developing the livelihoods of the local communities.
- **Improvement of socio-economic status:** it is recommended that mining companies should provide the necessary support to improve the socio-economic status of the rural communities surrounding the mines in Greater Tubatse Local Municipality.

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Appendix 1: Survey questionnaire

A. GENERAL INFORMATION

Questionnaire Number	
Date	
Name of Village	1=Ga-Selala; 2=Mooihoek; 3=Motlolo; 4= Driekop; 5=Ga-maroga

B. FARMER CHARACTERISTICS

No	Participant Demography	Code	Answer
1	Gender	1=Male; 2=Female	
2	Home Language	1=Sepedi; 2=Siswati; 3=Xitsonga; 4=Tshivenda; 5=English; 6=Afrikaans; 7=other(specify)	
3	Age	Number	
4	Marital Status	1=Single; 2=Married; 3=Divorced; 4=Widowed; 5=Other(specify)	
5	Family size	Number	
6	Level of Education	1=Never been to school; 2=No formal Education, 3=Primary Education; 4=Secondary Education; 5=College Education; 6=University Education; 7=Other (Specify)	
7	Do you currently have a plot allocated for farming?	0=No; 1=Yes	
8	If yes in question 7, what is the size of your plot?	Size (ha)	
9	Practicing Agriculture	0=No; 1=Yes	
10	Number of years involved in Agriculture	Number	

11	Main Source of Income	1=Mining employment ; 2=Farming; 3=Social Grant;4=Other employment type; 5=Self-employed; 6=Other(Specify)	
12	Type of farming	1=Own/Farm; 2=Communal Land; 3=Rental Land; 4=Other (Specify)	
13	Number of years staying in the village	Years	

C. HISTORICAL INFORMATION

No	Participant Demography	Code	Answer
14	Are you originally from this village?	0=No; 1=Yes	
15	Have you lost land because of mining activities in your area?	0=No; 1=Yes	
16.Before mining, what was land used for			
16a	Loss of culture	0=No; 1=Yes	
16b	Loss of social Life	0=No; 1=Yes	
16c	Loss of livestock	0=No; 1=Yes	
16d	Loss of agricultural land	0=No; 1=Yes	
16e	Loss of family members	0=No; 1=Yes	
16f	Other(Specify)		

D.SOCIO-ECONOMIC INFORMATION

D1. Physical capital

17. Have you received housing from the mining company?

0=No	1=Yes

18. Have you acquired infrastructure because of mines?

0=No	1=Yes

19. Which of the following were you able to do because of the existence of mines?

NO	Categories	Code	Answer
A	Build a new house	0=No; 1=Yes	
B	Bought a car	0=No; 1=Yes	
C	Bought furniture	0=No; 1=Yes	
D	Drilled a borehole	0=No; 1=Yes	
E	Other assets not mentioned	0=No; 1=Yes	

D2. Financial capital

20. Did any of your family member (s) work in a mining company in the past?

0=No	1=Yes

21. Is any of your family members currently working in the mining company?

0=No	1=Yes

22. Has your income improved because of the mines?

0=No	1=Yes

23. Did you acquired a job because of mines?

0=No	1=Yes

24. Are you able to access the following because of mines?

No	Categories	Code	Answer
A	Access to credit	0=No; 1=Yes	

B	Link to financial institution	0=No; 1=Yes	
C	Received financial support from mines	0=No; 1=Yes	

D3. Natural capital

25. Do you have better access to water because of the mines?

0=No	1=Yes

26. Has the size of the land allocated for crop production increased because of mine?

0=No	1=Yes

27. If you are a livestock farmer, does land allocated for livestock enough for grazing?

0=No	1=Yes

28. Do you have a period when you are not satisfied with the quality of the air you inhale?

0=No	1=Yes

29. What has been the impact of mining on the natural environment?

No	Categories	Code	Answer
A	Poor water quality	0=No; 1=Yes	
B	Reduced number of trees	0=No; 1=Yes	
C	Reduce water availability	0=No; 1=Yes	
D	Reduced air quality	0=No; 1=Yes	
E	Caused respiratory diseases	0=No; 1=Yes	

D4. Human capital

30. If you had enough land for farming, would you be interested in using it to produce agricultural production?

0=No	1=Yes

31. If you were to own a farm business, which skills would you use to benefit your business?

No	Categories	Code		Answer
A	Financial Management	0=No	1=Yes	
B	Computer	0=No	1=Yes	
C	Farming Skills	0=No	1=Yes	
D	Farm Management	0=No	1=Yes	
E	Marketing	0=No	1=Yes	

D5. Social capital (Livelihoods)

32. What has improved in your life since the existence of the mine in your area?

No	Categories	Code	Answer
A	Standard of living	0=No; 1=Yes	
B	Established Network	0=No; 1=Yes	
C	Have better relationship with stakeholders	0=No; 1=Yes	
D	Better access to food	0=No; 1=Yes	
E	Better access to education	0=No; 1=Yes	

33. Has the establishment of mines encouraged youth's participation in agriculture?

0=No	1=Yes

E. AGRICULTURAL PRODUCTION

No	Questions	Code	Answer
34	In your opinion, what is the impact of mining activities on crop and livestock production?	0=No impact; 1=Low impact; 2=High impact	
35	The type of crops grown in the past.		
35a	Maize	0=No; 1=Yes	
345	Groundnuts	0=No; 1=Yes	
35c	Pumpkin	0=No; 1=Yes	
35d	Butternut	0=No; 1=Yes	
35e	Sorghum	0=No; 1=Yes	
35f	Soya beans	0=No; 1=Yes	
35g	Beans	0=No; 1=Yes	
35h	Green beans	0=No; 1=Yes	
35i	Other (Specify)	Types	
36	What types of crops are you currently growing?		
36a	Maize	0=No; 1=Yes	
36b	Groundnuts	0=No; 1=Yes	
36c	Pumpkin	0=No; 1=Yes	
36d	Butternut	0=No; 1=Yes	
36e	Sorghum	0=No; 1=Yes	
36f	Soya beans	0=No; 1=Yes	
36g	Beans	0=No; 1=Yes	
36h	Green beans	0=No; 1=Yes	
36i	Other (Specify)	Types	

37	Did you produce enough crops in the past?	1= Yes; 2= No	
38	Has your crop production decreased because of mines?	1= Yes; 2= No	
39	Has your crop production increased because of mines?	1= Yes; 2= No	
40	What types livestock did you keep before the existence of mines?		
41a	Cattle	1= Yes; 2= No	
41b	Goats	1= Yes; 2= No	
41c	Sheep	1= Yes; 2= No	
41d	Pigs	1= Yes; 2= No	
41e	Poultry	1= Yes; 2= No	
41f	Donkeys/mules	1= Yes; 2= No	
41g	Other (Specify)	1= Yes; 2= No	
42	What types livestock do you currently have?		
42a	Cattle	1= Yes; 2= No	
42b	Goats	1= Yes; 2= No	
42c	Sheep	1= Yes; 2= No	
42d	Pigs	1= Yes; 2= No	
42e	Poultry	1= Yes; 2= No	
42f	Donkeys/mules	1= Yes; 2= No	
42g	Other (Specify)		
43	Has your number of livestock decreased because of mines?	1= Yes; 2= No	
44	Has your number of livestock increased because of mines?	1= Yes; 2= No	

45	What did you grow crops for before mines started?	1=Home consumption; 2=Selling; 3 Selling and home consumption; 4=Other (Specify)	
46	What do you currently grow crops for?	1=Home consumption; 2=Selling; 3 Selling and home consumption; 4=Other (Specify)	
47	What did you keep livestock for before the mines?	1=Home consumption; 2=Selling; 3 Selling and home consumption; 4=Other (Specify)	
48	What do you currently keep livestock for?	1=Home consumption; 2=Selling; 3 Selling and home consumption; 4=Other (Specify)	

F. GENERALS QUESTION.

No	Question
49	Are those expectations been met? 0=No; 1=Yes

THANK YOU FOR YOUR PARTICIPATION

Appendix 2: Participant information sheet

CAES Ethics clearance reference number: **2016/CAES/116**

04 November 2016

TITLE: **IMPACT OF MINING ON AGRICULTURE AND SOCIO-ECONOMIC ASPECTS IN THE RURAL COMMUNITIES OF GREATER TUBATSE LOCAL MUNICIPALITY.**

Dear Prospective Participant

My name is Mapuru Rachel Tsebe and I am conducting a research with Prof. M.A. Antwi, an Associate Professor in the Department of Agriculture and Animal Health towards a Master's degree in Agriculture at the University of South Africa. We are inviting you to participate in a study entitled Impact of mining on agriculture and socio-economic aspects in the rural communities of greater Tubatse Local Municipality.

WHAT IS THE PURPOSE OF THE STUDY?

The purpose of the study is to understand the impact of mines on agriculture and socio-economic aspects in the rural communities of Greater Tubatse Local Municipality and to propose a model for agricultural development in the area.

WHY AM I BEING INVITED TO PARTICIPATE?

I chose you to participate in the study because you have experience of how mining contributes to the socio-economic aspects of people living next to Dilokong mine. Your personal information was received from the Chief or Tribal authorities and the mine owners. The approximate number of participants targeted is 497 households.

WHAT IS THE NATURE OF MY PARTICIPATION IN THIS STUDY?

For you to participate in this study, you are required do the following:

- sign the consent form before participating in the study;
- participate in face-to-face interviews conducted by the researcher or her research team; and/or complete the research questionnaire; and
- not to provide your real name during the interviews or completion of the survey questionnaire.

The questionnaire will include general questions, demographic information, socio-economic characteristics, historical information, agricultural production information, reasons for practicing agriculture and/or not practicing agriculture in your household and your challenges in farming since the existence of mining. The expected time needed to complete the questionnaire is about 30 minutes. It will take about 40minutes to conduct the interview, if you prefer to be interviewed.

CAN I WITHDRAW FROM THIS STUDY EVEN AFTER HAVING AGREED TO PARTICIPATE?

Participating in this study is voluntary and you are under no obligation to consent to participation. If you decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason. Participants will participate purely by choice and participants will be free to withdraw at any time without providing reasons for their decision. The confidentiality will be observed professionally, and participant's identity will not be revealed. The names of the participants will not be included in the research publications emanating from the study.

WHAT ARE THE POTENTIAL BENEFITS OF TAKING PART IN THIS STUDY?

The potential benefits of taking part in this study area:

- you will understand the impact mining activities has on agriculture and socio-economic aspects in Greater Tubatse Local Municipality;

- it will help to determine whether the communities surrounding the mines benefits from mining activities; and
- the outcomes of the study will also help the government in decision making about allocating mining license and land for agricultural use.

ARE THERE ANY NEGATIVE CONSEQUENCES FOR ME IF I PARTICIPATE IN THE RESEARCH PROJECT?

There are no foreseeable physical risks associated with this study. The interviews conducted will not include emotional or sensitive questions.

WILL THE INFORMATION THAT I CONVEY TO THE RESEARCHER AND MY IDENTITY BE KEPT CONFIDENTIAL?

The confidentiality will be observed professionally, and participant's identity will not be revealed. The names of the participants will not be included in the in the research publication. A report of the study may be submitted for publication, but individual participants will not be identifiable in such a report

HOW WILL THE RESEARCHER(S) PROTECT THE SECURITY OF DATA?

Hard copies of your answers will be stored by the researcher for a period of five years in a locked cupboard/filing cabinet in the Department of Agriculture and Animal Health at the University of South Africa, in Florida Science Campus for future research or academic purposes; electronic information will be stored on a password protected computer. Future use of the stored data will be subject to further Research Ethics Review and approval if applicable. Hard copies will be shredded, and/or electronic copies will be permanently deleted from the hard drive of the computer by using a relevant software programme after a period of five years.

WILL I RECEIVE PAYMENT OR ANY INCENTIVES FOR PARTICIPATING IN THIS STUDY?

No payment or reward is offered for participating in this study.

HAS THE STUDY RECEIVED ETHICS APPROVAL?

This study has received written approval from the Research Ethics Review Committee of the College of Agriculture and Environmental Sciences (CAES) Ethic Committee, Unisa. A copy of the approval letter can be obtained from the researcher if you so wish.

HOW WILL I BE INFORMED OF THE FINDINGS/RESULTS OF THE RESEARCH?

If you would like to be informed of the final research findings, please contact Mapuru Rachel Tsebe on 073 033 6342 or e-mail mapurulega@gmail.com; the findings are accessible for a period of five years. Should you require any further information or want to contact the researcher about any aspect of this study, please contact Prof. M.A. Antwi on 011 471 9391; e-mail at antwima@unisa.ac.za

Should you have concerns about the way in which the research has been conducted, you may contact the research ethics chairperson of the College of Agriculture and Environmental Sciences (CAES) Ethics committee, Prof. E.L. Kempen on 011 471 2241 or e-mail at kempeel@unisa.ac.za, if you have any ethical concerns.

Thank you for taking time to read this information sheet and for participating in this study.

Mapuru Rachel Tsebe.

Appendix 3: Consent form to participate in this study

I, _____ (participant name), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable).

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I have received a copy of the participant information sheet.

Participant Name & Surname…… (please print)

Participant Signature……..Date……

Researcher's Name & Surname…… (please print)

Researcher's signature……..Date……