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UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Towards Sustainable Economic Development in the Gold Mining Areas of South Africa and Ghana

Adwoa Pokuaa Boaduo

A research report submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Engineering

Johannesbrug, 2017

DECLARATION:

I declare that this research report is my own unaided work. It is being submitted to the Degree of Master of Science in Engineering to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to any other University.

_____

(Signature of candidate)

_____ day of _____, _____

(day) *(month)* *(year)*

ABSTRACT

In many mineral resource rich African countries, mining activity makes a significant contribution towards the Gross Domestic Product (GDP) and economic growth. This stimulus gives the mining industry the potential to fuel growth and development. Although some mining areas have been able to experience positive economic growth, many have struggled to achieve and sustain economic development due to the inability to manage mineral wealth challenges. African mining regulatory bodies generally lack proper local planning, resulting in inadequate policy instruments to enable the sector to make a sustainable contribution towards economic welfare.

This research investigates how mineral wealth can be used as a catalyst for sustainable economic development. The research presents the case studies of three mining areas with the aim of determining why the economic development of Johannesburg differs substantially from that of Tarkwa and Obuasi. The research gives a comparative analysis of the political economy and socio-economic trends that have transpired in the three areas over the years. It ends by making recommendations on how Tarkwa and Obuasi can better manage the challenges of mineral wealth, and work towards achieving sustainable economic development that is like or even better than that of Johannesburg.

DEDICATION

To the almighty God for the mind and endurance he has given me. I dedicate this dissertation to all my loved ones, especially my family. To my sister Abenaa Boaduo, my brother Dr Nana-Kyei Boaduo and his wonderful wife Millicent, thank you for all your motivation, guidance and support. To my spiritual parents Mr Alex Nsiah, and his lovely wife Vivian, I thank you for the endless prayers. I give special thanks to my good friend Siyamazi Ndlovu and my husband Jamal Issaka for their support.

A special dedication and thank you to my late parents Dr Nana-Adu and Mrs. Mary Boaduo who sacrificed endlessly for my education. Thank you, mom and dad, may your wonderful souls rest in peace.

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I wish to thank my great supervisor Professor Frederick Cawood for his wisdom and guidance. A special thank you to Dr Tony Aubynn, the CEO of the Ghana Minerals Commission for encouraging the topic. I also would like to acknowledge the University of the Witwatersrand School of Mining Engineering for allowing me to conduct this research and providing all necessary resources.

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NOMENCLATURE

Acid Mine Drainage	AMD
Acquired Immune Deficiency Syndrome	AIDS
Africa Mining Vision	AMV
African Mining Vision	AMV
African National Resources Centre	ANRC
African Union	AU
AngloGold Ashanti	AGA
Chamber of Mines Research Organisation	COMRO
Corporate Social Responsibility	CSR
Department of Mineral Resources	DMR
Economic Recovery Program	ERP
Eye Witness News	EWN
Foreign Direct Investment	FDI
Ghana	Gh
Gross Domestic Product	GDP
Human Development Index	HDI
Human Immunodeficiency Virus	HIV
International Council for Mining and Metals	ICMM
International Labour Organisation	ILO
International Monetary Fund	IMF
Johannesburg Stock Exchange	JSE
Joint Venture	JV
Life of Mine	LoM
Local Economic Development	LED
Mineral and Petroleum Resources Development Act	MPRDA
Natural Resource Holdings	NRH
Precious Minerals Marketing Corporation	PMMC
Research and Development	R&D
Sexually Transmitted Diseases	STI
Small Scale Mining	SSM
South Africa	SA
South African Breweries	SAB
South African Rand	ZAR
Sustainable Economic Development	SED
United Nations	UN
United Nations Commission of Sustainable Development	UNCSD
United Nations Economic Commission for Africa	UNECA
United Nations World Commission on Environment and Development	UNWCED
University of Mines and Technology	UMaT
United States Dollar	USD

1 BACKGROUND AND OUTLINE OF THE PROBLEM

1.1 Introduction

There are several ways of achieving sustainable economic development in Africa; however, the challenge with working towards this goal lies in formulating and executing practicable economic development strategies that are grounded in the continent's unique strengths (AU, 2009). One of the great strengths of the African continent is the abundance of diverse mineral resources. Minerals act as natural capital that represents prospective wealth and income earning opportunities. The mineral resources can be used as a platform for economic development.

To assist the continent to realise this potential, in 2002, the United Nations Economic Commission for Africa (UNECA) published a training manual that focused on the management of mineral wealth and its role in socio economic development (UNECA, 2002). Later in 2008, the African Union (AU) formulated the African Mining Vision (AMV), an initiative that places long term economic development goals at the core of all policymaking decisions concerned with mineral extraction (AU, 2009). In February 2009, the AU released a report titled "Africa Mining Vision", which elaborated on this concept. The African Union also held a conference in 2011 for ministers responsible for mineral resources development, under the theme of "Building a sustainable future for Africa's extractive industries: From vision to action", to discuss the AMV. Two proceedings concerning the implementation of the AMV were published after this conference (AU, 2011). The AMV is a relatively new concept, and most of the publications under the topic focus on elucidation and strategies on how the vision can be best executed. The publications seldom focus on lessons learned from case studies of African countries that have succeeded or failed in achieving resource-based economic development.

1.2 Research Aim and Objectives

The aim of this research is to investigate why economic development in the auriferous areas of Tarkwa and Obuasi (Ghana) differ substantially from that of Johannesburg (South Africa). This statement is based on the author's observation of economic development in the three gold mining areas. The research will determine ways in which Tarkwa and Obuasi can be empowered to achieve mineral resource-based economic development. The following objectives will be achieved by this research:

i. To analyse the capabilities of the gold mining industries as well as the political and economic events that transpired over the years in Johannesburg, Tarkwa and Obuasi;
ii. To conduct a comparative analysis of the three case studies, and identify the mineral wealth challenges that hinder economic development; and
iii. To identify actions that can be followed to empower the better management of mineral wealth challenges in working towards sustainable economic development of the mining areas.

This topic is important because it will contribute towards the knowledge of sustainable economic development in Africa. It will also explore lessons to be learned to boost sustainable economic development using the mining industry. The topic will appeal to mining communities, organisations, researchers and policymakers. Mining companies can also use this research to develop socio-economic programs as part of their mining rights application. The approach of this project is unique because it was inspired by the author's observation of the economic anomalies between the three mining areas.

1.3 Evaluation of Related Studies

The African Mining Vision report titled "*Minerals and Africa's development"* AMV (2009), is based on the strategy of utilizing the continent's mineral resources to eradicate poverty, and reinforce sustainable growth and development. This report looks at the creation of strong linkages within the mineral resources sector. According to the AMV, policies that

promote upstream, downstream and side-stream linkages, give the mineral resources sector a better opportunity to contribute towards sustainable growth and development.

The objective of the African National Resources Centre (ANRC) is to *"boost the capacity of African Policy Makers to manage natural resources for improved development outcomes"* (ANRC, 2016). In a report titled "*Leveraging natural resources to accelerate human development in Africa"*, the ANRC highlighted that domestic resources have an essential role to play in addressing persistent human development needs across the continent. The report also stated that for natural resources to accelerate development, governments should have a practical policy framework that links revenue management decisions with human development programs.

A paper by Ayee et al (2011) titled "*Political economy of the mining sector in Ghana",* offered an assessment of the impact that the mining industry has had on the economic development of Ghana. This paper draws attention to the susceptibilities in the country's governance along the mining value chain. The paper stated that modern day Ghana has not been successful in translating mineral wealth into overall economic development. It also argued that the net impact of mining on economic development could prospectively be improved with applicable reforms in governance.

In a paper titled *"An assessment of Ghana's mineral policy in the era of sustainable development: a critical review of mineral royalties disbursements for communities",* by Debrah et al (2013) it was emphasised that the mineral wealth of a country arguably has a strong association to economic growth and development. This paper pointed out that Ghanaian rural communities in which mining activity exists usually display very little in terms of economic development. The paper further stated that the translation of mineral wealth to general development in the rural communities of Ghana has become a difficult task. The authors debated that Ghana's reorganizations of the mineral policy helped to attract foreign investors and strengthen the security of mining investments; conversely, it did very little to advance the association between economic growth and sustainable development in mining communities.

Ndaba 2010 in his paper titled *"Mining and local economic development: a case study of the Rustenburg local municipality",* focused on the role of the mining industry and local economic development in the Rustenburg municipality. Ndaba emphasised that local economic development plays an important role in enabling the mining industry to contribute towards the economic development of the Rustenburg municipality. This paper also looks at international and local approaches that have been exercised in achieving sustainable local economic development in mining regions. The author deduced that for sustainable economic development to occur on a local level, all stakeholders who are involved in and affected by mining operations, need to cooperate with each other to offer pre-emptive solutions and development strategies. Additionally, the process of local economic development should be designed, managed and administered by local authorities as this falls under tasks in their jurisdiction.

Chiomba (2015) wrote that, *"National mineral policy is a fundamental tool that can be utilised to orient the mineral sector of a nation towards sustainable development"*. This author offered an evaluation and a comparative analysis of the mineral policies for Namibia, Tanzania, Malawi and Zambia. Their analysis was conducted via the perception of economic and sustainable development. He weighed the three main pillars of sustainable economic development (i.e. the economic, social and environmental pillars). Chiomba (2015) concluded that the mineral policies of these Southern African countries have very strong economic and social pillars.

Altogether, the above-mentioned studies accentuate the fact that certain systems should be in place for mineral resources to become a catalyst for economic development. Firstly, a good policy framework on both a regional and a national level needs to exist. Secondly, there needs to be a synergy between the minerals policy as well as other policies related to economic development. Thirdly, there should be linkages between the mining sector and other sectors of the economy.

1.4 Benefits of the Research

This research will give a better understanding about the challenges of mineral wealth, and the issues underpinning sustainable economic development in the gold mining communities of Africa. It will also raise awareness about the social, health, safety and environmental challenges that exist in these communities (e.g. mercury poisoning, deforestation, community displacement etc.). This awareness will give areas and countries working towards mineral-based economic development the ability to anticipate and proactively manage the mineral wealth challenges that hinder economic development.

1.5 Rationale and Problem Statement

Sustainable development is measured by a core set of indicators that are grouped under 14 themes (DiSanno, 2007). Table 1.1 compares the development of the three gold mining areas by analysing the themes and indicators that are most relevant to this study. The table groups the themes and indicators into five categories and compares the gold mining industries.

Table 1.1: Sustainable Development Indicators

Indicators	Tarkwa	Obuasi	Ghana	Johannesburg	South Africa	Remarks
Sustainable Development (General)						
Population Size	90 477	168 641	24.6 million	4.4 million	51.7 million	
Urban dwellings (%)	30%	85%	50.9%	99,8%	63%	
Paved roads (%)	na	35%	13%	91%	21%	Tarkwa information not available
Poverty rate (%)	14%	5%	24%	20%	20%	Poverty in Johannesburg exacerbated by influx of rural and foreign population seeking for a better life.
% household with piped water inside	8%	17%	47%	65%	90%	

% households with access to electricity for cooking	1%	8%	0.5%	87%	78%	
% households with flush toilets and sewage waste disposal	3%	16%	3.4%	87%	57%	
Education attained - secondary to tertiary (%)	24%	36 %	31%	39%	45%	
Number of public hospitals	1	4	343	36 - 40	823	Public and private
Economic Development						
Main sector of employment	Agriculture , forestry and fishing	Whole-sale retail and trade	Agriculture , forestry and fishing	Finance, business services and ICT	Finance, real estate, business services	
% unemployment	11%	6%	5%	25%	30%	Percentage of labour force that is unemployed
Inflation – 2014 (%)	17%	17%	17%	6%	6%	
Human Development Index	na	na	0.57	0,74	0,66	HDI usually provides the best reflection of economic development and the standard of living
Economic Growth						
GDP in 2009 (billion USD)	n/a	n/a	26.0	112	284.2	The GDP values is for Tarkwa and Obuasi are not available.
GDP in 2014 (billion USD)	n/a	n/a	38.6	89.3	350.1	
GDP growth 09 –14 (%)	n/a	n/a	7%	-5%	4%	
Industrialization						
Population employed by manufacturing sector	8%	11 %	11%	13%	15%	
Gross value added by manufacturing (2006 – 2013)	n/a	n/a	-4%	n/a	-3%	Reduction in manufacturing sector for SA and Ghana between 2006 and 2013
Gross value added by mining and	n/a	n/a	7%	n/a	1%	Mining and quarrying sectors in

quarrying: (2006 – 2013)						SA and Ghana experienced growth between 2006 and 2013
Gold Mining Industry						
Start of modern mining	1870s	1870s	1870s	1880s	1860s	
Gold Produced (oz.)	n/a	n/a	100 million	n/a	1.6 billion	National figures were used because the figures for Obuasi and Tarkwa and Johannesburg are not available
Estimated gold remaining (oz.)	n/a	n/a	122 million	n/a	466 million	
Gold production 2014	n/a	n/a	2.9 million	n/a	4.8 million	
Number. of Gold refineries	0	0	1	1	1	

Sources: StatsSA (2016), Ghana Statistical Service (2010), Central Intelligence Agency (2009), Natural Resource Holdings (2013)

The following main observations can be made from Table 1.1:

- The population of Johannesburg is almost thirty times larger than that of Obuasi and Tarkwa. Johannesburg is also largely urbanised with only a rural population of 0.2%. The Tarkwa municipality is predominantly rural, and the majority of Obuasi is urban. According to Ampene (1965), Obuasi is known to be one of the first areas to experience urbanisation in the Ashanti Region; this is owed to the early discovery of gold.
- Johannesburg has the highest percentage of people who live in extreme poverty, but the general standard of living is higher[1]. This extreme poverty is connected to rapid urbanisation that caused a high rate of migration of rural and foreign populations into the area.

[1] The upper boundary poverty line for South Africa is currently ZAR 20.38 per day (1.35 USD), this is higher than the upper boundary poverty line of Ghana (0,94 USD per day) indicating that the average income per household in South Africa is higher than that of Ghana. In order to provide a fair assessment of poverty, the lower boundary poverty line of South Africa, which is ZAR14.56 (0.96 USD per day) was compared against the upper boundary poverty line of Ghana (0.94 USD per day).

- The main source of water that is used for general domestic purposes (this excludes drinking) in Obuasi and Tarkwa, is Bore-hole/Pump/Tube well. Most Johannesburg households access water via pipes that are inside the dwellings.
- In Ghana and Tarkwa, the main source of energy for cooking is wood and charcoal, while in Obuasi, charcoal and gas are mainly used. The main source of energy for cooking in Johannesburg and South Africa as a whole is electricity.
- There is currently a sewage system in place for liquid waste in Tarkwa and Obuasi, yet liquid waste in the areas is mainly disposed of in open public spaces. The disposal of solid waste in the Ghanaian areas is still a problem. In Obuasi, solid waste is mainly disposed of in a public dump container, while in Tarkwa, it is disposed in open public spaces. Eighty-seven percent of the Johannesburg population has access to flush toilets connected to a sewerage system that disposes both solid and liquid waste.
- The rate of unemployment is the lowest in Johannesburg in comparison to Tarkwa and Obuasi, the main reason being continuous urbanization. The majority of Johannesburg's labour force works in the finance, business and service sectors. Most of the Obuasi labour force is employed in the wholesale, retail and trade sector. The majority of the Tarkwa labour force is employed in agriculture and forestry.
- In 2014, Johannesburg generated a GDP which was more than twice that of Ghana.
- Modern gold mining began at the end of the 19th century in Tarkwa, Obuasi and Johannesburg. Since the commencement of modern gold mining, South Africa has produced ten times more gold than Ghana.
- South Africa is the largest gold producing country in Africa, and Ghana is the second largest.
- Although there is a gold refinery in Ghana, large gold mining companies export the gold produced in raw form and refine it in other countries. This deprives Ghana of added value prior to exportation.

The information in Table 1.1 shows that Johannesburg is more populated and more urbanised than Tarkwa and Obuasi. Tarkwa seems to be the least urbanised and least developed of the three mining areas. The development indicators of Johannesburg are also much higher than those of Tarkwa, Obuasi and in some cases (such as that of the GDP) Ghana. Although modern gold mining in all three areas started at the same time, South Africa has produced more gold than Ghana. The capability of South Africa to refine gold in an area close to Johannesburg enabled an increase in export sale and brought economic benefits such as job creation to Johannesburg.

1.5.1 Sustainable Economic Growth and Development

Sustainable Development

In 1987, the United Nations World Commission on Environment and Development defined sustainable development as, *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs".* According to the organisation, one of the prerequisites for achieving sustainable development is for society to meet human needs by increasing productive potential, while mutually guaranteeing equitable opportunities for every person in the present and the future. The United Nations Commission of Sustainable Development (2007) also stated that the principle of sustainable development is based on a three-dimensional model. This model focuses on the integration of three pillars which are social, environmental and economic; some scholars have included a forth pillar that focuses on culture, institutions and governance. In pursuance of sustainable development, a satisfactory balance of all pillars should be reached. The sustainable development pillars are displayed in Figure 1.1

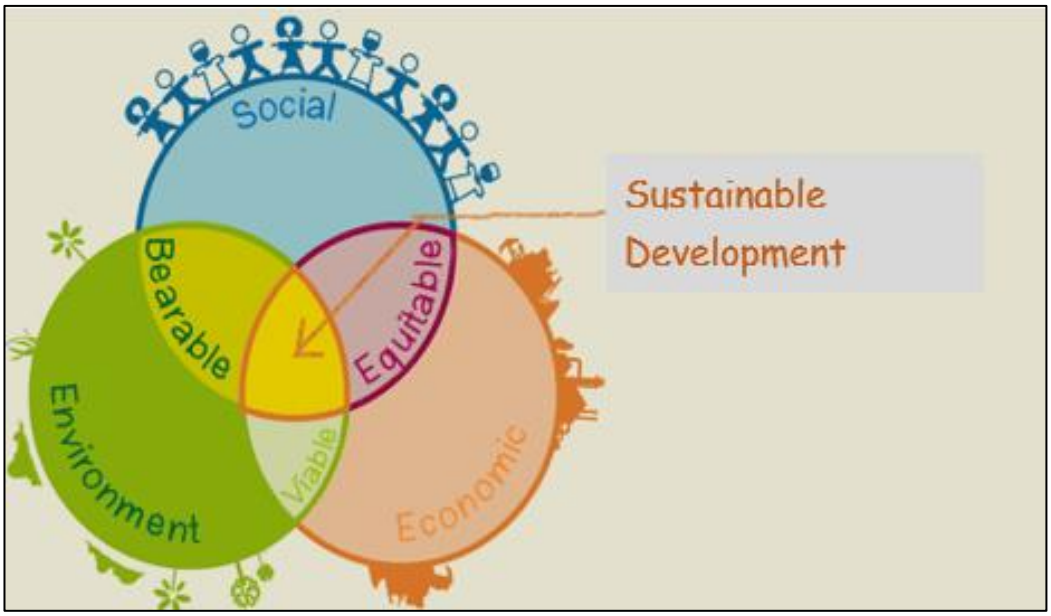

Figure 1.1: Integrated Pillars of Sustainable Development djouv.ca, (2010)

Sustainable development is determined by a set of indicators (see Table 1.1). These indicators give a measure of the progress that is made towards achieving goals that have been set within the pillars. The indicators perform the following main functions (DiSanno, 2007):

a) They clarify sustainable development goals, they simplify and break down aggregated information and provide it to policy makers;
b) They measure and calibrate progress made towards the goals; and
c) They provide early warning signs that can prevent setbacks within the economic, social, environmental and governance pillars

Sustainable development indicators should be established and measured in order for an area to work towards sustainable development goals.

Economic Growth

This research will focus on the indicators that measure the economic pillar, as well as the social and governance aspects that influence economic development. To better comprehend the economic pillar of sustainable development, one needs to be able to differentiate between economic growth and economic development. These two terms are

closely linked, and one can mistakenly assume that they share the same meaning. Wells (2014) defines economic growth as an indicator that measures the *"increase in the goods and services produced by an economy, typically a nation, over a long period of time".* It considers the goods and services produced by different economic sectors of the country. Economic growth is determined by calculating the percentage increase of the Gross Domestic Product (GDP) over a period, often measured annually. Table 1.1 shows that the GDP of Johannesburg dropped by 5% between 2009 and 2014, indicating a contraction in economic growth. The GDP values (indicators) for Tarkwa and Obuasi were not available.

Economic Development

Economic development is a broad concept that encompasses economic growth. Elle (2014) defined economic development as *"sustained, concerted actions of communities and policymakers that improve the standard of living and economic health of a specific locality".* Economic development demands sustained or continued actions from stakeholders to boost the peoples' morality and improve living conditions by providing employment and basic services such as housing, education, sanitation, water and electricity. Economic development is also concerned with economic sustainability, which is the ability to improve the living standards of the present generation without compromising the standards of the future generations.

According to Bucknall (2013) it is generally tricky to measure economic development, because the concept contains inputs that are influenced by issues such as politics and religion. Bucknall further stated the Human Development Index (HDI), a statistic that is derived from the indicators of a country's GDP, education and life expectancy, usually provides the best reflection of economic development and the standard of living. Considering this statement, the HDI for Johannesburg of 0.74 (see Table 1.1) places the area very close to the range of high human development[2]. This indicates that economic

[2] *"The ranges are 0–0.499 for low HDI, 0.500–0.799 for medium HDI, 0.800–0.899 for high HDI and greater than 0.900 for very high HDI" (Rodríguez, et al., 2009)*

development in Johannesburg is also close to the high range. Unfortunately, the HDI values for Tarkwa and Obuasi were not available.

According to the definitions of economic growth and economic development, it is possible for an area to experience positive economic growth but negative economic development and vice versa. This is all dependent on institutional policies and the development of good governance systems. The City of Johannesburg is a good example; Table 1.1 shows that Johannesburg experienced a 5% decrease in the GDP growth rate between 2009 and 2014, but had a 4% increase in the HDI during the same period[3]. In the case of Tarkwa and Obuasi, some indicators of human development (such as GDP) were not available and this made it difficult to measure economic growth and economic development.

Industrialisation

To better comprehend the concept of Dutch Disease, one should have a good understanding of industrialisation. O'Sullivan and Sheffrin, 2007 defined industrialisation as, *"the period of social and economic change that transforms a human group from an agrarian society to an industrial one, involving the extensive re-organisation of an economy for the purpose of manufacturing"*. Industrialisation embodies a developmental phase where a country's economy transfers its dependency from the primary sector to the secondary sector. During this phase, the manufacturing sector becomes a dominant contributor towards employment and the Gross Domestic Product (GDP). Industrialisation is considered an important tool that is used to achieve economic development. Studies have shown that the earnings and wealth levels of low-income groups in countries that have experienced industrialisation are much better than those of similar groups in countries that have not experienced industrialisation (Indevelopment, 2006). According to Marti and Ssenkubuge (2009) and Guadagno (n.d.), countries rarely develop without industrialising. The phenomenon of industrialisation breaks cycles of economic stagnation and contraction by expanding the manufacturing sector as well as markets for goods and services.

[3] 2009 HDI for information obtained from a report titled: City of Johannesburg Economic Overview: 2013

Industrialisation creates jobs, brings higher income to workers and improves the standard of living. According to these authors, industrialisation is measured by the size of the manufacturing sector as well as its rate of growth.

Brahmbhatt, et al. (2010) recounted that countries that experience the discovery of a large quantity of mineral resource deposits are most likely to be exposed to de-industrialisation, i.e. a shrinkage or stagnation in manufacturing and other sectors. In these countries, the discovery of mineral resources or a boom in commodity prices can create an economic shock that can be perceived to be permanent. This shock can cause attention to be diverted away from other essential sectors, shifting it mostly to the primary extraction of minerals, creating a phenomenon known as Dutch Disease. Dutch Disease is defined as *"The deindustrialization of a nation's economy that occurs when the discovery of a natural resource raises the value of that nation's currency, making manufactured goods less competitive with other nations, increasing imports and decreasing exports"* (InvestorWords, 2016). A study of Brazil, conducted by José Palma (2014), shows that Dutch Disease can cause rapid de-industrialisation. This manifests in the form of changes in the structure of employment across the sectors, as well as a drop in the size and speed of development in the manufacturing sector. The industrialisation indicators that are displayed in Table 1.1 show that South Africa and Ghana have experienced the symptoms of Dutch Disease. According to these statistics, the manufacturing sector currently contributes 13% to the economy of Johannesburg, 8% to Tarkwa and 11% to Obuasi. This is low compared to the 20 to 34% contribution that manufacturing has made to sixteen advanced economies of the world (Szirmai, 2009). Table 1.1 also shows that the gross value that the manufacturing industry added to the GDPs of South Africa and Ghana decreased between 2006 and 2013, while production from mining and quarrying increased during the period. In the case of Ghana, manufacturing halved and mining activity doubled. According to Brahmbhatt et al. (2016), Dutch Disease is best alleviated by good governance, which is created by developing good and workable mineral and economic policies that promote linkages to other sectors. Therefore, for South Africa and Ghana to

avoid Dutch Disease, there needs to be focus on formulating policies that promote the maximization of upstream, downstream, and side-stream linkages on a local scale[4].

1.5.2 Gold Mining Areas

For a gold mining camp or town to emerge, there must be a significant discovery of gold in the area, and this discovery would normally lead to a gold rush. The Business Dictionary (2016) defines a gold rush as, "*a surge in activity in a specific area by individuals seeking to capitalize on newly discovered gold present in the area, during which, workers will migrate to the area where gold has been discovered and work aggressively, trying to collect as much gold as they can"*. Table 1.2 shows some of the gold rushes that transpired around the world between the 19th and 21st centuries.

Table 1.2: Gold Rushes

19th Century	**20th Century**	**21st Century**
Canada, Australia, South Africa, United States, New Zealand, Ghana	Kenya, Fiji, Brazil Amazon, Papua New Guinea, Indonesia	Mongolia, Peruvian Amazon,

The most significant gold rushes occurred during the 19th century in Canada, Australia, South Africa, and the United States of America. Although Ghana and New Zealand also experienced gold rushes during this period, they occurred on a smaller scale. Table 1.2 also shows that modern day gold rushes are currently being experienced in countries like Indonesia, Papua New Guinea as well as the Amazon areas of Brazil and Peru. Further analysis reveals that modern mineral rushes are caused by a combination of regime policy and the discovery of deposits. The next section of the report will focus and elaborate more

[4] Development of up-stream links into financial services, consumables and services, down-stream linkages into beneficiation and manufacturing, side-stream linkages into infrastructure, Research and Development, Human Resources Development (AU, 2009).

on the emergence, history and the current state of the gold mining areas of Johannesburg in South Africa as well as Tarkwa and Obuasi in Ghana.

South Africa: Johannesburg

Callinicos (1980), a social historian and researcher, has written extensively about the emergence of the gold mining area of Johannesburg. Her book titled "*Gold and Workers 1886-1994"*, and a report compiled by Virtual Metals Research and Consulting Limited (2006) titled "*Reserves to Doré – The Gold Mining Industry"*, were the main sources that were used to acquire information about gold mining in Johannesburg. According to these sources, the gold mining industry is the only reason that the City of Johannesburg came into existence. The discovery of what seemed to be an infinite gold orebody, on a small farm located in a State formerly known as the Transvaal, transformed the land-locked area into the most prosperous mining region in the world. Prior to the discovery of gold, Johannesburg was merely an agricultural area with a small population. As word of this major finding spread across the world, foreigners made their way to Johannesburg deserting other gold fields, bringing mining and other knowledge and skills to the area. The deposits that were discovered were high grade, easily accessible, located close to the surface, and extended for kilometres in length and depth. This created favourable conditions that made early operations highly profitable. It also made it feasible to conduct additional detailed exploration of deeper portions of the orebody.

The discovery of the Witwatersrand basin has allowed South Africa to develop a first-class gold industry, which dominated the global mining scene for almost 120 years. The basin has produced an estimated 1.6 billion ounces of gold (see Table 1.1), making up over 30% of all of the gold ever mined in the world. Although gold production in South Africa has decreased over time, the country still produces the highest quantity of gold in Africa. Table 1.1 shows that South Africa produced 4.8 million ounces of gold during 2014. The gold mining industry has also helped South Africa achieve the following notable goals:

- The establishment of the City of Johannesburg, the economic hub of South Africa and the largest city in the world that is not located near a trade route, a large water way, or by the coast;
- It has acted as a catalyst for industrialisation and economic development, and enabled South Africa to become by far the most industrialised country in Sub-Saharan Africa; and
- It has created several important upstream, downstream and side-stream linkages, large parastatals, tertiary institutions, large gold refineries, beneficiation plants and factories, service sectors and crucial infrastructure such as roads.

Today, gold mining mainly occurs on old tailings dams and waste dumps that are on the outskirts of Johannesburg, but this is practised on a smaller scale. Although gold mining has played an important role in economic development, it has also contributed to rapid urbanisation. Quick influxes of the rural population into the city has created environmental, social and financial challenges. It has created an increase in the need for housing, resulting in accommodation problems and the development of shantytowns[5]. There is also immense pressure on utilities and a backlog on municipal services, resulting in some of the residents using illegal means to acquire utilities and services. This has consequently increased crime, health hazards and environmental pollution. Inequality and unemployment remain the biggest challenges in the area; this has led to industrial and community protests as well as various criminal activities and corruption. South Africa has established programs that involve governance, to address the social challenges that come with urbanisation.

The challenge for Johannesburg now lies in developing new and more advanced ways to further grow and diversify the economy and combat these challenges. The Johannesburg gold mining sector can be revived and contribute towards further economic growth and development. This can be achieved if South Africa makes positive research and development (R&D) advances towards profitable ultra-deep mining techniques.

[5] Information obtained from the 2011 census, published by the City of Johannesburg shows that 40% of the residents in the area of Johannesburg are subjected to inadequate housing, and 20% live in abject poverty

Johannesburg still contains abundant gold resources at greater depths; however there is a lack of adequate knowledge regarding profitable extraction the deeper gold deposits.

Ghana: Tarkwa and Obuasi

A few scholars have studied the history and socio-economic impact of gold mining in Ghana. Notable among them are Ofosu-Mensah Ababio (2012), Akabzaa and Darimani (2001), Hilson (2001), Taylor (2006) and Peters (2013). According to these authors, Ghana, formerly known as Gold Coast, has a well-documented history of being the principal global producer of gold between 1480 and 1600. During this period, Ghana produced about 8 million ounces of gold, which equated to more than one third of the global gold supply, however, production declined gradually after the 1600s because of a rise in global competitors and world wars.

Modern day gold mining in Ghana began at the end of the 19th century. It was ignited by big waves of international exploration that were termed the Jungle Boom. The Jungle Boom had a modest beginning because of two main difficulties that limited prospecting and exploration. Firstly, the gold deposits were located in dense forests that had poorly developed infrastructure; this made it difficult to physically access the orebodies. Secondly, native chiefs ruled a great portion of the land; this made it almost impossible to purchase a stake on a claim. These challenges were reduced over time because of the development of earth moving technology and the implementation of modern policies and regulations that made business attractive to foreign investors. The changes caused a significant influx of foreign miners into Ghana, and an increase in gold mining activities during the 21st century. This resulted in what seemed like a modern-day gold rush, caused by progressive law and policy.

Ghana has produced close to 100 million ounces of gold since the beginning of modern mining. According to the Global 2013 Gold Mine and Deposit Rankings, Ghana produced 2.9 million ounces of gold during 2014 (see Table 1.1), making the country the second largest producer of gold in Africa. The highest quantity of gold is sourced from the areas of Tarkwa (located in the Western region on the Tarkwaian system) and Obuasi (located in

the Ashanti region on the Birimian system). Similar to the emergence of early Johannesburg, the mining activities in these areas created the gold mining communities of Obuasi and Tarkwa. According to the Ghana Chamber of Mines (2012) and Ofosu-Mensah (2011), modern mining has brought the following benefits to the areas of Tarkwa and Obuasi:

- Rapid growth in the population and skilled labour;
- Access to previously non-existent physical and social infrastructure (such as roads, water, electricity etc.);
- An improvement in the quality of health services, hospitals, and clinics, providing easy access of western medication;
- Education in the form of better quality schools built for the children of expatriates that migrated to the areas; and
- The establishment of support services, providing a better level of human resource development, and technology access to remote and previously underdeveloped areas of the country.

Despite the development in infrastructure and facilities, the mining towns of Tarkwa and Obuasi have not developed to the same extent as Johannesburg. Table 1.1 shows that many of the people in both areas do not have access to basic services such as proper sanitation, water and electricity. Regrettably, both towns look very different from other gold mining areas that have experienced gold rushes and enjoyed the economic benefits of the industry. Examples of towns that benefited include Northern California and Denver in the United States of America, Kalgorie-Boulder in Australia or even Johannesburg in South Africa. The scholars argued that gold mining in Tarkwa and Obuasi has not made a meaningful contribution towards sustainable economic development for the following reasons:

- The benefits and opportunities associated with gold mining activities in Tarkwa and Obuasi have been greatly overestimated and they remain essentially intangible to the mainstream local communities;

- The environment has been degraded by mining activities, and this has diminished alternative livelihoods such as farming. This has brought further impoverishment to local communities that are directly impacted by the mining activities;
- Gold mining has displaced communities and created inconsistency in the distribution of wealth and royalties; and
- They concluded that the mineral wealth of Tarkwa and Obuasi has become a cause rather than a remedy for under-development.

1.6 Research Questions

Johannesburg, Tarkwa and Obuasi have been practising modern gold mining for well over a century. Although the economic benefits of the industry are evident in Johannesburg, it does not seem like the gold mining areas in Ghana have benefited sufficiently. For this reason, this research report presents the following main question: Why does one see more economic development in Johannesburg than in Obuasi and Tarkwa, even though modern gold mining began at the same time in all three areas? This fundamental question has resulted in the following secondary questions:

- What efforts did Johannesburg make to reach its current level of economic development?
- What are the lessons to be learnt from Johannesburg regarding the areas' transformation, from a mining camp to a world-class city?
- What measurable efforts have been taken in working towards economic development in Tarkwa and Obuasi?
- How can Tarkwa and Obuasi work towards achieving sustainable development that is like, or even better than that of Johannesburg?

1.7 Hypothesis

This study will be carried out to give a better understanding of the systems and measures that need to be in place to enable the mining industry to become a catalyst for economic development. If we understand how Johannesburg was able to use the gold mining industry

to achieve its current level of economic development, we can work towards achieving the same level of economic development, or better, in areas such as Tarkwa and Obuasi.

The main concern about this project is based on whether it is possible to compare Johannesburg with Tarkwa and Obuasi. The gold mining areas of Ghana are located more than 5000 km from Johannesburg, in environments that present different opportunities and challenges. There is also a possibility that the sizes of the orebodies in these areas might not be comparable. The availability of data and specific economic indicator fractions will also present a challenge. Another concern is that Tarkwa and Obuasi may have a higher probability of developing into mining ghost towns than economic hubs. Mining ghost towns have emerged even in what seemed to be the most prosperous areas such as California, Boogardie in Australia, Dawson in Canada and Virginia in South Africa.

1.8 Research Methodology

This research is a comparative study that is backed by an analysis of the political, economic, and social trends that have transpired in the South African and Ghanaian gold mining industries.

The **first phase** of the research will analyse existing literature. This will entail reading existing work about the topic at hand. Literature about the various mining towns that emerged from a gold rush and the expected evolution of the towns will be studied. This phase will also cover a historic analysis of the timelines of Johannesburg, Tarkwa and Obuasi. Literature about the challenges that mineral rich areas face when developing their natural resources will be analysed. The last sections of phase one will elaborate on the concepts of Local Economic Development and Sustainable Economic Development.

The **second phase** of the research will entail conducting case studies on the gold mining areas of Johannesburg, Obuasi and Tarkwa. These case studies will focus on information such as the mineral law of the countries, the natural characteristics of the gold deposits, the mining industries of the areas, the evolution of the economies and politics,

environmental and social impacts, initial mining investments that went into the areas, as well as research and development.

The **third phase** of the research will compare the three case studies and identify the key mineral wealth challenges the areas have faced in working towards developing their economies. This phase will also attempt to fit these identified challenges into the UNECA model of mineral wealth challenges.

The **final phase** of the research will propose recommendations that will empower the gold mining areas to better manage mineral wealth challenges, and work towards sustainable economic development.

Since the data that will be collected will not have equal levels of credibility; the authenticity of the less credible data will be verified by information from regulatory bodies such as the Minerals Commission and the Chamber of Mines. Official government databases such as Stats SA and Stats Ghana, websites of international organisations such as the United Nations and the World Bank, academic research and accredited economic databases will also be used for validation.

1.9 Report Structure Outline

Chapter 1: Background and Outline of the Problem

Chapter 1 begins by proposing the general problem as well as its background. This chapter exemplifies the framework of the research, the importance of the research, the objectives, and the methods that will be used to gather the information and compile the final report. Chapter 1 ends by pointing out the limitations of the study.

Chapter 2: Analysis of Existing Literature

Chapter 2 introduces and redefines the research topic. It cites published exemplary studies that are related to this research. The chapter commences by describing the different types of settlements that can emerge in an area where a mineral deposit is discovered. It then

shifts to giving an understanding of the historic timelines of Johannesburg, Tarkwa and Obuasi. The chapter then looks into describing the mineral wealth challenges (identified by the United Nations) that resource rich settlements may face. Chapter 2 ends by giving the reader an understanding of the concepts of Local Economic Development and Sustainable Economic Development.

Chapter 3: A Case Study of the South African Mining Area of Johannesburg

Chapter 3 begins by giving an overview of South Africa and the Witwatersrand gold basin. It describes the geological and geographical scene of the countries, and moves on to giving a recount of the mineral laws that transpired in the country since the late 19th century. The chapter then gives a detailed case study of Johannesburg with focus on the nature of the gold deposits, the gold mining industry, the production capability of the gold deposits, politics and economics, and the environmental and social challenges that the city has encountered as the result of extensive gold mining.

Chapter 4: A Case Study of the Ghanaian Mining Areas of Tarkwa and Obuasi

Chapter 4 begins by giving an overview of Ghana and the Ashanti gold belt. It gives an understanding of the geological and geographical settings of the country. It also briefly touches on the mineral laws that have regulated the industry since the start of modern mining. It then moves on to separately giving detailed case studies of Obuasi and Tarkwa. The case studies focus on the nature of the gold deposits, the gold mining industry and its production capability. They also give encounters of the political and economic events that affected the performance of gold mining in the two areas. The chapter ends by discussing the social and environmental challenges that the mining areas have faced because of extensive gold mining.

Chapter 5: Comparison between Johannesburg, Tarkwa and Obuasi

Chapter 5 presents a comparative analysis between the case studies of Johannesburg, Obuasi and Tarkwa (i.e. Chapters 3 and 4). This comparative study is conducted in the

form of multiple tables. The comparison identifies the factors that may have boosted or hindered the economic progress of the three areas. The chapter also identifies the mineral wealth challenges these areas encountered in attempting to translate mineral wealth into economic development. Chapter 5 ends by fitting the mineral wealth challenges that are identified in the comparative analysis into the mineral challenges model of UNECA.

Chapter 6: Conclusion and Recommendations

Chapter 6 draws conclusions from the study and makes recommendations. Based on the comparative analysis, the author makes recommendations on what Tarkwa and Obuasi can do to combat mineral wealth challenges. It briefly talks about the measures that Johannesburg can put in place to develop its economy further. These recommendations will enable the three areas to work towards sustainable economic development.

1.10 Conclusion

Chapter 1 focuses on introducing the research problem and providing background information that supports the problem. It offers an outline of the problem statement as well as the research aim, objectives and the methodological steps that will be followed in gathering information. This chapter also points out the limitations of the study.

Chapter 2 gives a theoretical structure for the research. It analyses literature on mining settlements, the historical timelines of the settlements of Johannesburg, Obuasi and Tarkwa. It also deliberates on Local Economic Development (LED) and sustainable development in mining areas.

2 ANALYSIS OF EXISTING LITERATURE

2.1 The Development of Mining Settlements

As stated at the beginning of Section 1.5.2 (Gold Mining Areas), a large discovery of a mineral deposit would normally lead to a rush that would spark the emergence of a new settlement in a previously underdeveloped region. A new mineral discovery could also expand an existing settlement. This section of the report focuses on the types of mining settlements that can emerge or expand because of mineral exploitation. It is based on a paper that was written by Bryceson and MacKinnon (2012). These scholars are amongst the few that have studied the link between the mining industry, settlements, industrialization, and urbanization.

The mining industry and subsequent industrialization have been catalysts for migration and population growth in specific urban areas. This is because mining activity has the potential to not only create employment opportunities within the primary sector, but to also create opportunities for labour to serve the emerging and expanding secondary and tertiary sectors.

The paper deliberated on a term called “mineralized urbanization”. It described mineralized urbanization as the impact that the cycles of mineral production and commodity chains have on the growth and settlement in urban areas. This applies on a local, regional and national scale. Mining settlements are tightly associated with mineralized urbanization, which in turn is strongly affiliated with commodity booms. Bearing in mind this connotation, mineralized urbanization is expected to increase in the event of a mining boom, and similarly if there is a downturn, urbanization will most likely follow a downward trend. Bryceson and MacKinnon (2012) categorized mineralized urbanization areas into two types of settlements. These are namely, specialized mining towns (towns that focus on the primary extraction of ore) and trade mining towns (towns that focus on the trade of products that are created higher up in the mining value chain).

2.1.1 Specialized mining towns

Specialized mining towns are described as settlements that are directly associated with the extraction of minerals. These settlements are usually located near the mineral deposit that was discovered. Specialized mining towns experience rapid urban growth and development in the early stages of establishment. This is because of the large capital injection that is associated with the commencement of new mining projects, and the expansion of existing projects. Unfortunately, the exclusive dependence on mining, and the remote location of these settlements do not result in a diverse economy. By virtue of this, the rate of economic growth and development in specialized mining towns has a high probability of decreasing or stagnating in the future.

In addition to becoming highly susceptible to external market forces, specialized mining towns tend to be subjected to the 'Gillette Syndrome'. This is a phenomenon that is mostly linked to rapid urbanization and settlements that emerge near large mineral resource deposits. The Gillette Syndrome is described as the social and corporeal disruption of a community resulting from rapid urbanization. It provokes problems such as a high crime rate, pollution, abnormally high costs of living etc.

2.1.2 Trade mining towns

Trade mining towns are described as settlements that concentrate on mining activity that is higher up in the value chain. These settlements encourage multiple supporting and alternative or advanced sectors to emerge from the mining sector. Trade towns focus mainly on the manufacturing and trading of mining products. These settlements are usually preexisting and enlarged by the mining industry. They also encounter many opportunities for diverse business expansion.

Some of the few examples of trade mining towns are San Francisco in the United States of America and Melbourne in Australia. During the Californian gold rush, the city of San Francisco was the main supply base for gold. The gold trade enabled this city to grow into one of the largest modern-day metropolises and financial centers in the world. Melbourne on the other hand has been the center of commercial directive in the Australian mining

industry since the days of the Victorian gold rush (1850s to the late 1860s). Towns that trade in mining products are more likely to experience higher development at a faster and more consistent rate than specialized mining towns. Trade also has the potential to foster indirect development in the mining areas and countries. This is most applicable to areas along trade routes, national capitals and coastal areas.

2.2 Historic Timeline –The Mining Settlement of Johannesburg

Many scholars have written extensively about the evolution of the Johannesburg mining settlement, the gold mining industry, and the resulting economic development. Notable amongst them are Harrison and Zack (2012), Bryceson and MacKinnon (2012), Crankshaw and Parnell (2004) and Callinicos (1980). Cawood and Minnitt (1998) gave a recount of the development of the mineral rights system of Johannesburg throughout this period.

The literature written by the above-mentioned academics dates back from the genesis of modern gold mining in 1886 to the present. The author has divided the analysis of these literature into 3 eras, which are, **1886 to 1948**, the discovery of gold in Johannesburg to the election of the National Party, **1948 to 1994**, the beginning to the end of the apartheid era, and lastly **1994 to 2011**, the democratic era.

1886 – 1947 –Discovery and Expansion

Johannesburg was established in 1886 by the discovery of an enormous high-grade gold orebody. This discovery sparked the biggest gold rush in the world and quickly transformed a struggling, land-locked area that was dependent solely on agriculture, into the most prosperous mining region in the world. Johannesburg immediately became a specialized mining settlement that drew the attention of foreign (mainly European) economies. Since most of the valuable ore reserves were located underground, the existence of potential small scale and artisanal miners was diminished immediately. This enabled large mining companies to quickly dominate mineral ownership.

One decade after its discovery, the Witwatersrand basin became the largest gold producing area on earth. The area attracted an influx of highly skilled migrant European and Australian expatriates, however, this influx sparked political turmoil between the British and

the locals (the Boer republic). Following conflict in the mid-1900s, the British successfully secured Johannesburg and gained full economic and political dominance of the area. This victory and the favourable climatic conditions empowered the Europeans to settle comfortably in Johannesburg. Settlement encouraged the foreigners to keep the mineral wealth in the area and invest in the local economy rather than channelling it offshore. This mineral wealth is what was used to shape the early local and national economies.

According to Cawood and Minnitt (1998), the discovery of gold resulted in the swift passing of a law that reserved all mineral rights for the State. To promote the development of mining projects, the State established various stands for auction to mining houses. In doing so, the State allocated surface right permits of privately owned land to mining companies, tarnishing the individual rights of the existing landowners. Much later in the 1990s, this law was abolished and mineral rights were returned to the landowners. This was a momentous step towards shifting the mining industry from the public sector to the private sector.

During the first quarter of the 20th century, mining activity increased Foreign Direct Investment (FDI), and created an enormous demand for labour. To meet the high demand in labour and reduce mining costs, mining companies sought to recruit low-cost and unskilled migrant workers from neighbouring countries over the locals. Significant sources of cheap labour were from countries such as Mozambique, Malawi, Botswana, Namibia, Lesotho and Zimbabwe, who fuelled the migration of immigrants into Johannesburg. Government supported the idea of low labour costs to safeguard the future profitability of the gold mines, and the economic development of Johannesburg.

In 1932, the price of gold saw an increase of more than two-fold overnight, and it continued to increase steadily over the next years. This increase was triggered by South Africa's abandonment of the gold standard[6] (see Figure 2.1). The high gold price spiked several prospecting and exploration activities in Johannesburg, resulting in an increase and expansion in mining projects and further promotion of population and economic growth.

[6] The business dictionary (2014) defines the gold standard as a *"System of backing a country's currency with its gold reserves. Such currencies are freely convertible into gold at a fixed price, and the country settles all its international trade transactions in gold"*

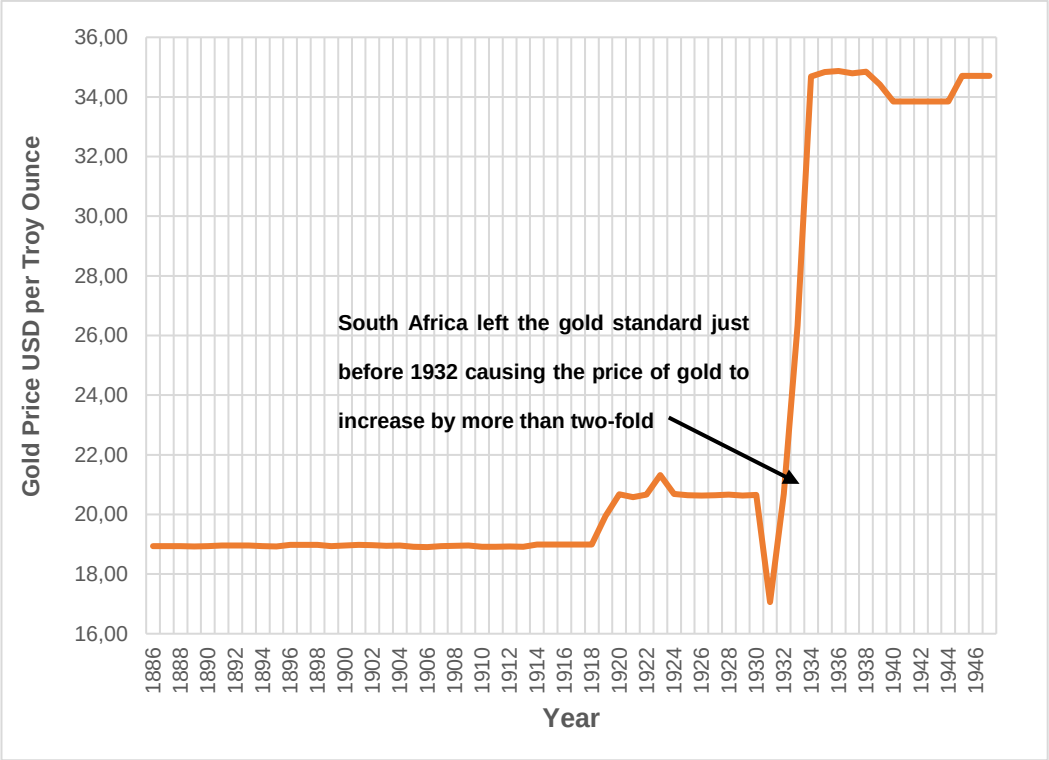

Figure 2.1: Gold Price 1886 to 1946 OnlyGold.com (2015)

The Second World War transpired (from 1939 to 1945) following the increase in the gold price. It brought about two significant shifts in the South African economy, which were:

- Channeling of a significant number of male labour into the World War; and
- The alteration of national economic policies to advocate for import substitution. This promoted the replacement of imported products with domestic production.

These conditions combined with an increase in prospecting and exploration, created a very high demand for labour in the Johannesburg gold mining industry. The demand in labour spiked an increase in mining wages. This wage increase could not be matched by other sectors. To mitigate the labour shortage, racial segregation laws were suspended to allow black workers and cheap migrant labour into the industry. This also enabled the labour to move into the urban dwellings. The migration resulted in the expansion of native or black informal settlements on the outskirts of Johannesburg.

Johannesburg was a specialized mining settlement for nearly the first half of its existence. During these early years, there was no guarantee that the Witwatersrand gold mining

industry would survive. This condition was aggravated further by the fluctuations in production caused by political instability and external market factors. The circumstances crated great concerns about the probability of the young mining economy collapsing and the area becoming a ghost-mining town.

1948 – 1994: The Apartheid Era, the Peak and Decline of Gold Mining

The late 1940s brought the election of a new government and the enactment of the apartheid law[7]. Despite apartheid, the Johannesburg goldfields continued to flourish and attract a large amount of capital. South Africa was at the peak of gold production, accounting for 30-40% of the global output, a value which peaked to 78% in 1970. The gold mining industry was the single biggest employer in Johannesburg.

The mining industry was also on a path of creating strong linkages to other sectors of the economy. The establishment and growth of tertiary institutions such as the Johannesburg Stock Exchange and the Anglo-American Corporation of South Africa also contributed to more profits being drawn into the city. Johannesburg was well on its way to becoming a major capitalist and trade centre.

During this period, the manufacturing sector was also experiencing an upward path in development. Although the manufacturing sector initially acted as a service industry to the large mining sector, it began to outperform the mining industry. Between the years of 1960 and 1970, manufacturing began to gradually overtake the mining sector and became the center of the economy. By 1980, the manufacturing sector had employed close to one million people in Johannesburg. Unfortunately, one year after reaching its peak, the growth of the sector began to stagnate and decline. This resulted in labour migrating back to mining and the tertiary sectors. Gold output from the Johannesburg mines followed a similar downward trend after 1980. This was due to the depletion of existing ore reserves, and difficulties in accessing the deeper mineral resources. Despite the reduction in gold

[7] Apartheid was a law that enforced racial segregation and restricted the influx of blacks in the urban areas.

output, gold mining in Johannesburg remained profitable. This was mainly due to the spike in the gold price in 1980[8].

Mining legislation that was enacted during this era promoted privatization, making the industry even more attractive to potential investors. The Mineral Laws Supplementary Act 10, that was passed by the South African government in 1975, opened channels that gave mining companies the ability to acquire minerals that were difficult or impossible to access previously. This and other Acts that were passed assisted prospecting to be administered in a way that promoted optimal exploitation of the resources. Nonetheless, the mineral rights system in the country was complicated and there was great uncertainty concerning the ownership thereof.

During this era, the government also endorsed the establishment of the Chamber of Mines Research Organisation (COMRO). COMRO was a proactive facility that focused on Research and Development in the mining industry. It also worked on developing solutions for key problems that faced the South African mining sector. The research that was conducted by COMRO resulted in several step changes because of world-class worth. South Africa became known as a mining research capital of the world. COMRO brought solutions that enabled gold mines to thrive and mine at greater depths.

1994- End of apartheid, upsurge of Johannesburg, and decline of gold mining

The democratic era brought the abolishment of several apartheid laws in South Africa. This gave Johannesburg mineworkers the liberty to move around and settle in urban areas, which they were formerly denied access. The abolishment was followed by a high influx of labour and people seeking better opportunities, causing an oversupply of local labour in the Johannesburg gold mining sector. The poor integration of formerly excluded individuals into the urban areas fuelled and prolonged some of the pronounced effects of the Gillette Syndrome (i.e. inequality).

[8] In 1980, gold reached its highest average of 630 USD per troy ounce. This was caused by the United States of America's exit from the gold standard.

During this period, South Africa continued to experience a sharp decline in gold mining activity. According to Harrison and Zack (2012), gold production declined by 80% between 1970 and 2011. The gold price fluctuated between 380 and 270 USD per troy ounce, hitting its lowest figure (270 USD) in the year 2001. The declining gold price combined with the fact that prospective deposits were of a lower grade and located at greater depths, resulted in a drastic reduction in the rate of investment and employment. Another major factor that contributed to the regression of the gold mining sector was the reversion in R&D. The closure of COMRO starved the industry of solutions to technical challenges that the mining industry was facing. In the past, research was always ahead, however when COMRO closed, mining activity began to catch up with the research. Parts of the ore bodies could not be mined because research was not done. In the 2000s, research was conducted into the limits of mining knowledge. It is because of limited knowledge that the Wits gold mines can no longer continue to mine the way they had previously mined despite the relatively high gold price. Research and Development can reinvigorate and create new employment opportunities both inside and outside the mining cluster. This would be good for sustainable economic development, and it can lead to Johannesburg becoming the technology hub of Africa.

This era also brought some clarity on the system of mineral right distribution. On the 1st of May 2004, the promulgation of the Mineral and Petroleum Resources Development Act (MPRDA) Act 28 of 2002, in replacement of the Minerals Act, enabled the transfer of privately-owned mineral rights to the State. Through this, the State created the ability to separate mineral rights from the land ownership and ensure unbiased access to mineral resources for all citizens. This law was enacted to promote sustainable development of the country's mineral resources.

Originally built to be a specialized mining settlement, Johannesburg has surpassed the life cycles of the gold mines and continues to advance and prosper. The city is much admired for leaping from a greenhorn unstable mineral-based economy, to an advanced modern economy within a period of 130 years. According to Harrison and Zac (2014), European cities developed at a much slower rate as compared to Johannesburg. Today the gold

mining sector contributes less than 5% to the GDP of Johannesburg. The little mining activity that occurs is of a small-scale, and it takes place on tailings dams and waste dumps that lie on the outskirts of the city. The ability of Johannesburg to evolve into a varied and progressively growing urban agglomeration has caused the area to be compared to cities such as San Francisco and Melbourne.

Johannesburg now faces the challenges of urbanisation, and discovering ways of further developing the economy. Rapid migration has brought social challenges such as increased alcohol and drug abuse, high crime rate, health challenges (high rate of HIV/AIDS). Acid Mine Drainage[9] (AMD) has been one of the biggest environmental issues caused by abandoned gold mines. Although there have been concentrated efforts from government to address these challenges, they remain a great concern for the city.

2.3 Historic Timeline –The Mining Settlements of Tarkwa and Obuasi

This segment of the report examines literature conducted by Ayee et al., (2011), Ofosu-Mensah Ababio (2012), Akabzaa and Darimani (2001), Hilson (2001), Taylor (2006), Debrah et al., (2013) and Peters (2013). The first goal of this analysis is to increase understanding about the way the mining settlements of Tarkwa and Obuasi emerged and evolved over the years. The second goal is to understand how the gold mining industry has influenced mineral-based economic development in these two mining settlements.

Most of the literature that exists about the Ghana mining areas is at a country or national level. The supply of literature that looks into the mining settlements of Tarkwa and Obuasi is limited compared to the volume that is available for Johannesburg. Despite this, the existing information gives the reader a good idea about the issues that shaped Tarkwa and Obuasi.

[9] Acid Mind Drainage occurs when contaminated water from the abandoned mines, tailings dams and waste dumps discharges to the surface, contaminating fresh water suppiles, vegitation and infrastructure.

The analysis of the Ghana mining settlements has been divided into three key historic phases, which are **1874 to 1956**, the pre-independence period, **1957 to the mid-1980s**, the post-independence and nationalisation period, and the **mid-1980s to present** (post ERP).

1874 – 1956: Pre-independence Period

Gold mining in Ghana dates to pre-colonial times. During the colonial era, Ghana was named Gold Coast because of its auriferous nature. Before the country was colonised by the British, mining activity was predominantly artisanal and the locals conducted it. Artisanal and Small-Scale Mining (SSM) served as an important source of employment and livelihood to the local communities. This industry has been the central factor to the establishment of many Ghanaian kingdoms and the source of their power and wealth for empires such as the Ashanti. During the pre-colonial times, Ghana accounted for 36% of the global gold production. However, production declined in the years to follow due to political instability and the establishment of stronger global competitors.

Modern mining in Ghana began during the 1880s under the administration and capital ownership of British concessionaries. Gold exploration and prospecting in Ghana was called the Jungle Boom. The activity had a modest beginning because of two limiting factors. Firstly, the location of the gold deposits in dense forests, this made it difficult to physically access the ore bodies. Secondly, native chiefs ruled a great portion of the land and it was impossible for the British to gain ownership of such gold bearing land. Despite the accessibility challenges, the mining industry was vibrant and intense; prospecting and exploration continued.

The areas of Tarkwa and Obuasi were known for their abundant gold resources and centuries of artisanal mining. These two areas became targets for intense prospecting and exploration during the era of modern mining. Tarkwa is historically known as the primogenital hub of formal mining in Ghana, and its location along several trade routes gave it an economic advantage. Like Tarkwa, the mining settlement of Obuasi was known for production of high quality gold. At a point in history, the Obuasi mine accounted for

over sixty percent of the total gold produced in Ghana. This made Obuasi mine the single biggest foreign exchange earning industrial institution in the country.

During the colonial era, the minerals policy of Ghana was moulded by British mining interests, the primary goal was to satisfy the economic welfare of the British. Seeing that colonial mining policies advocated for the autonomy of the British Empire, mineral wealth was channelled away from the country and the areas of Tarkwa and Obuasi. The minerals policy also empowered colonial authorities to pass legislation that declared small-scale mining operations illegal. Bearing in mind that small-scale mining had been a very important source of livelihood for Ghanaian local communities, this law deprived many households of income. Although the number of large-scale mines increased under the rule of colonial territories, the operations were too few to have the same developmental impact. The large mining operations that existed were not enough to absorb the surplus of people who had lost employment due to the prohibition of small-scale mining. This factor raised the rate of unemployment in Tarkwa and Obuasi; it also gave energy to the culture of illegal small-scale mining (galamsey).

Most of the new infrastructure that emerged in Tarkwa and Obuasi was developed to make the stay of the expatriate employees comfortable. It was also built to facilitate ore extraction and transportation. The living conditions in most of the mining settlements remained unchanged. Tarkwa and Obuasi communities were predominantly rural, with dwellings (huts) built out of resources from the forests such as wood, clay and palm branches. Building was unsystematic with a lack of proper planning, with no in-house water or drainage systems. Large mining companies made some structural improvements by building mining camps that were equipped with health and recreational facilities for their employees. Although living conditions remained unchanged in most parts of the rural areas, mining brought a culture of modern building and recreation.

Modern mining continued to attract Foreign Direct Investment (FDI) into the country and heightened the development of rail infrastructure in the country. During 1901, the British colony extended a railway line from Sekondi port to Tarkwa, and in 1903, the railway line

from Obuasi to Sekondi was constructed. This infrastructural development assisted in the transport of gold ore from site to port, making the mining industry even more attractive to investors. The infrastructural development contributed to the sharp increase in gold exports[10]. It also resulted in an increase in migration to the areas of Tarkwa and Obuasi.

High migration into the area brought about several negative social impacts such as a high crime rate, the weakening of the agricultural sector and health issues. Ofosu-Mensah Ababio (2012) wrote that, there was a high prevalence and incidence of venereal diseases in Obuasi during the 1950s caused by an increase in prostitution. There was also an increase in the contraction and the spreading of tuberculosis and occupational health diseases causing a large number of labour to perish. The deficiency of health education and poor health facilities played a factor in the fast spreading and poor treatment of these diseases. Environmental pollution caused by mining activities also brought economic challenges. Agricultural land became contaminated and degraded and this contributed to the abandonment of alternative livelihoods. The reduction in alternative livelihoods, coupled with the inability to create linkages to other sectors of the economy, caused both settlements to become extremely dependent on the primary extraction of gold.

Gold production in Ghana hit its highest figure of 882241 ounces in 1941. However, production began to decline during the Second World War; by 1945, production had dropped to 527628 ounces. Production continued to decline in the subsequent years, and these declines were fuelled by fear amongst the investors, which was sparked by the country's movement towards independence. Investors slowly began to pull out of Ghana causing the mining industry to deteriorate further.

1957 – 1980s: Post-independence and Nationalisation

After the country gained independence in 1954, the Government of Ghana took back the minerals sector. Unfortunately, the Nkrumah regime inherited a gold mining industry that had experienced decades of neglect, degradation and disinvestment. To save the industry,

[10] Increased from 14.5 million ounces per annum to 22.3 million ounces between 1880 and 1955.

the government enacted legislation that allowed the mining industry to be State-owned. The regime's strategy was to take a pragmatic approach nationalisation with reference to foreign investment. Since most of the Ghanaian mines were already suffering prior to nationalisation, the administration had planned to nationalise poorly performing mines owned by foreigners who were looking to opt out. The thought was that nationalisation would save the mines for closure and subsequent job losses. The government had nationalised all the mines in the country, except for Ashanti Gold Corporation's Obuasi mine, which was nationalised later in 1972. Ghana produced and bought its own minerals during this period. Unfortunately, the country did not have the capital or management skills to revive the ailing gold mines and return them back to their productive state. The reduction of mining capital and political instability that followed independence crippled gold mining exploration and development. Skills were further limited by the burden of high personal tax rates which made employment in the country unattractive to skilled expatriates. Even though gold production increased shortly after nationalisation, it experienced a rapid decline from 1958. Although the objective of nationalisation was to create employment and encourage the development of other industries, it had the opposite effect on the economy. In the long term, it would have a prolonged negative impact on the mining industry as well as the economy of Ghana. Ghana's GDP declined by 1.6% per annum, it fell by a large 14.5% in 1975. The country also had trouble in the form of a depreciating currency and foreign exchange shortages. This caused the cost of living to be very high, and life for many people (both locals and expatriates) became very difficult. There was also a deterioration in infrastructure and insufficient energy supply to meet increasing industrial demands.

Gold mining areas such as Tarkwa and Obuasi saw a significant reduction in mining investment and exploration activities. Although there are no statistics available to indicate the decline in employment, it is known that gold mining output fell by 25% between 1970 to 1977. This led to the closure of many State-owned mines. The long period of decline in mining and the economy created setbacks that persisted in the mining areas for over twenty years.

1980s to date: Privatisation to Present Times

During 1983, to rescue the country's economy and revive the mining industry, the new government announced their intention of privatisation as well as the relaxation of nationalisation regulations. The implementation of the Economic Recovery Program (ERP) resulted in what seemed to be a modern-day boom in the gold mining industry, breathing instant life into the economies of Tarkwa and Obuasi. The ERP had an instantaneous positive impact on mining investment, enabling the country to attract more than 5 billion USD in FDI.

To accommodate the ERP, the mining sector underwent several organisational adjustments, policy adjustments, and other changes in the regulatory structure. These changes included the divestment of State owned mines, the establishment of the Ghana Minerals Commission, legalization of small-scale mining and establishment of the Precious Minerals Marketing Corporation, a body that would facilitate the sales of ore produced by small-scale miners. The country also negotiated generous fiscal and other incentives with international investors and mining companies, creating a favourable investment environment that resulted in the establishment and expansion of mining companies and support services.

The ERP revived the mineral economies of Tarkwa and Obuasi, and enabled Tarkwa to become home to six surface gold mining operations, this includes one of the world's biggest surface gold mines. Ghana experienced a staggering 700% increase in gold production between 1986 and 2005. Although the expansion of large-scale gold mining brought several economic benefits on a national scale, it resulted the displacement of the small-scale gold miners, causing infringement on sources of livelihood and increase in conflicts.

The legalization of small-scale mining in 1989 had a positive impact on the industry because it formalized the small-scale gold trade and reduced illegal smuggling networks. After small-scale mining was legalised, the country recorded an increase in the flow of small-scale gold revenue into the national economy. By 2011, the small-scale gold mining industry contributed about 28% to the total gold production. Small-scale mining is currently

the largest employer of the mining labour force in Ghana. Although there are no precise figures available, it has been estimated that over 1 million people are engaged in the activity of artisanal and small-scale mining. Small-mining is currently reserved for the country's locals only. One of the main challenges these mining areas faces is that most small-scale miners operate illegally without the correct acquisition of mineral rights.

Although mining has brought population growth and the development of infrastructure to Tarkwa and Obuasi, the areas have not developed to the level that was expected. Many of the residents still do not have access to basic services such as proper sanitation, water and electricity. It is argued that gold mining in Tarkwa and Obuasi has not made a meaningful contribution towards sustainable economic development for the following reasons:

- The benefits and opportunities associated with gold mining have been greatly overestimated and they remain essentially intangible to the mainstream local communities;
- The environment has been degraded, and this has diminished alternative livelihoods such as farming, bringing further impoverishment to local communities that are directly impacted by the mining activities; and
- Gold mining has displaced communities and created inconsistency in the distribution of wealth and royalties.

The result is that the mineral wealth of Tarkwa and Obuasi has become an obstacle rather than a remedy for under-development. The political challenges and instability the country has experienced has brought prolonged negative impacts on communities that are heavily dependent on mineral production such as Tarkwa and Obuasi. Today both towns remain specialised mining settlements that struggle to decouple themselves form the primary extraction of gold.

2.4 The Challenges of Mineral Wealth

The discovery of a noteworthy mineral resource will spark the emergence of a mining settlement. The future development of this settlement depends on how the minerals are produced and how the products are managed. When managed correctly, mineral wealth can fuel local and national economic growth and development.

A book titled “Management of Mineral Wealth and the Role of Mineral Wealth in Socio-economic Development” published by the United Nations Economic Commission for Africa UNECA (2002) gives good perception into the management of mineral wealth. This book contains a compilation of papers that were written by various scholars and promotes awareness. It also serves as a guideline for the design and implementation of policies associated with mineral wealth. The book presents the challenges that are associated with mineral wealth on a national level, and provides guidance about how these challenges can be better managed. It is entrenched in the principal belief that the awareness of the economic potential of minerals rests critically on good governance and institutions. The success of mineral-based economic development is dependent on how well the prevailing challenges are managed.

The guide begins by explaining what a mineral economy is, and continues to identify countries that have mineral economies. Although there is no standard definition of a mineral economy, the term generally describes a nation with an economy that is largely dependent on the extraction of mineral resources. The International Monetary Fund (IMF) defines a country as having a mineral economy or being mineral-dependent if the export of minerals makes up more than 25% of the value of merchandise exports. In 1998, the World Bank published a list of developing countries which had mining exports that exceeded an average of 10% between the years 1990 and 1999 (Table 2.1). The table shows that during the 1990s mineral export contributed 34% and 30% to share of merchandise exports in Ghana and South Africa respectively. Figures for 2012, obtained from the International Council for Mining and Metals (ICMM) show that by 2012, mineral dependence of both countries had increased by more than 10%. Although South Africa has experienced a

drastic decline in gold production over the years, there has been an increase in the production of other minerals such as platinum group metals, base metals, and diamonds. In the case of Ghana, 90% of mineral exports are sourced from gold production, this means that the country's dependence on one mineral has increased over the years.

Table 2.1: Mineral exports Ghana and South Africa

Country	**Mineral Export Contribution 1990-1999**	**Mineral Export Contribution 2012**
Ghana	34%	48%
South Africa	30%	42%

Source: UNECA (2002)

Despite the perceived benefits of mineral wealth, the mineral economies of both Ghana and South Africa have struggled to reap full economic benefits of the mining sector. According to UNECA (2012), the underwhelming performance is mainly attributed to the poor management of challenges that are associated with mineral wealth, and substandard institutions and governance.

2.4.1 Unfavourable External Market Forces

The prices of precious minerals such as gold are known to be unstable and volatile amidst times of economic distress. The volatility of commodity prices can lead to unstable, unpredictable and declining revenues causing a decline in mining investments. When gold mining projects are abandoned at the start or midway due to market volatility, other community or economic development projects are withdrawn. This contributes to the subsequent reduction in the rate of economic growth.

Mineral prices are established by international markets. In the case of gold and its current market, it is hard to predict prices accurately. In the event of a decline in the gold price, countries that are greatly dependent on gold exports and international markets such as Ghana, would have to export ever increasing quantities of gold (a finite resource) to match a basket of goods similar to that of imported manufactured merchandises. The requirement

to increase production quantities continuously will be a challenge because of the conventional and limited methods of gold production. Failure to meet the requirement of an annual increase will result in lower future economic growth.

2.4.2 Dutch Disease

Sachs and Warner (1995) present the following argument: *"Government and the policies created by government play a decisive role in determining whether minerals are a blessing or a curse"*. The way government responds to difficulties such as Dutch Disease[11] remains one of the main challenges of the mineral wealth.

When faced with Dutch Disease, governments become more inclined to adopt systems that adjust the economy to enable it to reap maximum financial benefits from recently discovered or developed mineral resources. This action tends to affect the local currency by strengthening it. Although a stronger local currency is good for domestic imports and consumers, it does not count in favor of exporters, who depend on income that becomes delimited by foreign currency. Dutch Disease can also lead to an increase in input costs, specifically wages, consequently drawing the labor force from other sectors into the extractive industries. This would force other sectors to increase their input costs, resulting in their contraction. When the national economy is adjusted to benefit from a temporary boom, it often becomes problematic to transition it back to its reliance on other sectors after the boom has subsided.

UNECA (2012) further argues that the mineral sector has low potential to fuel economic growth compared to the manufacturing sector. This is attributed mainly to the fact that manufacturing is more associated to the principle of learning-by-doing[12] than mining, resulting in increased productivity and reduced production costs.

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[11] Dutch Disease: "The deindustrialization of a nation's economy that occurs when the discovery of a natural resource raises the value of that nation's currency, making manufactured goods less competitive with other nations, increasing imports and decreasing exports". (InvestorWords, 2016)

[12] Learning by doing: *"a situation in which workers learn new skills from their work, and so increase productivity"* (Dictionarycentral, 2016)

2.4.3 Political Concerns

History has taught us that the abundance in mineral resources is likely to lead to instability, inefficiency and corruption in government. Political influence can direct the benefits of mineral wealth only to an elite few. It can also affect the national currency to the detriment of exporters (appreciating the national currency). These conditions can have a negative impact on long-term economic development.

The management of large windfall revenues generated from the minerals sector by the State and other stakeholders is also a major problem that resource rich African countries face. Mining revenue is poorly distributed and spread thin across many sectors. Mining revenues and royalties are sometimes squandered by government, rather than strategically invested in the rest of the economy and citizens. In addition to the wasteful spending and poor distribution of mineral wealth, other issues associated with politics are lack of accountability, poor delineation of property rights, as well as incorrect pricing of inputs and products. Such a bureaucratic burden contributes to the investment unattractiveness of a country.

Political tension can also emerge from inconsistencies with the usage and distribution of mineral wealth on local and national scales. The dispersion of mineral wealth nationally usually outweighs the local distribution. Hence the negative effects of mining activity are hardest felt by the local areas in which mining occurs. The existence of contradictory local and national agendas makes it essential to adopt a good clear, and cooperative working relationship between national government, local government, other local stakeholders, and the mining companies.

2.5 Local Economic Development

The concept of Local Economic Development (LED) dates back to the 1900s. Although there is no standard definition for LED, several scholars have attempted to define the term. Blakely (1994) defined LED as *"the process that local government or community based organisations engage in to stimulate or maintain business activity and or employment*". The World Bank (2010) described LED as an opportunity for local government to work

together with private sectors and local communities to advance the local economy. The International Labour Organisation (ILO) affirmed that LED empowers communities and it creates a platform for dialogue, transparency and accountability. It is vital for LED strategies to be custom-made to suit the economic environment of a specific local setting. This means that each LED strategy is unique. Tailored LED strategies make it easier to meet the critical economic needs of the communities. According to the World Bank (2016), some of the principal goals of LED should be to:

- Increase the capacity of the economy and to create wealth within the communities;
- Ultimately boost sustainable economic growth and development in the local community;
- Ensure that there is growth and development within all sectors of local economy; and
- Ensure that all the above goals are sustainable and can endure global economic fluctuations.

LED is built on the concept of community-led initiatives that maximise the usage of primary resources that can be used to address local economic problems such as poverty, unemployment, and a general lack of basic human needs. These goals can only be achieved by increasing job opportunities and job retention, increasing income earning levels, attracting investment into the area, and ensuring a better quality of life (The World Bank, 2010).

LED also cultivates good communication between private organisations, local government and the local community. During this process, local government, the community, private and public sectors, within a specific geographical location, work together towards the creation of a sustainable and growing local economy. Good communication between stakeholders enables private organisations (such as mining companies) to become aware of the needs of the communities and consider them when creating Corporate Social Responsibility (CSR) plans.

According to Rodríguez-Pose and Tijmstra (2009), LED strategies are not common in middle to low income African countries. In cases where LED strategies exist, they tend to be very poorly administered. This contributes to challenges such as a lack of clarity regarding economic development requirements and objectives, poor communication of economic development plans, and a lack of harmony between various stakeholders. Meyer (2013) found that the complex challenges are usually encountered from drafting the policy to implementation of the LED process, resulting in the abandonment of the strategy or poor implementation. These challenges are as follows:

a) Poor community involvement in the planning and execution process of the LED;
b) A shortage of requires skills for the planning and execution of LED projects;
c) A shortage in staff and funding;
d) Low prioritizing and a lack of support from the private sector; and
e) Poor monitoring and evaluation of LED projects.

2.5.1 Local Economic Development in Mining Settlements

Because of the finite nature of mineral deposits, it is important for mining communities to develop approaches that can promote sustainability of the economic benefits brought by mining operations. These minerals serve as primary resources that have the potential to unlock wealth and catalyse economic development. However, in order to achieve this, mineral resource extraction has to be incorporated into the local and regional development plans (Ndaba, 2010). This will empower the local economy to establish systems that will enable the maximisation of linkages to the sector and creation of other opportunities.

In the development of LED strategies, it is important for mining communities and other affected stakeholders to be well represented and actively involved. The interaction between local and national government is also a critical factor. Local government should not only actively engage with central government about the dispersal of mining revenues, but it should also communicate resource-based economic development plans. Although mineral revenues make an important contribution towards the economy, the disbursement is less sustainable and does not have wide reaching effects. The best solution is to create

additional linkages, on a local scale and use mining to advance other sectors of the economy. Economic linkages will enable economic diversification and allow the economy to work towards decoupling itself from the primary industry.

2.6 Conclusion

Chapter 2 begins by identifying that two different types of mining settlements can emerge from the discovery of mineral deposits. These are specialized mining towns and trade mining towns. The analysis of the historic timelines of the mining settlements gives an idea that Johannesburg began as a specialized mining town and evolved into a trade-mining town, while Tarkwa and Obuasi remain specialized mining towns. This is attributed to the economic and political events that have transpired over the life of the settlements. The chapter then moves to discussing the challenges associated with mineral wealth. The challenges identified by literature fall under the main categories of Unfavorable External Market Forces, Dutch Disease and Political Concerns. Chapter 2 also explained the concept of Local Economic Development. It identified that it is important for local communities to develop bottom-up LED strategies (custom made to suite their local economic conditions) that feed into the national economic development plan.

Chapter 3 presents the case study of Johannesburg. It gives an analysis of the gold reserves that existed in the area. It also looks at the development of the economy and legislation that enabled the gold sector to catalyse economic development.

3 A Case Study of the South African Mining Area of Johannesburg

3.1 South Africa

The Republic of South Africa is located at the Southern tip of the African continent (see Figure 2.2). South Africa has a land area of 1.2 million km^2, and shares its borders with Namibia, Botswana, Zimbabwe, Mozambique, as well as the kingdoms of Swaziland and Lesotho. The climate zone in South Africa ranges from Mediterranean in the South West, to temperate in the interior and subtropical in the South East. The country is made up of a population of 51.8 million people (StatsSA, 2016).



Figure 2.2: Location of South Africa and Ghana Google Maps (2016)

3.1.1 The Witwatersrand Gold Basin

South Africa is well known for its Witwatersrand gold basin (Wits basin), which is the largest gold deposit in the world discovered to date. The Wits basin has produced more than 2 billion ounces of gold, which is just over one third of the gold that has been produced globally (Chamber of Mines, 2016). The basin has a length and width of 350km and 20km respectively, it is predominantly an underground geological formation. Primary gold deposits within the Wits basin commonly occur in the form of quartz pebble conglomerates. The formation outcrops in the Witwatersrand area, which is where the first gold was discovered. The underground location of the gold deposits is the main reason why gold prospecting has predominantly occurred underground. A substantial amount of sampling of the gold orebodies occurred underground while large-scale prospecting (geological borehole drilling) occurred on surface. Since orebodies located underground require a large amount of capital to exploit, artisanal and small-scale mining in virgin areas was uneconomical and became diminished from the onset. This left the gold mining opportunities in the hands of large-scale miners who were labelled as the 'Randlords' (Cairncross and Dixon, 1995).

The Wits basin hosts some of the deepest and richest gold mines in the world. The deepest is AngloGold Ashanti's Mponeng mine, which mines and develops at depths that range between 2.4 km and 3.9 km (Barradas, 2015). Natural Resource Holdings (2013) estimated that 460 million ounces of gold remain in the Wits Basin at an average grade of 8.7 g/t. The Tau-Tona gold deposit was identified to have the highest grade of the remaining gold deposits (28 g/t).

3.1.2 Mineral Law and Mineral Tenure in South Africa

Prior to the Witwatersrand gold rush, the land tenure of freehold nature existed in the country. This meant that the landowner had full dominium over their land, and he or she was automatically the owner of the minerals contained in the soil. After 1813, the quit-rent tenure system, also known as erfpacht, gained momentum. This tenure entailed giving external parties the ability to acquire a long-term lease over land at a set price. If the holder

of the erfpacht tenure did not previously own mineral rights on that land, he or she was not allowed to hold future mineral rights for that land (van der Schyff , 2011).

In 1858, the Transvaal Republic enacted a law that sought to vigorously promote the development of the gold mining industry. This saw the government compelling private landowners, who were not in possession of mineral rights, to sell or lease their land at an equitable price. In the event that precious metals were discovered on privately-owned land, the State had the right to take over administration of the mining activity on the condition that the landowner was compensated. Tenders were subsequently issued and public diggings were declared on privately owned farmlands. Companies were allowed to buy the rights, prospect and erect surface infrastructure for underground mining. This action breached the personal rights of the landowners. The law was overturned in 1883 when it was established that the ownership of mineral rights could not be separated from land ownership. The earlier law was once again reinstated in 1885 Cawood and Minnitt (1998); van der Schyff (2011).

In addition to provoking confusion in land ownership, the Wits gold rush also became the source of many clashes between the 'Native' Boer Republic and the British. Land invasion and contradicting interests in gold exploitation fuelled wars such as the Jameson raid and the Anglo-Boer war. After the Europeans' success in defeating the Boers in these wars, they assumed political and economic control of the Transvaal Colony[13]. This massive victory encouraged the Europeans to permanently settle in the area (Callinicos, 1980).

In the years following, the various sovereign republics merged to create the Union of South Africa. During the Union era, mining legislation continued to allow the State to reserve mineral rights for precious stones and precious metals. The Union also continued the royalty payment system of the country, which dated back to 1866. The first royalties law stipulated a standard 2.5% royalty distribution. However, as time went on, the concept of

[13] Although the Europeans dominated he industrial and commercial scene of the country, the Afrikaners upskilled themselves, they gathered knowledge and created collectives of financial organizations. In due course, they also became key players in more advanced sectors of the economy.

lease consideration was introduced into the royalty calculations of gold deposits. Two different royalty calculation formulas were adopted, the formulas were dependent on the profit made, and were applied to minimum and maximum leases Cawood and Minnitt (1998); van der Schyff (2011).

During the late 19th and 20th centuries, mineral rights ownership in South Africa went back and forth between landowners and State. Different minerals were classified under different forms of ownership. This made the allocation system difficult to understand and complex to follow. A simpler and comprehensive system was only established at the end of the 1990s. Despite complexities, land disputes, and political differences, there was a common goal of keeping the mineral wealth in the country and channelling it towards the growth and development of the local and national economies.

In 2002, the South African government enacted the Mineral and Petroleum Resources Development Act (MPRDA). According to this Act, the State reserves the right to optimally exploit mineral resources in South Africa. Chapter two of the MPRDA states the following:

"Mineral and petroleum resources are the common heritage of all the people of South Africa and the State is the custodian thereof for the benefit of all South Africans" (MPRDA, 2002).

The MPRDA acknowledges that the country's minerals belong to the people, and that the minerals are under the guardianship of the State. The State therefore reserves the right to grant mineral rights to all parties that are interested in furthering their mining interests. The State also works with the Department of Finance to determine the fees and levies applicable to the mining industry (MPRDA, 2002).

3.2 Johannesburg

The City of Johannesburg is situated in the Gauteng province of South Africa, 65km from the country's capital Pretoria. Gauteng is a land locked province, which is located 610 to 1400km from the country's ports (see Figure 2.3). Johannesburg is one of the youngest major cities in the world and contains a population of 4.4 million people, it occupies a land area of 1645 km^2. The city lies on the interior plateau of South Africa, which is

characterized by flat terrain and sparse forestation. These topographical factors contributed to the ease of exploration and access of ore bodies EWN (2016) ; Stats SA (2016).

Johannesburg experiences a temperate climate; it is relatively dry and receives an average rainfall of 543mm per year. The city has an average annual humidity of 59% and a mean temperature of 16.2 degrees Celsius[14] (ClimaTemps, 2016). The climate of Johannesburg is similar to that of European countries. It experiences hot summers and cold winters that can see temperatures dropping to sub-zero levels. The similarities between the climatic conditions of Johannesburg and Europe contributed to the creation of pleasant living conditions for the migrants. This played a role in encouraging permanent settlement.

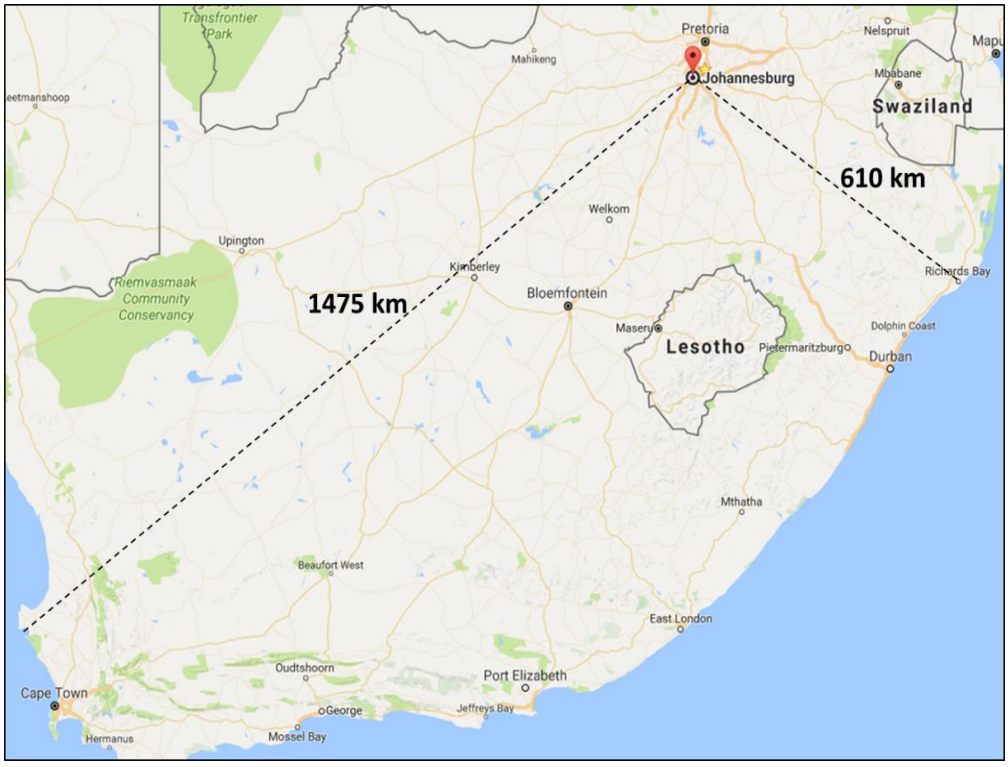

Figure 2.3: Location of Johannesburg Google Maps (2016)

[14] Johannesburg experiences an average maximum temperature of 22.4 ^{O}C and an average minimum temperature of 10 ^{O}C (ClimaTemps, 2016)

3.2.1 The Johannesburg Mining Industry

Before the formation of the Union of South Africa, the area of Johannesburg fell under the sovereign State of the Transvaal Republic. Prior to the discovery of gold, the economy of the Transvaal was solely dependent on agriculture. Rail infrastructure was virtually non-existent in the area. During the 1890s Witwatersrand gold rush, the ore that was mined was transported either by ox wagon or by foot to the nearest railheads, which were located 300-500km away. In the following years, more discoveries were made on various small farms. These farms eventually merged into a mining town that was named Johannesburg. The gold deposits that were discovered were high grade, easily accessible, located close to the surface and they extended for kilometres in length and depth. These favourable conditions made early operations highly profitable and made it feasible to conduct detailed additional exploration of deeper portions of the reef (Callinicos, 1980).

The Central Rand Mines

The settlement of Johannesburg was established near the Central Rand Goldfields, depicted in Figure 2.4. The Central Rand was one of seven prominent gold fields in the country (Harrison and Zack, 2012). During the early 1900s, Johannesburg was directly and indirectly surrounded by more than 70 mining operations which stretched from the far East Rand to the West Rand (see Figure 2.4). According to The London Financial Times (1909), thirty active mines surrounded Johannesburg directly in the Central Rand (see Figure 2.5). These mines occupied a cumulative land area of less than 150km^2 and predominately practised large-scale deep level mining[15]. In the late 19th century, the following five large-scale mining companies dominated the area:

- Consolidated Gold Fields of South Africa;
- Union Corporation;

[15]Jager and Ryder (1999) categorize mining depths as follows: Shallow environment: less than 1000 m below surface, medium mining environment 1000 m-2250 m, deep mining: 2250 m -3500 m. Any mining activity that occurs beyond a depth of 3.5km would be classified as ultra-deep mining.

- Rand Mines;
- Johannesburg Consolidated Investments (JV between the Robinson and Barnato groups); and
- General Mining and Finance (Cripps, 2012).

The sixth company, the Anglo-American Corporation of South Africa, joined this group in 1917 (Harrison and Zack, 2012). These companies devised a group control system of the gold mines, which remained fundamentally unchanged for up to 20 years (Cripps, 2012). The concentration of multiple companies in the small area brought intense business competition to Johannesburg. It also brought a wide pool of diverse financial, technical, and administrative expertise. For investors, this meant an increase in the diversity of shares that were available for purchase, and for the growing population, it meant an increase in employment and business opportunities. The above factors made the area even more attractive for investment and migration. Broomhead (1909) gave a detailed account of the ore reserves that were estimated for these mines as well as the amount of capital that was invested during the 1900s. The 15 largest ore reserves in the Central Rand are tabulated in Table 2.2. Figure 2.6 summarizes the information about mining tenures as indicated by the Central Rand Gold Company.

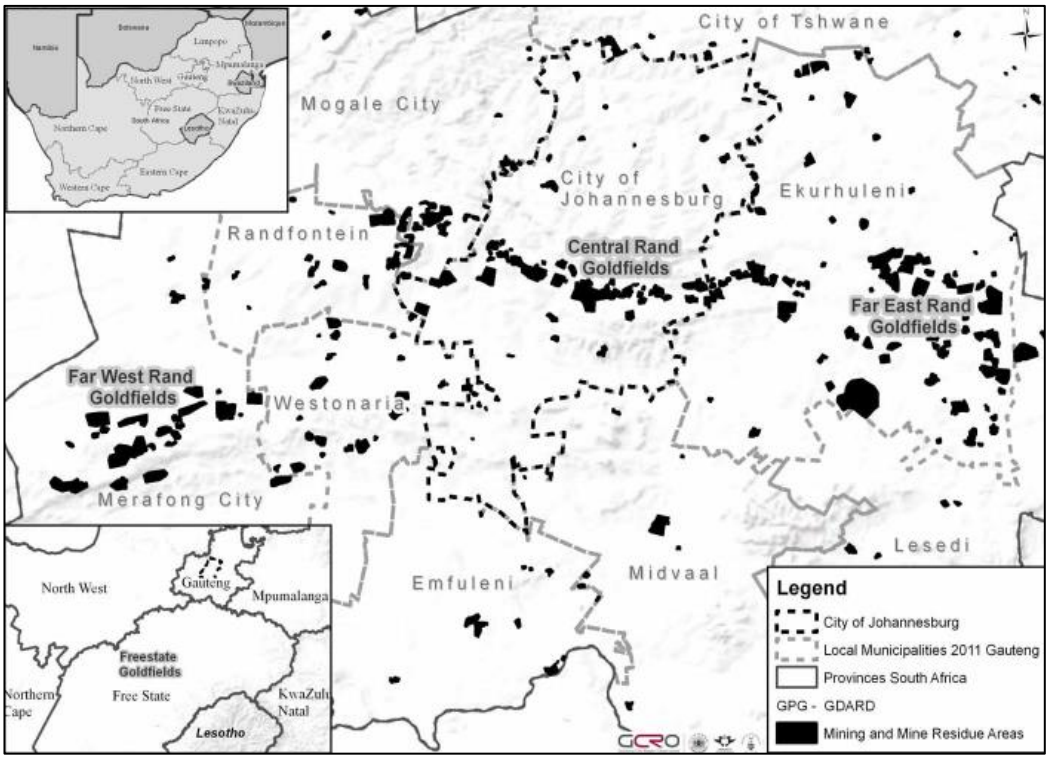

Figure 2.4: Gold fields of the Gauteng Province Harrison and Zack (2012)

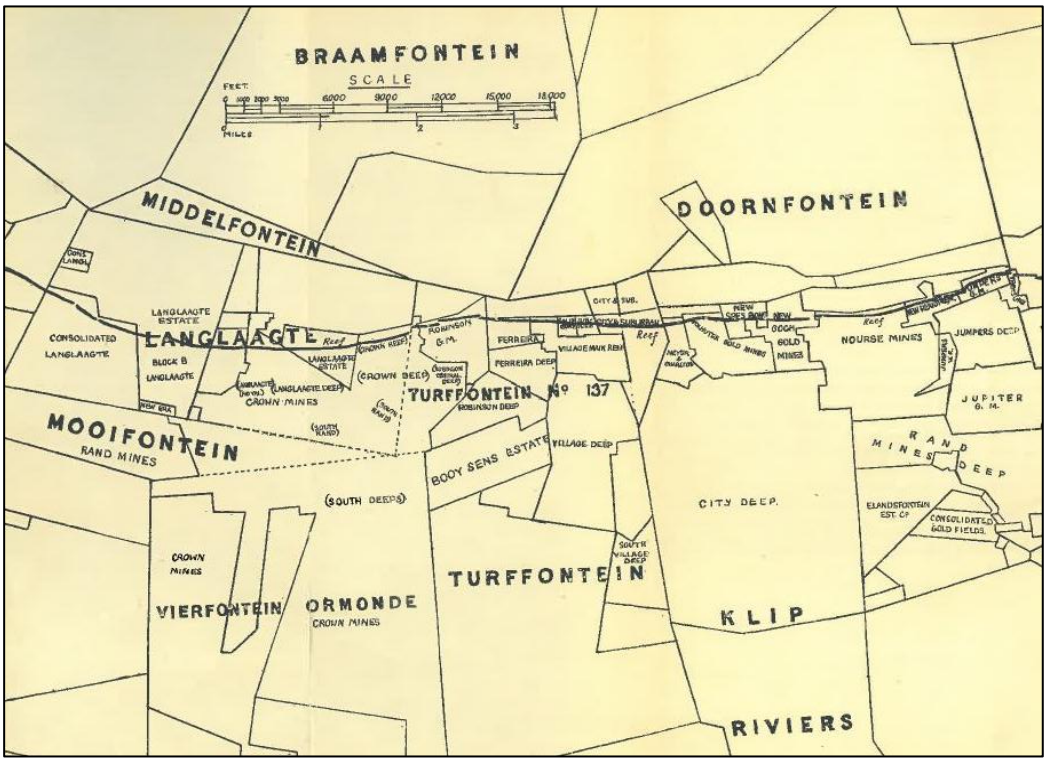

Figure 2.5: Mines of the Central Rand Gold fields in Johannesburg Broomhead (1909)

Table 2.2: Reserves and Capital of the Central Rand Mines Broomhead (1909)

Mines	Ore reserves (t)	Grade (g/t)	Capital (USD)
Simmer and Jack East	575 550	9,3	700 000
Simmer and Jack	2 036 000	11,8	3 000 000
City Deep	449 143	14,1	1 250 000
Ferreira	1 317 565	14,5	95 000
Ferreira Deep	1 506 197	14,1	910 000
Village Deep	1 949 267	8,7	1 060 671
Village Main Reef	2 837 729	10,9	472 000
Robinson GMC	1 856 014	17,6	2 750 000
Robinson Central Deep	971 573	15,8	500 000
Robinson Deep	1 250 000	12,8	980 000
Crown Reef	624 214	12,60	120 000
Crown Deep	1 544 584	12,60	300 000
Laanglagte Deep	1 135 500	14,9	800 000
Laanglagte Estate	1 321 377		470 000
Consolidated Laanglagte	504 540	13,4	745 547
	19 879 253	**13,1**	**14 153 218**

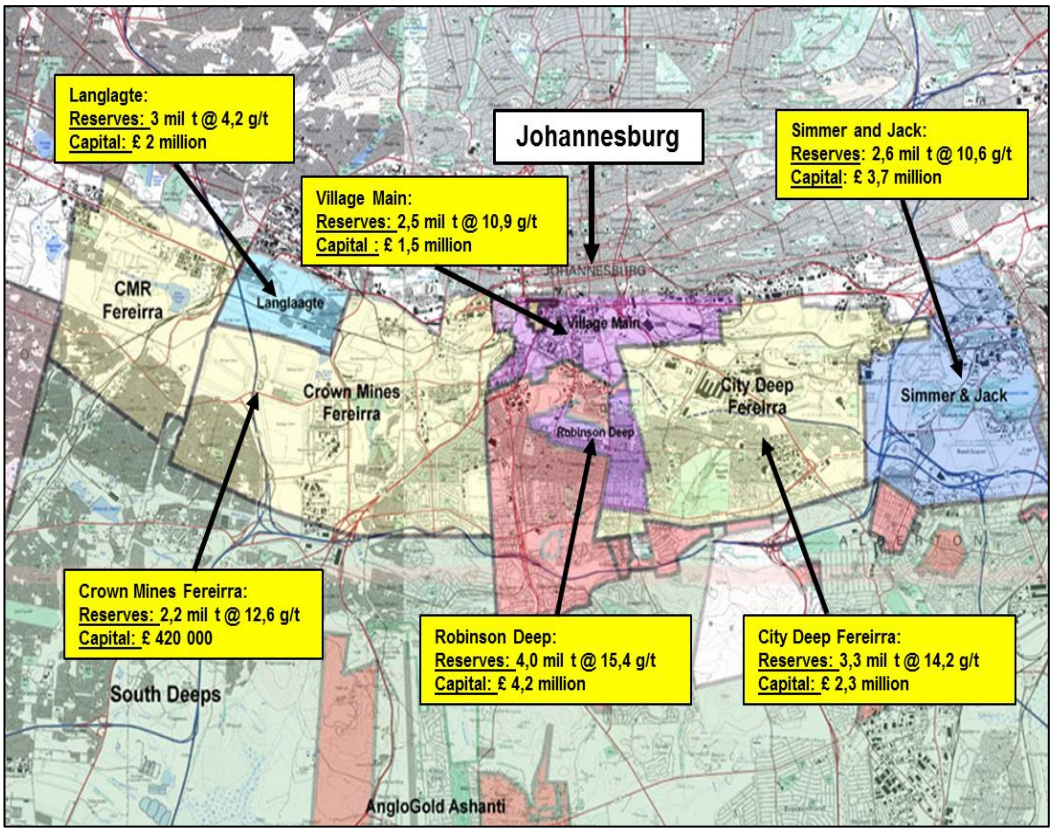

Figure 2.6: Map of Mining Tenures in Johannesburg Central Rand Gold (2010)

Table 2.2 shows that in 1909, the payable gold reserves surrounding Johannesburg were estimated to be over 19 million tonnes at an average grade of 13 g/t. In 1911, the Central Rand produced 80% of the national gold output. In total, the Central Rand accounted for 15% of South Africa's entire gold output. Table 2.2 also shows that the mining industry of Johannesburg attracted direct initial investments that amounted to roughly 14.1 million USD, the equivalent of 1.7 billion USD in present day terms Harrison and Zack (2012); Broomhead (1909).

Increasing the profitability and longevity of the Witwatersrand Gold Mines

After the establishment of the gold mines, the mining companies embarked on a wide-ranging cost reduction initiative. The objective was to bring low-grade ore reserves (which were considered anything less than 6 g/t) into the payable zone and increase profitability. The initiatives were greatly supported by the South African government to ensure the longevity of the mines. One of the ways in which cost reduction was achieved was by improving rail infrastructure from underground to surface. Rail infrastructure was also developed between the Transvaal area and the major ports of South Africa. This development increased the volume of ore transported underground and between the trade routes. It also reduced transportation costs by eliminating labour intensive and time-consuming methods of transportation. The mines also focused on the reduction of labour costs, which was achieved by conducting bulk recruitment of cheap migrant labour. Government backed the mining industry via legislation that endorsed the recruitment of inexpert low-waged migrant labour from the neighbouring colonial territories. This fuelled the migration of foreigners into Johannesburg. Neighbouring towns, cities and countries have long perceived Johannesburg as the City of Gold and a hub of wealth and opportunities. Although this legislation was highly controversial and promoted racial injustice (and segregation), it helped to achieve the desired outcome of reducing overhead costs, increasing profitability and the longevity of the mines.

The government also supported the establishment of mining R&D centres because it saw that future technological developments would assist the mining industry to become more

sustainable and more economic. Mining companies invested in Research and Development (R&D) initiatives that focused on technological developments that aimed towards creating efficient mining and processing methods. Engineers and scientist came from all over the world to aid in mining R&D. The following R&D breakthroughs were developed:

- The improvement of processing technology such as the introduction of the cyanide process[16], and the inclusion of tube mills in ore treatment, which enabled the grinding of fine ore; and
- The improvement of rock drilling and blasting technology (Cripps, 2012).

Research and Development also helped to create a demand for new goods and services for the industry, creating more opportunities for procurement. The cost reduction and improvement in rock drilling and blasting technology enabled the mines to include large mining blocks that were previously abandoned in the reserve count. This increased the payable reserves as well as the life of mine (LoM) of the operations. The developments in processing technology allowed the profitable treatment of previously discarded ore, enabling some mines to further increase their LoM by 40-60%. During the 1890s the president of South Africa endorsed the development of the explosives industry, a very significant step towards industrial development by the mining. These developments increased the attractiveness of the Johannesburg gold mining industry to investors Broomhead (1909); Sawyer (1907).

3.2.2 Mineral-based Local Economic Development in Johannesburg

In its early years, the City of Johannesburg was a buzzing mining camp. Gold production catered chiefly for European markets that were governed by the gold standard. During this time, economic growth and development of the settlement was extremely fragile and heavily reliant on the gold mining industry. The dependence of the economy on the primary

[16] The cyanide process maximised the gold contents that were extracted from the ore (Cripps, 2012).

production of gold made it highly susceptible to mine production tailbacks[17] as well as negative financial speculation (Harrison & Zack, 2012).

Prior to the 1880s, the economy of Johannesburg was solely dependent on agriculture. The economy was largely in the hands of the Boers who were mostly farmers and had very little to no knowledge of manufacturing. During the time of the gold rush, the agricultural sector was quickly overshadowed by the mining industry (Cripps, 2012).

The rapid rate of growth and the high influx of locals and foreigners in Johannesburg caused the settlement to be dependent on imported foods, resulting in a very high cost of living at the time. Colonial powers sought to reduce the high cost of living by reviving the agricultural sector and promoting the local production of food. This entailed the recruitment of British expatriates into the Boer farmlands to facilitate the transfer of advanced agricultural skills to the locals. This not only reduced living cost but it also created employment and several business opportunities along the chain of food production. It created an important side linkage to the mining industry. Purchasing local foods also enabled the mining industry to feed their rapidly growing work force at a much lower cost. Later on, the government introduced the Agricultural Marketing Act of 1937 and the Co-operatives Act of 1939. These interventions practically eradicated foreign competition in the agricultural sector. Other side linkages that were created from the mining sector during the early 1900s were South African Breweries (SAB) and the Portland Cement Company Cripps (2012); ITAC (2011).

The gold mining industry was also directly responsible for the creation of upstream linkages, such as large South African-owned mining companies, Goldfields and Anglo American, which established their headquarters in Johannesburg. One of the strategic

[17] Such as the economic down turn that resulted from the technical difficulties (technology limitations) that were associated with extracting gold form from pyrite, which was intersected 100m below surface. This brought the sector and the economy to a standstill. (Harrison & Zack, 2012)

moves of past governments was the establishment of value addition services[18] to cater for the country's gold sector.

Value addition is an important activity when it comes to working towards mineral-based economic development. It improves the economic welfare of the local economies by increasing revenue because the value of refined gold is much higher than that of the raw product. In 1920, the South African Chamber of Mines established the Rand Refinery, an institution which has been internationally recognized as *"the largest integrated single-site precious metal refining and smelting complex in the world"* (Rand Refinery, 2015). The refinery is located approximately 16km east of Johannesburg, it has refined close to 50000 tons of gold in its 96 years of existence. The Rand Refinery's success was attributed to economies of scale; it was located close to the Central, East and West Rand mines. This gave it the ability to service a large number of mines at an affordable rate. Secondly, local value addition was empowered by legislation, which aimed to create an environment that would enable South Africa to develop its mineral wealth to the fullest potential Rand Refinery (2015); AngloGold Ashanti (2015); and DMR (1998).

In addition to this, large-scale parastatals such as Eskom and Transnet were established to cater to the energy and transport demands of the economy and the growing population. The creation of tertiary institutions such as the Johannesburg Stock Exchange (JSE) was also directly linked to the Witwatersrand gold rush. Founded in Johannesburg during 1887, the initial function of the JSE was to expedite the eruption of trade that was sparked by the discovery of gold. After its establishment, the JSE began to channel various profits towards Johannesburg. In the years following its foundation, the JSE also listed several large companies outside the mining industry. In 1963, the JSE joined the World Federation of Exchanges, and today, it is the largest stock exchange on the African Continent (JSE, 2013).

[18] Value addition entails the augmentation of the value of gold by processing and refining the raw material to a higher quality. The objective of value-adding is to sell a better quality or final product at a higher cost to a more advanced market

A major challenge that Johannesburg encountered was the scarcity of water in the area. There were no waterways inside or near the city and water was in very high demand because of the rapidly growing population and more especially the gold mining sector. This increasing demand prompted the development of one of the first major water companies in South Africa, the Johannesburg Waterworks, which was established by a mining exploration company in 1887. After the British and Boer reached a consensus in 1902, the Rand Water Board Incorporation Ordinance was established and tasked to address issues of water supply. The increasing demand of water in the Witwatersrand also prompted the development of major water projects such as the Vaal River scheme, the Vereeniging, Zwartkopies and Zuikerbosh pump stations, the Vaal Dam and most recently, the Lesotho Highlands Water Project (Crooks, 2004).

One of the important economic benefits of the mining industry was that it was a significant source of job creation. The mines of the Central Rand were predominantly underground conventional mines which required a large amount of labour (ranging from unskilled, semi-skilled to skilled) compared to surface mines, which require a small number of skilled labour. Prior to the 1970s, 80% of the mining labour comprised of underpaid labor from neighboring countries. During the period of peak production (mid-1970s), the number of locals employed by the industry rose from 87000 to 333000. The sudden high demand of local labour was brought about by the collapse of colonial governments surrounding the country, which resulted in many of the migrant labour returning home. This boost in employment brought stable income to more than 250000 South African households

In 1924, the government implemented a tariff policy that encouraged import substitution and advocated for the protection and cultivation of the domestic industries (ITAC, 2011). This significantly assisted the manufacturing sector and enabled its contribution towards the GDP to increase by 15% between 1918 and 1925 (Harrison and Zack, 2012).

At the beginning, it was not perceived that Johannesburg would survive beyond the mining phase. There was a profound anxiety amongst the residents that the city would collapse during mine closure. Despite this wide spread concern, authorities pursued the plan of

using the mining industry to grow and develop the economy. This enabled Johannesburg to evolve from a highly specialized mining town to a trade mining town. The gold mines ultimately shut down, but the economy of the city continued to flourish. The creation of strong linkages during the early stages of the industry resulted in a domino effect that rippled across the entire economy. The gold mining industry ignited a chain reaction of corresponding successful economic activities. Mining was unequivocally an important catalyst of local economic development by the creation of employment, disbursement of taxes, creation of procurement and community investment (AngloGold Ashanti, 2015). The Central Rand Goldfields did far more than produce the City of Johannesburg, they also enabled South Africa to leap from greenhorn quasi-state to an advanced industrial economy, within a comparatively[19] short period of 80 years (Harrison and Zack, 2012).

3.2.3 Mining Induced Environmental and Re-settlement Challenges

The exploration phase of a mining project normally involves the clearing of vegetation and the disturbance of the environment. This is done to allow heavy equipment and machinery fitted with drill rigs to access the exploration area. In the case of areas that have sparse forestation, deforestation may not be a significant issue. Mining site preparation (preparation to build mining infrastructure) could also bring about the disturbance of the population that has settled on the land. Fortunately, there were no large-scale displacements of residents in the case of Johannesburg. This was because several mining tenures were already acquired before settlement occurred on gold bearing areas. The State also proactively identified and demarcated large portions of auriferous land through a proclamation system. This helped to prevent residents from settling on mining land thus preventing the future potential problem of resettlement (Chernaik, 2010).

Mining that was conducted in Johannesburg was predominantly underground. Although in certain places, portions of gold reefs outcropped on surface, surface mining was not conducted. The surface and shallow parts of the reef were left unmined and acted as crown

[19]This period is short in comparison to Europe, which took a number of centuries to industrialize (Harrison & Zack, 2012).

pillars[20], to prevent surface subsidence. Underground mines generally have a smaller surface environmental footprint compared to surface mining operations. This is because a minimal removal of overburden is required to establish the operation and the underground excavations. The underground gold mines exploited a narrow and tabular orebody, and access to the orebody occurred via subsurface decline tunnels and mineshafts. The mines comprised of a network of horizontal and inclined tunnels that accessed the orebody directly (Chernaik, 2010). Although underground mining is more expensive, capitally intensive and more labour intensive than surface mining, it causes much less environmental destruction. The underground location of the excavations is one of the reasons why mining-induced land loss occurred on a smaller scale in Johannesburg compared to areas where surface mining is practised. Loss of land most likely occurred in areas where surface infrastructure such as shafts, office blocks, processing plants and refineries were erected. Displacement would have also occurred where the mine water, waste rock and tailings were disposed. This minimal surface footprint made it possible for agriculture and other economic activities to coexist with mining in undisturbed parts of the land. Although mining-induced displacement was not a major issue, the mining industry brought about illegal small-scale mining and several environmental challenges, which are largely felt in the present day.

In the past, mining companies identified areas that overlaid shallow underground excavations and considered those areas unsuitable for living, and unsafe for the development of infrastructure. After the closure of the mining companies, informal settlements began to develop on top of these unoccupied plots of land. An issue that resulted from this was illegal miners (locally called 'zama-zamas') making use old mine shafts to access abandoned underground workings and mine for gold. The underground workings were accessible because some of the abandoned mines did not seal off abandoned ramps and shafts well. Illegal mining activity has led to fatal injuries where

[20] Crown Pillar: *"any rock structure that remains between an underground mining excavation and the ground surface, such as above an underground stope, or above a near surface ramp or drift"* (Hutchinson, et al., 2001)

illegal miners have been: trapped underground by rocks falling from the unstable excavations, suffocated from inadequate ventilation, and had dangerous confrontations with security and the police.

Another challenge Johannesburg faces is that of the abandoned tailings dams and waste dumps that lie on the outskirts of the city. These materials originated from the hundreds of millions tonnes of waste that was generated underground and treated at processing plants. Usually, the tailings that are generated are of an equivalent amount to the waste rocks that have been removed from underground. This toxic landscape frequently contains material that is laced with chemicals such as cyanide. The lack of stringent environmental laws in the past encouraged the poor management of tailing disposals. In the long term, the toxic constituents of these tailings dams have seeped into the environment, contributing to the challenge of Acid Mine Drainage (AMD), which has led to the degradation of soil and the contamination of water. The aerial photograph in Figure 2.7 shows the water that is mixed with chemical seepage accumulated around the tailings dams.



Figure 2.7: Aerial Photograph showing the accumulation of AMD on a Johannesburg Tailings Dams The Guardian (2015).

Most of the informal settlements of Johannesburg lie on the outskirts of the city near the tailings dams and often on land undermined with shallow excavations. Poor people who

were marginalized during the apartheid era mainly inhabited these settlements. According to an article published by The Guardian (2015), the tailings dams contain fine radioactive particles that have traces of copper, cyanide, lead and arsenic. During the windy seasons, the tailings release these particles in to the atmosphere and this poses a health risk to the residents. The residents of the settlements surrounding the tailings dams report many respiratory illnesses cases such as ubiquitous, asthma and tuberculosis. According to this article also, some companies illegally use the tailings to manufacture bricks and other material for construction. Figure 2.8 shows the Riverlea neighbourhood on the outskirts of the South of Johannesburg, which lies in the shadow of a large tailings dam (The Guardian, 2015).



Figure 2.8: A neighbourhood on the outskirts of Johannesburg The Guardian (2015)

The abandoned mines of Johannesburg are also infamous for poor reclamation and poor closure. When mining activities ceased, the mining sites were not returned to the condition that resembled those which existed prior to mining. This is mainly due to the lack of environmental legislation that dealt with mine closure in the past. The poor closure has had an immense environmental impact that has continued for decades and could possibly continue for centuries (Chernaik, 2010). AMD is also created in the underground excavations of the abandoned mines. It is created when oxygenated water that has

accumulated from underground flooding is exposed to minerals from the rock such as pyrite. The AMD seeps into ground water sources and eventually reports to water bodies on surface. Acid Mine Drainage also causes degradation of building infrastructure (McCarthy, 2011).

The increase of the gold price over the years and advances in processing technology have encouraged the burgeoning of small-scale mining on these tailings dams. Some mining operations are known to have reopened the surrounding mines and revisited the tailings to extract the residual gold. The tailings are also known to contain artisanal miners who illegally pan for gold on mine property.

3.3 Conclusion

The prosperity of the Johannesburg gold mining industry is attributed to many factors. These factors fall under the main categories of: natural surroundings, migration, politics and economics. The Wits Basin is the largest gold deposit ever discovered in the world, and the City of Johannesburg emerged out of the outcrop of what seemed to be an endless source of gold. The abundance of high quality gold sparked the migration factor and an influx of foreigners who brought diverse and advanced skills into the area. Favourable natural and political conditions encouraged permanent settlement of these foreigners; this allowed the skills to be retained and mineral wealth to be kept in the country. The Central Rand Goldfields were home to a high concentration of underground mining operations and capital investment, which encouraged competition and boosted economic growth. The government acknowledged that the mining industry was the cornerstone of economic development. This encouraged it to exercise its political power to ensure the longevity of the mines and the creation of strong linkages to the industry. This led to the successful development of economic linkages and sparked a positive effect across the entire economy. The linkages enabled Johannesburg to decouple its economy from the primary mining industry, and thrive beyond the life cycles of the mines.

Despite the economic success that has been brought about by the gold industry, the City of Johannesburg faces environmental and urbanization challenges. The former has

manifested in air pollution, and Acid Mine Drainage that has contaminated the city's water supply. The latter has revealed itself through poverty and inequality, high crime rates, inadequate service delivery etc. Johannesburg now faces the challenge of finding sustainable means of growing and developing its economy further. It also faces the challenge of developing ultra-deep mining methods and technology that can tap into the remaining gold resource, as this could contribute to future economic growth. In Chapter 4, a case study of the Ghana mining areas of Obuasi and Tarkwa is presented in a similar manner that Johannesburg has been presented in Chapter 3.

4 A CASE STUDY OF THE GHANA MINING AREAS

4.1 Ghana

The Republic of Ghana is located on the West coast of Africa (see Figure 2.2). Ghana has a land area of 238,535km^2 and shares its borders with Burkina Faso, Côte d'Ivoire, Togo, and the Gulf of Guinea. At the beginning of the 20th century, Ghana was placed under the rule of the British colony, and it was one of Britain's most successful colonies. During the era of colonisation, Ghana was fittingly named the Gold Coast, a name that described the abundance of gold resources in the country, as well as the significance of these resources to the British. In 1957, Ghana became one of the first African countries to gain independence ICMM (2007); Botchaway (1994).

Ghana is located in an equatorial zone that has a warm and humid climate. Ghana experiences two seasons, which are the rainy season and harmattan. The latter is comparable to winter and is characterised by dry and dusty desert winds that blow from the Sahara Desert into West Africa. According to the 2010 population census, Ghana is made up of ten administrative regions, and contains a population of approximately 24.6 million people Ghana Statistical Service (2010); Aquastats (2005).

Over the past 120 years, the government of Ghana went from colonial rule to independence, to military dictatorship to democracy. The country has been ruled by a centralized government, which according to literature, has functional but weak regional and local structures. Local governments, municipalities and traditional Stools (i.e. chiefs that preside over various districts) conduct administration of the local communities. One of the disadvantages of this centralised government system is that the local bodies have very limited capacity and resources that they can devote to local development issues. Local authorities therefore must rely on government and other organisations (such as donors and the private sector) to address local development challenges (ICMM, 2007).

4.1.1 The Ashanti Gold Belt

Ghana is renowned for its abundance of gold resources, and a mining industry that dates back to the 15th century. The gold that is produced in Ghana is sourced from the Ashanti volcanic belt and its neighbouring marginal basins. The Ashanti belt ranks amongst the most auriferous zones in the world. The Primary gold deposits of the Ashanti belt normally occur in the form of complex quartz veins, quartz pebble conglomerates, placer gold and disseminated sulphide. The gold that was produced before the 20th century was mainly sourced from alluvial secondary deposits that were located along valleys, riverbanks, inside-streams and rivers. Exploitation of primary deposits became more popular at the start of modern mining (the late 19th century). The Ashanti belt has produced over 100 million ounces of gold since the start of modern mining.

Since a large portion of the Ashanti Belt geological formation outcrops on surface, prospecting has mainly been on surface. The belt currently hosts some of the most prominent gold mines in West Africa, such as AngloGold Ashanti's Obuasi mine and Goldfield's Tarkwa mine. The Ashanti belt is also home to the mining settlements of Tarkwa and Obuasi, areas that are known for their centuries of artisanal gold mining. Artisanal mining served as a direct and indirect source of income to many residents in the surrounding rural areas. Because of their history of artisanal mining, Tarkwa and Obuasi became target areas of intense prospecting and exploration during the era of modern mining Ghana Statistical Service (2014); Akabzaa & Darimani (2001); and Kuma, et al (2010).

4.1.2 Mineral Law and Mineral Tenure in Ghana

Prior to colonisation, customary law governed land tenure in Ghana. This meant that the land and everything within the land was owned by the natives and managed by the local chiefs according to the customs of the indigenous communities. Under customary law, land that was granted for mining purposes could not be used in a manner that was detrimental to the environment, or the interests of the community members. Mining was conducted using purely artisanal methods and did not involve the use of toxic chemicals

(such as mercury) or advanced and heavy machinery and equipment. It is because of this that the activity had relatively low environmental impacts and was able to coexist with agriculture (Botchaway, 1994).

After the colonisation of Ghana, the British imposed a legal system that supported statutory tenure in an attempt to overrule customary law. According to Botchaway (1994), this colonial legislation introduced complexity, confusion and turmoil that has persisted for more than a century in land and mineral rights ownership. British legislation acknowledged that the land belonged to the natives and it did not explicitly claim the land from the natives. It only claimed land which was bought or attained for public use. The British acquired several gold concessions and invested capital to build mining operations.

The British colony also introduced an Ordinance into the mining regulation system. The aim of the Ordinance was to regulate the allocation of mining concessions. This Ordinance resulted in the creation of the mining concessions court, which had the authority to validate and grant concessions between the natives and the concessionaries. Even though the Ordinance and statutory tenure were in place, some of the Chiefs refused to give up their land, making it almost impossible for the British to gain ownership of some of the auriferous land. One of the complications with the concessions Ordinance was that it did not clarify the rights and responsibilities of the concessions holders and the natives or landowners. This made it difficult to determine which party could be held accountable for negative environmental impacts. This is one of the reasons why disputes concerning the ownership of mining land and mining rights have been resurrected a number of times over the years, especially when it comes to accountability for environmental and social challenges. Another problem with the Ordinance was the fact that all the laws, contracts and grants were technical and also written and communicated in English. At that time, the majority of the Ghanaian chiefs and landowners were not familiar with the English language. Because of this, they were unable to understand the situation that was imposed upon them. This enormous gap in communication and comprehension was unjust for the Ghanaians from a negotiation standpoint. Botchaway (1994) argued that most of the mining concessions that

belonged to the British were acquired in a deceitful manner because consultation and compensation of the landowners was very poor or even non-existent.

During the colonial era, the mining interests of the British moulded the Minerals Policy of Ghana. The main objective of this policy was to satisfy the economic welfare of the British. British economic interests therefore took precedence over those of Ghana. The mineral wealth of Ghana was channelled away from the country, and was instead used to fuel the British economy. This went on for half a century. In addition, there were no systems in place to allow local authorities to exercise their concerns about the economic, environmental and social impacts of mining in their communities. The colonial mineral policy also empowered authorities to pass legislation that declared artisanal and small-scale mining illegal. This action deprived many households of income, it also birthed the culture of 'galamsey' (Botchaway, 1994).

Ghana gained independence in 1957, under the regime of Kwame Nkrumah. Independence enabled the country to take back control of the mineral rights. The Nkrumah regime inherited a gold mining industry that had experienced decades of neglect, degradation and disinvestment. In an effort to save the industry, government enacted the Lands Act (125) of 1962 and the Concessions Act (164) of 1962. The Lands Act made provision for royalties to be paid by companies mining on privately owned land. Royalties were determined by means of a sliding scale that ranged from 3% to 12% of the mining revenue. The Concessions Act revoked the aforementioned Concessions Ordinance that was introduced by the British colony. The strategy of the Nkrumah regime was to take a pragmatic approach to nationalisation with reference to foreign investment. This was to be achieved by nationalising poorly performing mines, which were owned by foreigners looking to opt out. The concept was that nationalisation would save the mines from closure and subsequent job losses. Regrettably, nationalisation proved to be a poor decision. Ghana did not have the capital or management skills to revive the ailing gold mines and return them back to their productive state. Nationalisation brought prolonged negative impacts on the mining industry and the economy. The decline in mining production and revenue was not the cause of the economic downfall, it was rather a consequence of the

ailing economy. During the time of political turbulence, the economy collapsed for nearly three decades, this caused mining to suffer together with other industries. No gold mine was opened in the country between 1957 and 1900 ICMM (2007); Botchaway (1994); and Taylor (2006).

In 1983, the Rawlings administration embarked on a mission to revive the downward spiralling Ghanaian economy. The new government announced its intention of privatisation, as well as the relaxation of nationalisation regulations. Figure 4.1 shows that after the implementation, the country began to experience an increase in the GDP, and positive economic growth by 1986. In 1986, Ghana implemented a mining code that provided generous fiscal incentives to international mining companies. The objective was to attract foreign investment that would revive the mining industry and enable it (specifically gold) to become a major source of FDI in the country. The strategy paid off and the economic benefits were felt immediately after the implementation of the ERP. This strategy revived the gold mining industry and attracted more than 5 billion USD of FDI into the national economy ICMM (2007); Akabzaa and Darimani (2001).

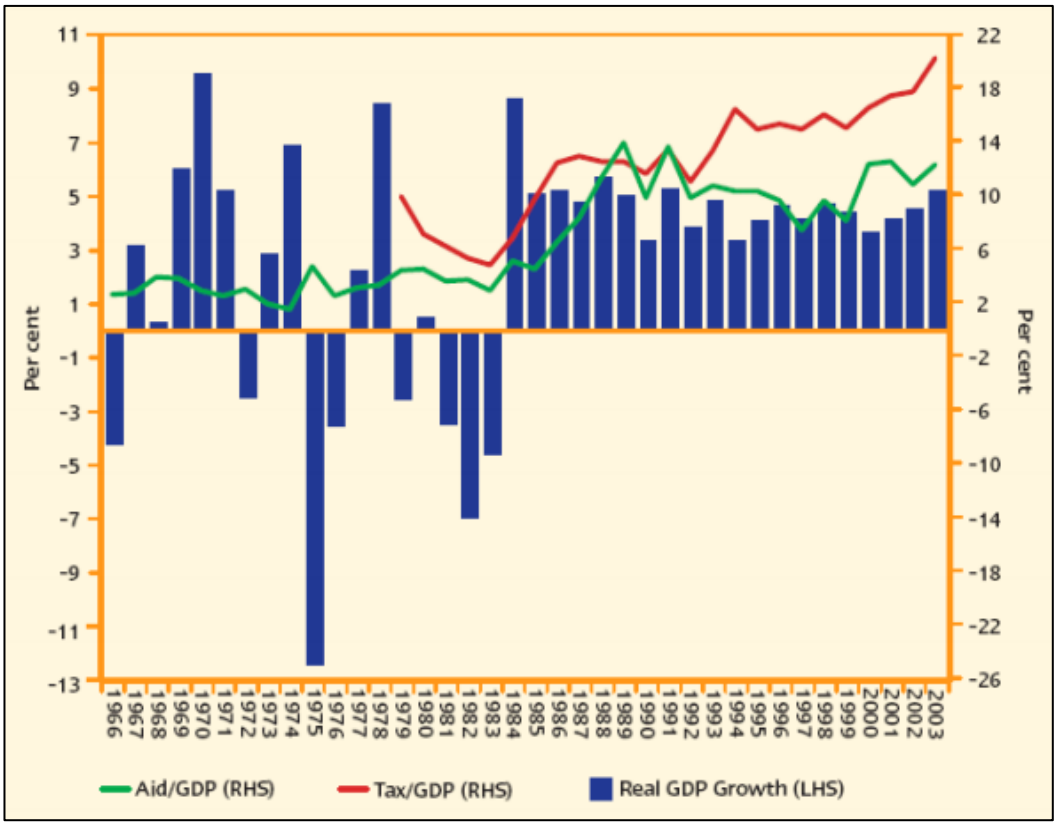

Figure 4.1: GDP Trend of Ghana 1966 to 2003 World Bank African Development Indicators (2004)

Currently, most vested lands in Ghana are properties of a stool (the chief authority), but are managed by the government. Section 2 of the Minerals and Mining Act 703 of 2006 states the following:

"Where land is required to secure the development or utilization of a mineral resource, the President may acquire the land or authorize its occupation and use under an applicable enactment for the time being in force is required to secure the development or utilization of a mineral resource" (Ghana Minerals and Mining Act, 2006).

The Act stipulates that the minerals are owned by the State and the President, through applications that are sent to the country's Minerals Commission, which has the authority to grant mineral rights. Landowners still reserve the right to benefit financially from mining activity that occurs on their land in the form of royalties. Over the years, the government

reduced royalties to a sliding scale of 3% - 6% (Aboagye, 2014). The sliding scale was abolished in 2010, and a fixed royalty rate of 5% was set across the entire board (Rutherford & Ofori-Mensah, 2011).

Despite opposition from many of the local communities, the government of Ghana continues to extend generous mining contracts and offer indigenous land to multinational companies. The locals meet these investments with resistance because of the insufficient royalties and very few sustainable economic benefits they receive. Furthermore, the locals feel like the current circumstances do not empower them to become productive participators in the mining activity. There is a wide and rational perception that the benefits of large-scale gold mining are not able to offset the loss of alternative livelihoods and environmental degradation (Aboagye, 2014).

4.2 Obuasi

Obuasi is a mining town that is located in the Adanse State of the Ashanti Region in Ghana. The town has a land area of 1624km^2, and is home to 168641 residents. Obuasi is situated 60 km away from the metropolitan of Kumasi and about 300km away from the capital of Accra (see Figure 4.2). Obuasi is land locked and located more than 200km away from the main ports of Ghana (Tarkoradi and Tema). The town is located in a semi-equatorial climate area, which experiences two periods of maximum rainfall ranging between 1250 mm and 1750mm per annum. Obuasi experiences a mean temperature of 25.5 degrees Celsius and an annual relative humidity that ranges between 75% and 80% (Obuasi Municipal Assembly, 2014).

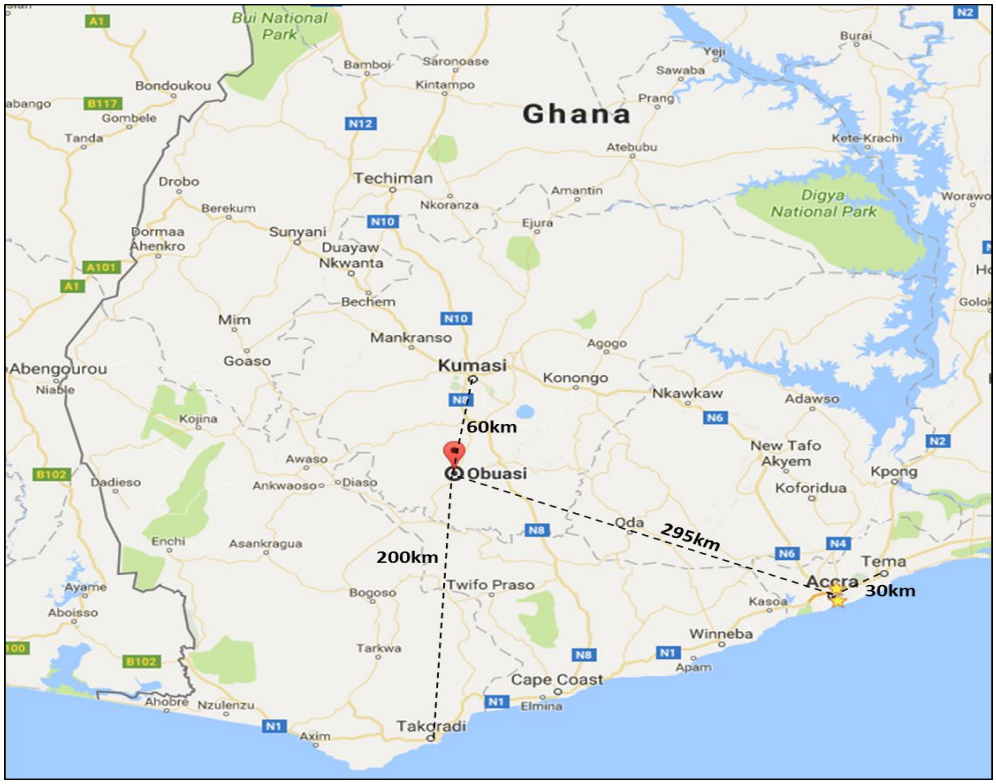

Figure 4.2: Location of Obuasi Google Maps (2016)

The town is located in a densely forested area that lies between undulating valleys. During the late 19th century, the dense forestation contributed to the difficulties in exploration and exploitation of gold ore bodies. This is because access to the gold ore bodies required deforestation, which in turn required the use of heavy machinery and earth moving technology. Earth moving technology became advanced during the late 20th century. The difficulty in physically accessing the ore bodies contributed to the sterilisation of some of the gold deposits.

4.2.1 The Mining Industry

Obuasi mine was the first deep underground mine to operate in Ghana. The Ashanti Goldfields Corporation (AGC) commissioned the mine in 1897. Obuasi mine was and is currently the only large-scale mine and formal employer in the town. Historically, the operation produced 38 million ounces of gold and it comprised of the underground mine,

open pits[21] and tailings reclamation. At a point in history, Obuasi mine accounted for over 60% of the total gold produced in Ghana. This made it the single largest foreign exchange earning industrial institution in the country (Ofosu-Mensah Ababio, 2012).

In 2004, the Ashanti Goldfields Cooperation merged with AngloGold to form AngloGold Ashanti. AngloGold Ashanti has to date invested more than 632 million dollars of capital into Obuasi mine. According to the company's 2015 financial report, AngloGold Ashanti currently holds a total land area of 474 km^2 around Obuasi. The green boarders in Figure 4.3 show the mineral tenure of the company.

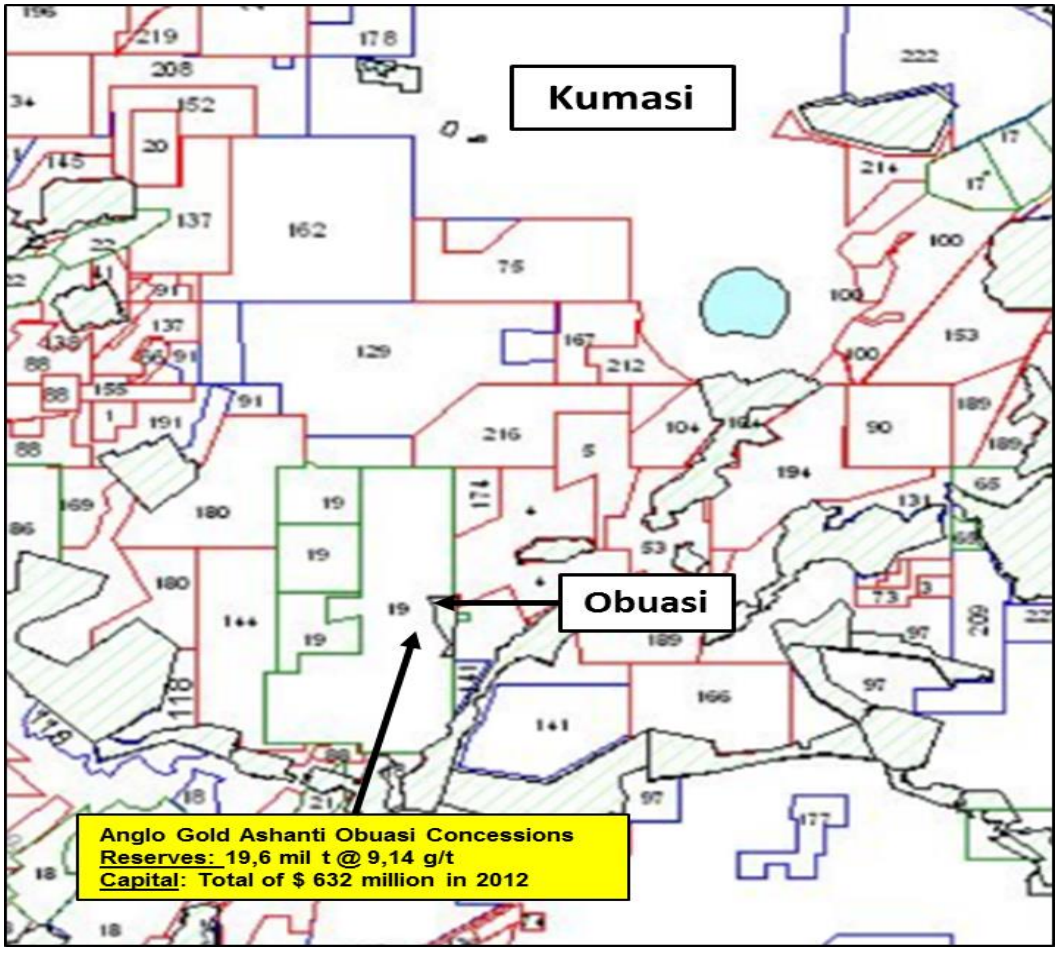

Figure 4.3: Map of Mining Tenures in Obuasi Ghana Minerals Commission (2012)

[21] The open pit ran concurrently with the underground mine from 1988 to 2000

The tenure occupied makes up 30% of the total land area of Obuasi[22]. This tenure is so vast that it leaves no reasonable size of prospecting land for potential large or small-scale competitors. One of the challenges of this dominant mining tenure is that small-scale mining activity occurs illegally within the concessions of the company. According to the municipality's Medium-Term Development Plan report, the source of livelihood for roughly 18% of the population is gained from galamsey (illegal small-scale mining). This figure has been on the rise because of the high level of youth unemployment, which sits at 64%. The company has undertaken a pledge to engage in a legal process that will allow it to return as much as 60% of the concession area to the Ghanaian Government AngloGold Ashanti, (2009); AngloGold Ashanti (2016); and Obuasi Municipal Assembly (2014).

At the end of 2014, production at the underground mine came to a halt and the mine transitioned to limited operations' mode (i.e. care and maintenance). This transition was the result of a shortage in new mining blocks and the decline in the gold price. The former was caused by underground development falling far behind production during the years of mining. The mine was in the process of developing a decline to access new mining blocks, but development ceased in December 2014 due to a lack of capital and the low gold price. This stoppage resulted in the mine reducing its labour force from 5000 people to a skeleton crew of about 850 people (a retrenchment of over 80% of the workforce). There are no figures available to indicate the percentage of the workforce that was from the host community. Obuasi mine is currently producing revenue from the treatment of tailings dams. While searching for a joint venture partner, the company is conducting a feasibility study into redevelopment; it is also investigating optimal methods of extraction. In 2015, AngloGold Ashanti estimated that 19.55 million tonnes (9.14g/t) of ore reserves remained in the ground, and over 632 million USD of initial capital had been invested into Obuasi mine AngloGold Ashanti (2016); AngloGold Ashanti (2009).

[22] In 2008, the Ghanaian Government agreed to extend the duration of this mining lease up to 2054

4.2.2 Mineral-based Economic Development in Obuasi

Obuasi is considered a relatively new, ethnically diverse urban area. Similar to Johannesburg, the town owes its heterogeneity to the gold mining industry, which attracted a large fraction of the labour force from surrounding West African countries. Obuasi is currently the ninth largest municipality in Ghana and the second largest in the Ashanti region (after Kumasi). The town has contributed significantly to the foreign exchange that Ghana has earned from the gold mining industry over the past seven years.

In addition to subsidizing foreign exchange, AngloGold Ashanti has a long record of contributing towards local economic growth and development in its host town. According to the ICMM (2007), AngloGold Ashanti spends an estimated 7million USD a year on social investments in Obuasi. The company has made the following significant social investments to date:

- Building of infrastructure such as the local hospital, schools, and recreational facilities such as stadiums;
- Access to utilities such as water and electricity, and provision of free electricity to communities which were relocated during mining induced resettlement;
- Human resources development by providing up skilling opportunities such as technical training and apprenticeships; and
- Encouraging economic diversification by piloting the development of alternative livelihoods in agriculture and aquiculture at abandoned mining sites.

According to the Obuasi Assembly Municipal Report of 2014 - 2017, AngloGold Ashanti has also preserved large areas of teak plantation within its concessions. In addition to social investment on a local level, the company has also made a substantial contribution towards economic growth and diversification on a national level. It was a significant contributor in the establishment of agricultural enterprises, financial institutions such as the Merchant bank, Ghana's first five-star hotel, and a major lime producing company (ICMM, 2007).

Research conducted by the ICMM revealed that many Ghanaians are not aware of the contribution that AngloGold Ashanti has made toward economic growth and diversification. In fact, many parties have criticized the company of not having enough involvement in social investment. Despite efforts to uplift the community, there is still a huge lack of basic infrastructure in Obuasi. This visible deficiency is what fuels the discontent of the residents. It is the primary responsibility of local government to provide basic infrastructure, however, local government fails to play its role. This results in the mining companies being burdened because the community and local bodies expect the companies to act as surrogate governments ICMM (2007); Domfeh (2014); andOfosu-Mensah Ababio (2012).

AngloGold Ashanti has been criticized for not creating enough direct business opportunities for the locals. This is because very small portion of procurement (less than 10% is allocated to the local community. The stakeholders see this as depriving the locals of potential economic gains. The company however justifies the low allocation of procurement with the historic culture of outsourcing procurement (nationally and internationally) because the skills and resources that were required to fulfil the procurement needs were not available (and are still not available) locally. This deficiency is largely due to the insufficiency of resources available to empower the locals to generate skills and ways to enable them to secure procurement opportunities. According to the ICMM (2007), municipalities do not have adequate resources to address development challenges in the local communities. This is firstly because of the centralised system of resource allocation, and weak regional administration structures. The local governments heavily rely on national government to plan and provide for their local communities. Secondly, the governance systems that are in place work to encourage national rather than local development. The disadvantage of this centralized system is that the mining revenue generated by the local communities is primarily used to meet the demands of the nation before those of the mining communities. This results in a tiny portion of mining revenue making its way back to the host gold mining communities (ICMM, 2007).

There are wide spread apprehensions that the local government of Obuasi squanders the little mining revenue that is allocated back to the communities. The municipality of Obuasi

has been accused of not considering or attending to the basic needs of the local community during its spending. An example of this instance was in 2007, when local assembly powers used 89000 Ghana Cedi (the equivalent of 21000 USD), to build a mediocre arch at the town's entrance. This spending was considered to be wasteful, bearing in mind that the mining community yearns for basic needs such as access to drinkable water, better quality education, health care systems, better road network (see Table 1.1, Chapter 1). This has resulted in organisations such as the Ghana Extractives Industries Transparency Initiative (GEITI) scrutinising sub-national revenue management and other local benefits from the mining industry Domfeh (2014); Ofosu-Mensah Ababio (2012); and ICMM (2007).

The disadvantage in Obuasi is that all the eggs have been placed in one mining basket. AngloGold Ashanti has been the only large-scale formal employer in Obuasi for many years. This is an indication of a lack of economic diversity. During peak production, the mine employed less than 0.5% of the total local population. When the underground mine was placed on care and maintenance, more than 80% of the workforce was retrenched. This not only resulted in significant job losses, but also the failure of businesses that were linked to the mining industry. The local municipality has expressed that it is looking into methods of developing economic linkages that can decouple the local economy from the industry for the future. The trade sector (comprising of transport, banking, finance, telecommunications), currently engages the majority (40%) of the employed community members in Obuasi. This sector is followed by the mining industry (which engages 35%), and lastly agriculture (25%). The municipality has identified challenges and potentials for growth for each sector such as livestock and poultry, grass-cutter rat and rearing and fishponds for agriculture. Although poverty remains a problem in Obuasi, the levels have been on the decline since 1990. There is also evidence that gold mining communities such as Obuasi experience quicker declines in poverty rates compared to other areas, which have very limited mining activity Domfeh (2014); Obuasi Municipal Assembly (2014); ICMM (2007); and Ghana Statistical Service (2010).

4.2.3 Environmental Challenges and Mining Induced Re-Settlement.

Environmental Challenges

Many rivers and streams drain the area of Obuasi. It is also endowed with springs, which have the potential to be used as transferrable drinking water (Obuasi Municipal Assembly, 2014). Unfortunately, neuro-toxic chemicals that are discharged during mining activity have contaminated many of the water bodies in the area. These chemicals together with general waste have polluted many of the perennial water bodies in the area. The sources of these mining chemicals are predominantly illegal small-scale mining activities that mostly occur on surface, inside and along the banks of streams and rivers. Tailings dams and mine waste dumps generated by large mining companies also emit toxic chemicals that find their way to the environment, but these occur on a smaller scale. According to the Ghana Environmental Protection Agency (2009), the arsenic concentration level in the Nyam river of Obuasi was measured to be 13.56 milligram per litre versus the 0.01mg/l permitted by the World Health Organisation (WHO). The manganese concentration level of River Asuakoo was measured to be 22.74 milligram per litre versus the 0.4 mg/l allowed by the WHO. If present in high quantities in drinking water, these dangerous chemicals have the potential to cause birth defects and negatively disturb mental development. This will affect consequently the intelligence quotient of children in the community (Obiri, 2009). Water pollution has also deprived numerous agricultural areas from irrigation. Figure 4.4 shows the impact that mining (more especially galamsey) has had on some of the main water bodies, such as the principal river Pra.



Figure 4.4: Past and present aerial photographs of River Pra Myjoyonline.com (2015)

Mining Induced Resettlement

Gold mining activity in Obuasi has led to the resettlement of residents. In 2011, AngloGold Ashanti embarked on a project to relocate the residents of the Dokyiwa, a community located close to Obuasi, to an area that was not very far from the original settlement. According to the Ghana Business News (2011), this project entailed building 115 housing units, basic infrastructure, social, health and educational facilities to ensure that the displaced residents lived comfortable lives. The relocation area also contained large farmland; this helped to encourage the residents to continue pursuing agriculture. AngloGold Ashanti was extolled for the "win-win" relationship, which the company established with its communities (Ghana Buisness News, 2011). Despite these efforts, the negative environmental impacts and social adversities continue to outweigh the mining benefits. The mining induced displacement and environmental disruption has intensified the clash between mineral rights and traditional rights. (Aboagye, 2014).

Although there is a compensation policy for mining induced displacement in Ghana, Akabzaa and Darimani (2011) stated that the policy does not recognize the tenure status

of several locals. The compensation policy for displacement is inadequate and it does not take into consideration the tenancy status of many locals. A large number of the displaced residents lose their previous livelihoods and experience the brutal cycle of poverty. The deprivation of alternative livelihoods is one of the conditions that force the residents of the mining communities to turn to galamsey[23].

Forced displacement of large magnitude can impose serious hardship on the local population. Communities that are subjected to resettlement become extremely vulnerable. They beget severe societal, economic, and environmental challenges such as:

- Loss of productive assets and income generating sources;
- Relocation to highly competitive areas, where the community's prolific skills may be less applicable;
- Dismantling and weakening of community structures, traditional powers and societal networks; and
- Scattering of families and dilution of cultural identity (Aboagye, 2014).

Involuntary resettlement may diminish the potentials of communal help and bring about severe poverty and long-term adversities. This contributes to the backsliding of economic growth and development Aboagye (2014); World Bank (2012).

4.3 Tarkwa

The area of Tarkwa is situated in the Wassa West District of Ghana. Tarkwa is located 290 km from the capital Accra, and 65 km from Tarkoradi (the home of Ghana's largest port), this is depicted in Figure 4.5. Tarkwa is located in a tropical rain forest; it lies between two mountain ranges (in a valley). The topography predominantly consists of mountains and undulating valley bottoms that are covered by dense forestation[24]. Tarkwa has a total

[23] Galamsey: Illegal small scale mining
[24] The general height of the trees in ranges between 15 m and 45 m. (Akabzaa & Darimani, 2001)

land area of 978.26 km^2, and a population of 90477 residents Akabzaa & Darimani (2001) ; Ghana Statistical Service (2010).

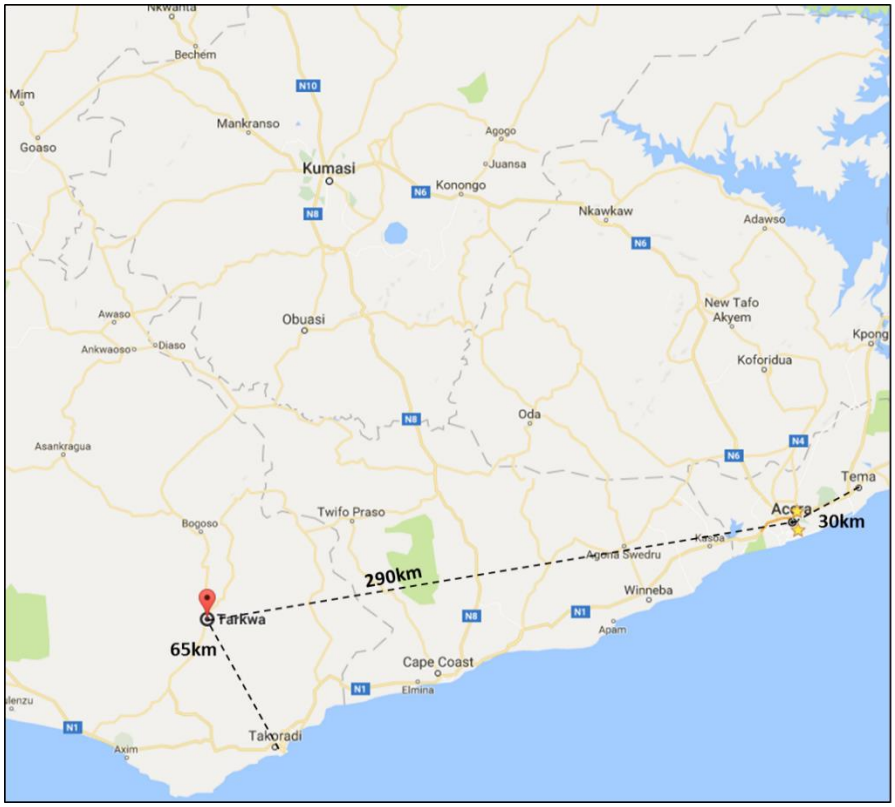

Figure 4.5: Location of Tarkwa Google Maps (2016)

4.3.1 The Mining Industry

The pre-modernisation history of the mining industry of Tarkwa is very similar to that of Obuasi; in that mining activity was predominantly artisanal, and in the hands of the locals. The Economic Recovery Plan implemented by the Rawlings administration greatly stimulated Tarkwa's mining industry during the 1990s. Tarkwa has since then attracted a number of large-scale mining companies. The area currently has the highest concentration of gold mines in West Africa. Considered as the mining centre of Ghana, Tarkwa contains more than 50% of the large-scale mines in Ghana. It accounts for 30% of the gold produced in the country. In addition to the large-scale mines, Tarkwa contains over 600 unregistered small-scale mines and 100 registered small-scale gold and diamond mining companies.

There are also approximately 30 companies (foreign and local) in the area conducting gold and diamond exploration(Akabzaa & Darimani, 2001).

Goldfields, Abosso Goldfields and AngloGold Ashanti predominantly hold gold concessions in Tarkwa. In 2002, Goldfields and Repadre Capital Corporation acquired a 90% stake of Abosso Goldfield (Bloomberg, 2016). This research report refers to these amalgamated companies as Goldfields. According to a concessions map published by the Ghana Minerals Commission (2010), Goldfields holds the largest concessions in Tarkwa, followed by AngloGold Ashanti (see Figure 4.6). The concessions of Goldfields cover a total area of approximately 445km^2, and the AngloGold Ashanti concessions in Tarkwa cover a total area of 110km^2 Amponsah-Tawiah & Dartey-Baah (2011); Akabzaa & Darimani (2001); and AngloGold Ashanti (2015).

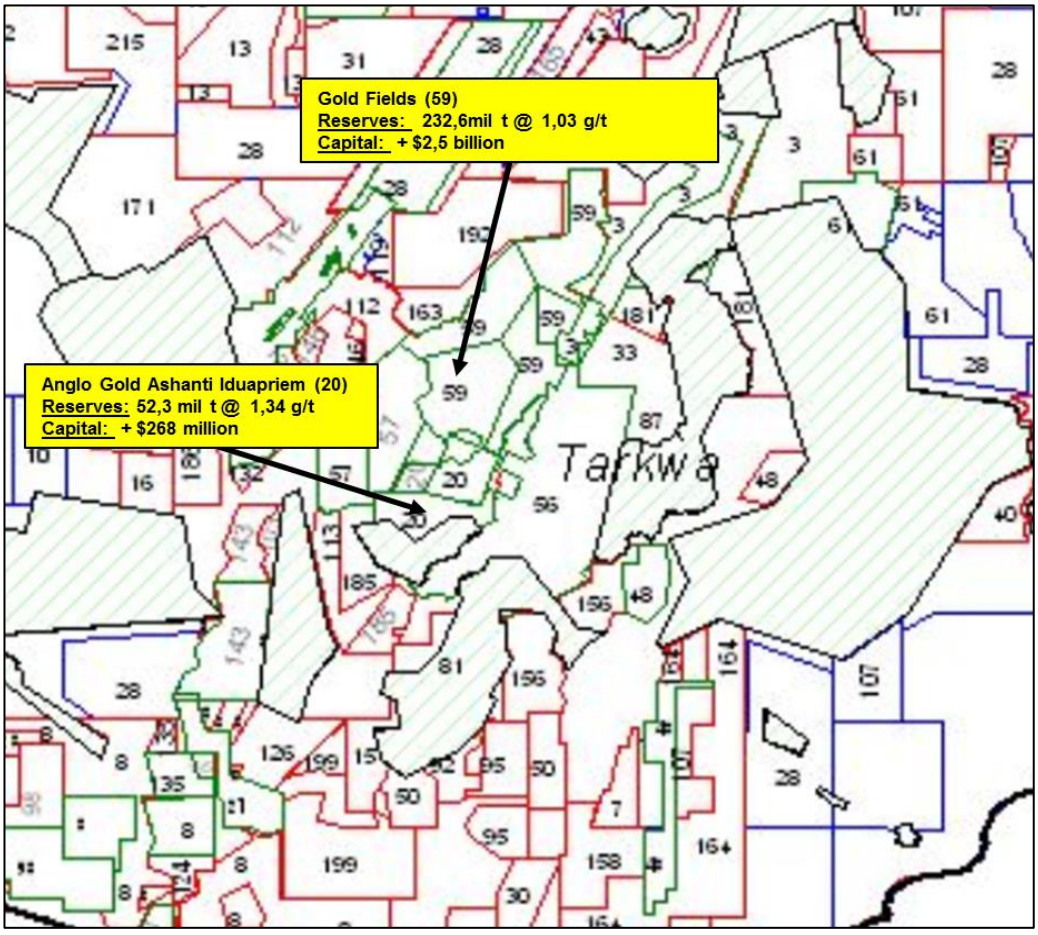

Figure 4.6: Map of Mining Tenures in Tarkwa Ghana Minerals Commission (2012)

Goldfields operates two large-scale mines (Tarkwa and Darmang), which contain eight open pits and a cyanide heap leaching operation. During the late 19th century to the mid-20th century, Tarkwa and Darmang fell under the Abontiakoon concessions, which in addition to the surface mines, contained two underground operations[25] that were assimilated under Abosso mine. A vertical shaft for the underground workings was sunk in 1935 and in 1960, the mining areas were abandoned and left to flood. During the LoM, Abosso underground mine produced an estimated 2.7 million ounces of gold at a grade that averaged 9g/t (Goldfields, 2016).

In 1961, the government formed the State Mining Corporation (SMC), a company created to take over the mining operations in Tarkwa. The SMC consolidated multiple operations under a State-owned enterprise named Tarkwa Goldfields Limited. Mining activity resumed under new ownership and a vertical shaft was sunk again in the 1970s. After the implementation of the ERP, Goldfields entered into a contract with the Government of Ghana and took over the Tarkwa operations[26]. Goldfields subsequently conducted further exploration, which lead to the discovery of more reserves in the area. In the years following, the company commissioned a main open pit within the concessions. The current LoM for Tarkwa is 16 years, and 5 years for Darmang. In 2016, Goldfields announced that it would invest 2.5 billion dollars into the Ghana operations over the next 11 yearsGoldfields (2015); Goldfields (2016).

According to the Goldfields 2015 annual report, Tarkwa and Darmang has a work force of 6670 (i.e. employees and contractors) of which 50% are permanent employees. Sixty-seven percent of the above-mentioned workforce is sourced from the local community. The report also shows that 9% of the procurement was distributed to the host /local community in 2015, while 64% was given nationally Goldfields (2015); Goldfields (2016).

[25] Adjah Bippo and Cinnamon Bippo mines
[26] The mining leases held by Goldfields Ghana expire between 2018 and 2027; however, the company has applied to extend these leases beyond their expiry dates.

The AngloGold Ashanti concessions are a combination of Iduapriem, Ajopa North and Teberebie properties. AngloGold Ashanti currently operates a large open pit named Iduapriem mine, which is located 10km from the town of Tarkwa. Iduapriem mine comprises of the Iduapriem and Teberebie operations. Although Iduapriem mine has been in operation for many years, its history is not as well documented as that of Goldfields. AngloGold Ashanti was granted a lease over the Iduapriem concessions in 1989, and 2 additional leases in 1992 and 1998[27] (AngloGold Ashanti, 2009). The Ashanti Goldfields Corporation initially owned the mine, and in 2000, they transferred 85% ownership to AngloGold. In 2008, AngloGold merged with Ashanti Goldfields to form AngloGold Ashanti.

AngloGold Ashanti estimates the reserves of Iduapriem to be 52.58 million tonnes at a grade of 1.34 g/t. The company has invested over 28 million USD into the project since 2007 (see Table 4.1). In 2009, Iduapriem mine had a labour complement of 1447 people, of which 50% were permanent employees. The company does not give an indication of the number of people employed from the host community (AngloGold Ashanti , 2015).

Table 4.1: Reserves and Capital Invested into Obuasi AngloGold Ashanti (2015) and Goldfields (2015)

Tenure / Concession Holder	Mines	Ore reserves (t)	Grade (g/t)	Capital (USD)
Gold Fields	Tarkwa	144 800 000	1,25	>2 500 000 000
	Darmang	21 200 000	1,43	
	Surface Stocks	66 600 000	0,43	
AngloGold Ashanti	Iduapriem	34 770 000	1,52	>268 000 000
Total / Average		**267 370 000**	**1,04**	**> 2 768 000 000**

[27] These leases expire between the years of 2018 and 2019

4.3.2 Mineral Based Economic Development in Tarkwa

According to the 2010 population census, only 39% of the population in Tarkwa is employed (i.e. 35319 out of 90477 people). Mining and quarrying provides employment to only 7988 people, i.e. 22% of the employed population. The majority of the employed population (32%) is engaged in the primary industry of agriculture, forestry and fishing.

During the late 1990s, there were both underground and surface mining in Tarkwa. However, in 1999, the underground mines were decommissioned, and this resulted in the retrenchment of 1000 workers. Today, only surface mining exists in the area. Surface mines are often low labour, highly mechanized, and capitally intensive operations. These mines require a small amount of skilled labour to operate. This means that even though there is a high concentration of large-scale mines in Tarkwa, the mines do not offer a significant amount of employment. The few employment opportunities that exist require a skilled workforce; this narrows employment opportunities further down Akabzaa & Darimani (2001); Ghana Statistical Service (2010).

The influx of mining companies has resulted in a high rate of migration, and consequently a rapid growth in the size of the population. This has brought about several social challenges; it has put a strain on service delivery, and affected the cost of living. Tarkwa now experiences several symptoms of Dutch Disease. According to Akabzaa and Darimani (2001), the mining boom resulted in salaries becoming extremely disproportionate. This is because expatriates and mining employees earn more than their colleagues in other sectors and they earn these high salaries in foreign currency (USD). The recipients of the high salaries have swayed the pricing of goods and services towards the higher end. This together with the high import of food in Ghana has contributed to an escalation in the cost of living. The disproportion in earning has made it difficult for other sectors to compete with the mining sector because they cannot attract and retain skilled labour. It has become difficult for the average person to afford day-to-day necessities.

The Tarkwa municipality is also centralized and does not have a set LED policy and plan. These two conditions make it difficult to execute economic development plans to a satisfactory level[28]. Over the years, Tarkwa municipality has been brought under the spotlight for failure to cater for the increasing demand of basic human needs. Waste management, especially that of solid waste has become a calamitous concern in the town (Frempong, 2013). According to the 2010 Population and Housing Census, only 3% of the population has access to sewage facilities for waste disposal. In 2011, economic activity was disturbed when Tarkwa came to a halt because commercial public transportation service providers withdrew their services due of the poor nature of the local road network. The issue was that the road network was so poor that it increased the number of road incidents, vehicle maintenance costs, and dust pollution. The demonstration left several traders, mine employees and other residents stranded and unable to commute to work. In the 2015 budget report, the Tarkwa municipality acknowledged the poor condition of the local roads (GhanaWeb, 2010).

Although mining activity generally has very weak links with national economy, it has a pivotal impact on the mine host communities. The migration of multinational mining companies into Tarkwa brought substantial physical and social infrastructure such as health facilities, educational facilities, and utilities. One of the most significant social investments in the town is the University of Mines and Technology (UMaT). Established in the mid-1900s, the primary goal of the university was to produce specialists and skilled workers to cater for the labour requirements of the mining and allied industries in the country. Over the years, UMaT has grown and it now attracts students from other West African countries such as Nigeria, Mali, and Burkina Faso. Mining also brought an inflow of mining support services such as security companies, service contractors, food services, transportation, construction companies etc. in the area Akabzaa and Darimani (2001); UMaT (2014).

[28] See section 4.2.2 about centralization that weakens resource allocation to communities in Ghana.

Goldfields Community Investment Initiatives

Goldfields has launched a Sustainable Community Empowerment and Economic Development program (SEED) in its host communities. The company has spent close to USD 2.5 million in development projects in Ghana. Figure 4.7 gives a breakdown of the Goldfields community investment budget.

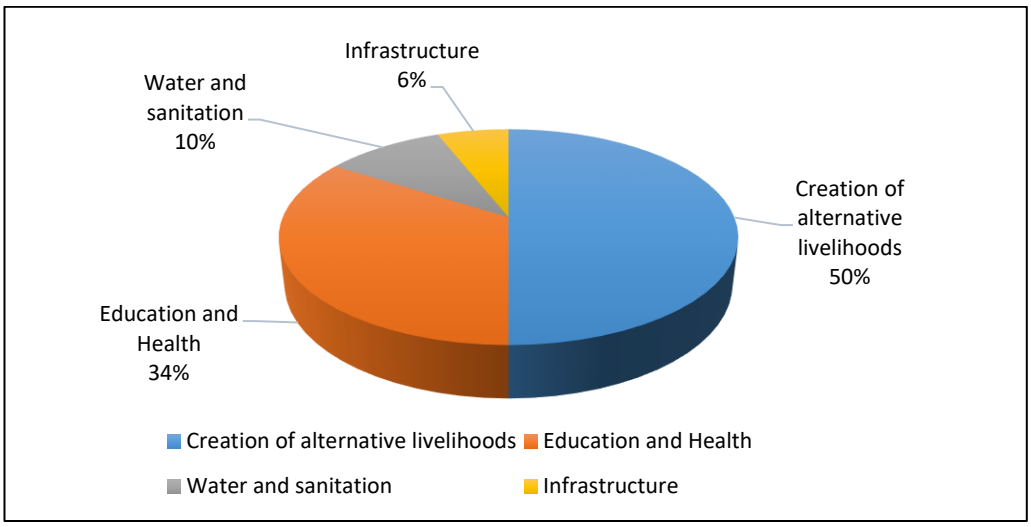

Figure 4.7: Breakdown of the Goldfields Community Investment Budget Goldfields (2015)

According to Goldfields (2016), the SEED program has benefited over 3000 members of their host community directly and at least 15000 people indirectly. The following projects have been launched under the SEED program:

- The distribution of more than 17000 oil palm seedlings;
- The facilitation of oil palm processing via the provision of oil palm processing amenities;
- The creation of aquaculture farms that have developed into one of the most productive farms in the country;
- The establishment of livestock programmes; and
- A community project which is aimed at teaching the locals about agriculture.

AngloGold Ashanti Community Investment Initiatives in Tarkwa

AngloGold Ashanti continues to play a significant role in community investment. According to an article published by GhanaWeb in 2016, the company has implemented a number of local economic development initiatives. The primary objective of this is to equip community members with skills that would enable them to become employable and self-sufficient. The company also strives to boost the capacities of local contractors, to empower them partake in the supply chain process. An example of this is a case where AngloGold Ashanti, with the aid of local government, organised a series of business management workshops that have empowered individuals to venture into entrepreneurship, and start businesses that offer services (e.g. cleaning services) to the mines (GhanaWeb, 2016).

4.3.3 Environmental challenges and Mining Induced Re-settlement.

Environmental challenges

For large-scale surface mining to occur, a substantial amount of land has to be alienated and cleared. During the stages of site preparation and production, heavy machinery and equipment are used to explore and exploit the ore body. The high concentration of surface mining in Tarkwa has resulted in the clearance of vast amounts of land. Between 1992 and 1997, large-scale surface mines were emerging at a high rate in Tarkwa and this caused vegetation to decline by several hundreds of thousands of hectares. A study conducted by Schueler et al (2011) revealed that surface mining has resulted in 23.4% deforestation and 45% farming land loss in the mining concessions of Tarkwa and Darmang (see remote sensing maps in Figure 4.8).

Mining companies also make use of cyanide heap leaching processes to extract gold. This can be very hazardous to the environment as well as the health of human beings and animals because there is a high risk of cyanide finding its way into water bodies and the fragile ecosystem. Pollutants emerging from mining activities have contaminated many of the drainage systems in Tarkwa. Surface mining actives also emit dust into the atmosphere, they cause blast vibrations damage surrounding infrastructure, and they

create noise pollution. Acid Mine Drainage emitted from the waste dumps in the area has also brought about environmental issues (Akabzaa and Darimani, 2001).

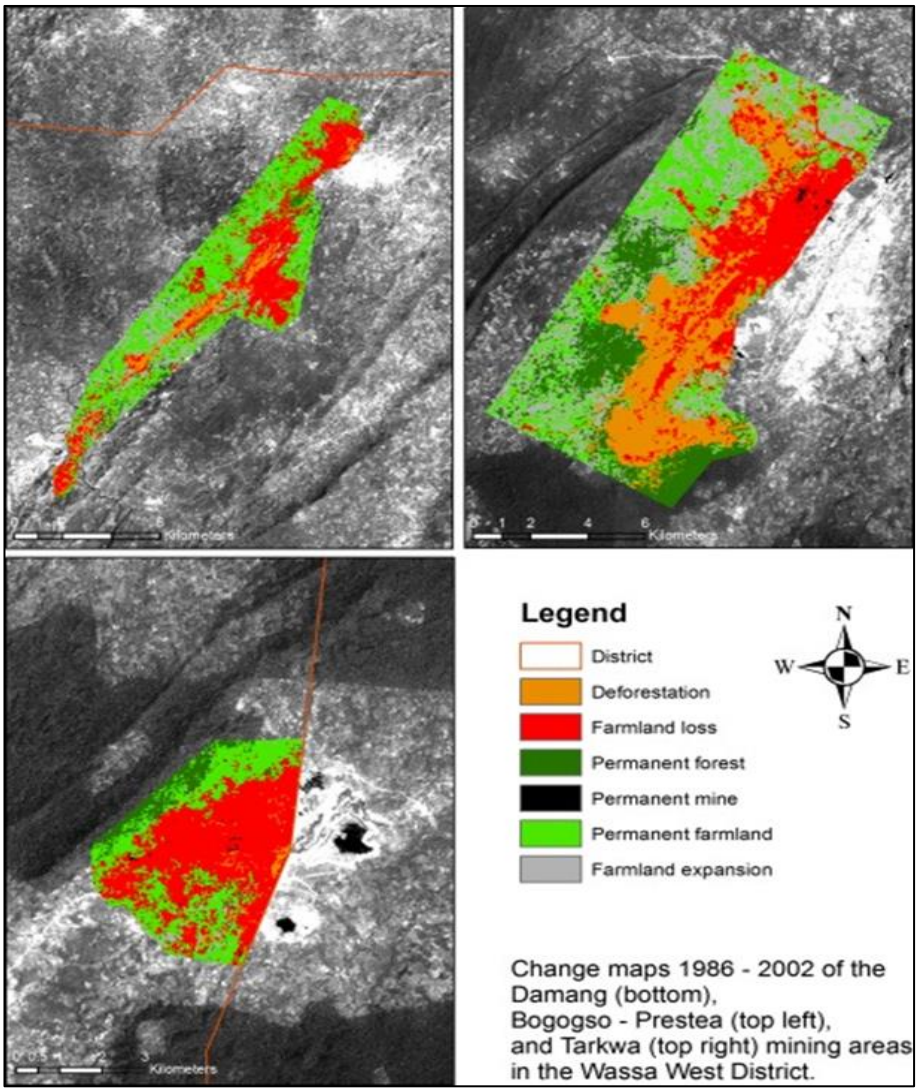

Figure 4.8: Change Maps of land loss and deforestation in Western District Schueler et al (2011)

Mining Induced Re-settlement

The establishment of Goldfields' Tarkwa open pit resulted in the resettlement of 3000 residents. AngloGold Ashanti also faced displacement challenges in 2003 when the construction of the Teberebie waste dump area forced 100 households to relocate. According to the mining companies, approximately 22267 people were displaced from 20

communities in the area between the years of 1990 and 1998. While mining companies assisted the relocation of others, some of the residents were forced to migrate and search for farmland without the aid of government or organisations. In addition to this, hundreds of residents are compelled to relocate annually because of continuous mining development Terminski (2012); Akabzaa and Darimani (2001).

4.4 Conclusion

The current state of the mining industries and the economies of Tarkwa and Obuasi were driven by politics, economics, nature and human population. Both towns are popular today because of gold mining activity. Under the rule of the British colony, the minerals laws were designed to channel mineral wealth away from the Ghanaian economy and towards the British economy. This legislation deprived the Ghanaian economy of mineral wealth for a period of 60 years. Shortly after Ghana gained independence, the state of the economy declined. This caused the gold mining sector to contract for about 50 years. The implementation of the ERP revived the ailing mining sector, and attracted many multinational companies to the areas of Obuasi and Tarkwa. Favourable legislation and developed mining and earth-moving technology enabled companies to access previously sterilized orebodies. This initiated what seemed like a second gold rush in the country. Currently, there are only two large-scale mining companies operating in Tarkwa and Obuasi. The majority of these are surface mines that are unable to generate significant employment or procurement opportunities.

Although mining activity has boosted economic growth in both communities, economic development lags behind and economic linkages are weak in both areas. The centralized system of the national administration has resulted in local government becoming dependent on national government for development plans and resources. The mineral wealth that emerges from these communities is used to meet national demands first, then it is spread thin across the national economy. The local government does not use the little resources that find their way to the host communities effectively. Mining activity has also brought about several environmental challenges such as water contamination, air pollution

and degradation of vegetation. The excavation of the large surface mines has caused mass displacement of several households. These challenges have affected community structures, quality of life and deprived several households of livelihoods. Chapter 5 gives a comparison between the case studies of Johannesburg (Chapter 3) and Tarkwa and Obuasi (Chapter 4).

5 FACTORS THAT INFLUENCE THE ABILITY OF MINERAL WEALTH TO CATALYSE ECONOMIC DEVELOPMENT.

5.1 Comparative Analysis of the Johannesburg, Obuasi and Tarkwa Case Studies

The case studies in Chapters 3 and 4 gave an overview of the various natural, technical, economic and political events that have transpired in the mining areas of Johannesburg, Tarkwa and Obuasi. The chapters described how these events have influenced the ability of mineral wealth to be translated into economic development. The information presented in the case studies can be used as a frame of reference to compare and contrast between the three mining areas. In the first part of this Chapter, a comparative analysis is conducted with the aim of identifying the critical factors that played a role in catalysing or repressing mineral resource-based economic development in the mining areas. In the second part of Chapter 5, the research examines how the identified factors fit into the mineral wealth challenge categories that were identified by the United Nations Economic Commission for Africa (UNECA) in Chapter 2 (2.4 The Challenges of Mineral Wealth).

5.1.1 Factors of Nature

Environmental Climate, Location and Landform

It was identified that the physical characteristics of the landform, the climate, and the location of the auriferous area, played a significant role in the advancement of mineral wealth. Table 5.1 compares the climate, landform and location of Johannesburg, Obuasi and Tarkwa.

Table 5.1: Climate, Landform and Location Factors

Factors	South Africa	Johannesburg	Ghana	Obuasi	Tarkwa
Climate and Location					
Climate	Mediterranean to temperate to subtropical	Temperate to dry	Equatorial	Semi-equatorial	Tropical
Topography	n/a	Plateau - Flat Terrain	n/a	Mountainous, located in a valley	Mountainous - located in a valley
Forestation	n/a	Sparse forestation	n/a	Dense forestation, forest region	Dense forestation, forest region
Distance from ports (km)	n/a	610 -1475	n/a	200-325	65-220

Table 5.1 shows that Johannesburg has a relatively dry and cool climate. This area experiences four seasons, which are similar to those of European countries. Tarkwa and Obuasi are located near the equator; because of this, the areas experience a hot and humid tropical climate that is very different from that of Europe. At the time of the gold rushes, most of the labour and investors who immigrated were of European origin. Since the Johannesburg climate is similar to that of Europe, permanent settlement in the area was favorable. The tropical climate of Tarkwa and Obuasi contributed to the areas being less favorable for permanent settlement.

Topography and the density of vegetation also played a role in the attractiveness of the mining areas. Johannesburg is located on flat terrain and at the time of the Wits gold rush, it had sparse forestation. This meant that accessing the orebodies did not require extensive deforestation and the use of advanced earth moving technology. This made the orebody more easily accessible on surface. Obuasi and Tarkwa are located in mountainous and densely forested areas. As a result, advanced earth moving technology was required for deforestation along the mountains and the valleys in the early days of mineral development in those areas. Earth moving technology was not advanced during the early to mid-20th century, which contributed to the sterilization of some of the orebodies in Ghana.

Tarkwa has the most favorable economic location out of the three areas; firstly, because it is located close to one of the major harbors in Ghana (65km away) and secondly, because of its location along a trade route. Johannesburg, on the other hand, was located the furthest from national harbors, major waterways or trade routes. Despite its unfavorable economic location, the area was able to develop its economy exceptionally fast and well. This is because of the quality, quantity and the distribution of its gold deposits, and the way in which the State handled the mineral wealth.

Production capability of the Orebody

Quality and Quantity

Orebodies have a limited ability to produce because of their finite nature. The size and the quality of a gold orebody determines the quantity and quality of gold that is produced, as well as the number of years it can produce. Factors such as the number of ore deposits in an area, the sizes of these deposits, and the grade are fixed by nature. An ore deposit cannot produce more than its capability or higher than a certain grade.

Figure 5.1 shows that 9 million ounces of gold were estimated at an average grade of 13.1g/t for the Central Rand Mines of Johannesburg during the early 1900s. Such production is almost double of that which was estimated for Obuasi (5.7 million ounces at 6.7g/t). The reserves of Tarkwa have been estimated at 232 million tonnes at an average grade of 1.04 g/t. Although the tonnes contained in Tarkwa are higher than those of Johannesburg, the average grade of gold is less than a tenth of the Johannesburg's gold. Because of the large extent of the Tarkwa orebody, it has the potential to produce more gold ounces (622000 ounces extra) than Johannesburg. However, to achieve this, the mines in Tarkwa would have to move a greater amount of rock compared to those of Johannesburg. This would require more production, a higher gold price, more means to

move the tonnes, and more years. The comparison shows that the gold of Johannesburg was very high quality and it was present in large quantities[29].

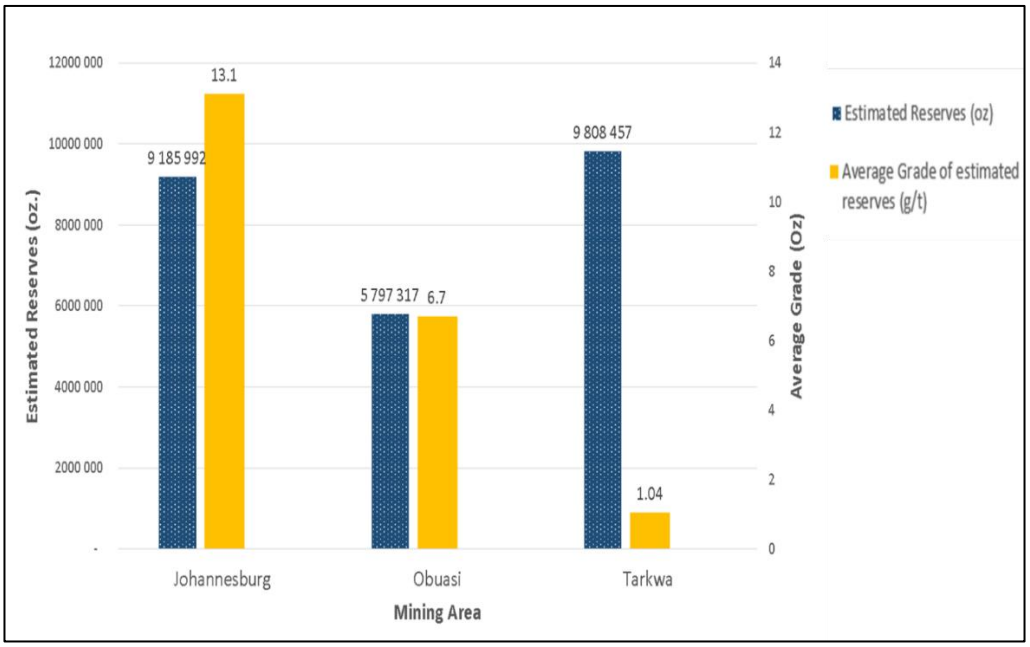

Figure 5.1: Estimated Reserves for Mining Areas

The different quantities and qualities of the orebodies in these areas have resulted in different amounts of revenues and investments being directed into the areas. This makes it highly unlikely for all three areas to achieve the same level of mineral-based economic growth.

Concentration of Mining activity

The mines of Johannesburg were more densely concentrated. The Central Rand Mines occupied a collective tenure of about 142km^2, a space that contained more than 70 underground mines (Broomhead, 1909). The number of mining operations in Johannesburg during the early 1900s was more than 70 times the number of mines in Obuasi and 35 times the number of mines currently operating in Tarkwa. Furthermore, the

[29] Natural Resource Holdings (2014) estimated the highest resource grade in South Africa to be 28g/t (the TauTona gold deposit) and 5.35 g/t for Ghana (the Obuasi deposit).

Johannesburg mines were concentrated in half the space of the Tarkwa and Obuasi mines (see Table 5.2). The author constructed tenures to give the reader a graphical depiction of the concentration of the mines within the tenures in the areas of the case studies.

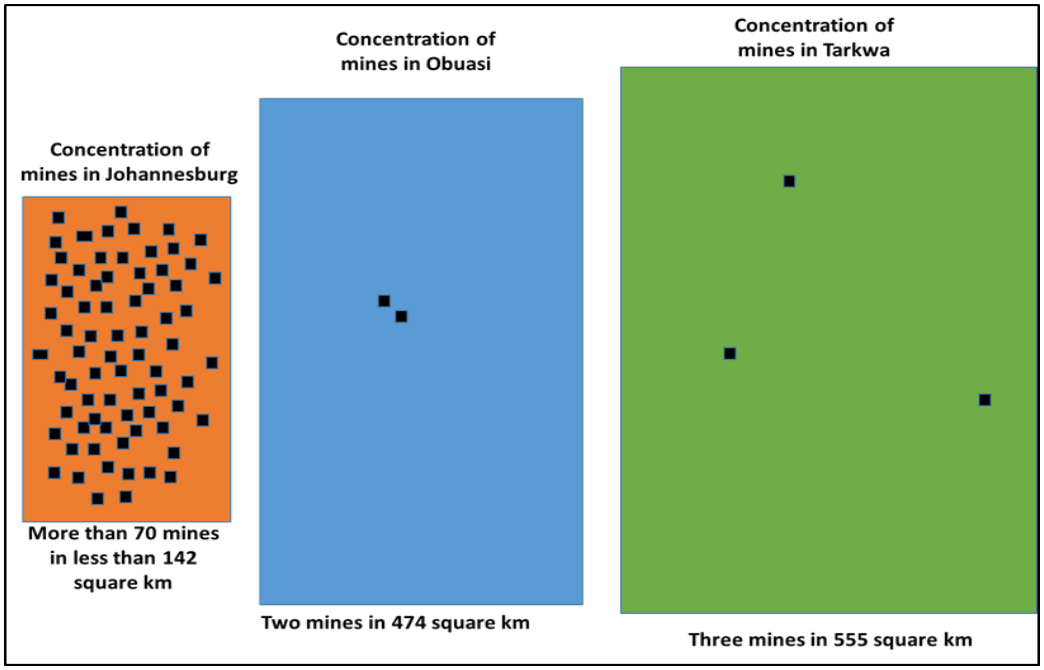

Figure 5.2: Concentration of Mining tenures

Table 5.2: Number of Mining Operations within Mining Tenures

Capability of the Orebody					
Factors	**South Africa**	**Ghana**	**Johannesburg (1900s)**	**Obuasi (2014)**	**Tarkwa (2014)**
Area of gold tenure (km square)	n/a	n/a	142	474	555
Number of gold mining companies in the area	n/a	n/a	5	1	2
Number of mining operations within tenure	n/a	n/a	70 underground	2 (1 surface and 1 underground)	3 Surface

5.1.2 Investment

During the 1900s, the Wits gold rush attracted skilled labour and investors who were largely of British descent. The British gained political and economic control of Johannesburg and chose to settle permanently. A large amount of capital was invested in the small mining area. Approximately 1.7 billion USD (present value) was invested in an area less than 142 km^2. This means that about 12 million USD were invested for every km^2 of mining tenure in Johannesburg. In Obuasi and Tarkwa, 1.3 million and 5 million USD have been invested respectively, for every square kilometre of tenure. This means that the capital that was invested in the Central Rand was almost ten times the capital invested in Obuasi, and double that of Tarkwa. The presence of a large number of mines in Johannesburg also meant a higher diversity in investment. This increased the investment options and attractiveness of the Central Rand.

The permanent settlement of the investors and labour in Johannesburg resulted in the mineral revenues being kept in the area. This revenue was used to grow and develop the local economy for 117 years. The collaboration of the British and Boer governments in later years helped to ensure the longevity and profitability of the mining industry as well as the prosperity of the local economy. Johannesburg was used to fuel the long-term economic growth and development of the rest of the country. In the case of Ghana, although the British colonised the country, they did not have power over some parts of the land. The investors did not permanently reside in Ghana, and mineral wealth was as a result channelled out of the country and into the British economy. This occurred from the 1900s to the 1960s. The Ghanaian economy began to benefit effectively from the gold mining industry in the 1990s after the implementation of the ERP. The Ghanaian areas have only been reaping the economic benefits of mining for 27 years; these areas are 90 years behind Johannesburg (see Table 5.3).

Table 5.3: Investment Factors Broomhead (1909), Goldfields (2015) and AngloGold Ashanti Financial Report (2014)

Factors	South Africa	Johannesburg	Ghana	Obuasi	Tarkwa
Initial Investment					
Year of Modern Mining	1873	1887	1897	1897	1935
Year that area started to benefit from mineral wealth	1900	1900	1990	1990	1990
Local of Foreign Investors	n/a	Local	n/a	Foreign	Foreign
Number of years that mineral wealth has been injected into the local economy	117	117	27	27	27
Estimated capital invested into mining operations (USD)	n/a	1 700 000 000	n/a	632 000 000	2 800 000 000
Mining investment per km^2 of tenure area (USD/km^2)	n/a	11 971 830	n/a	1 333 333	5 045 045
Mining investment per km^2 of entire area (USD/km2)	n/a	1 033 435	n/a	389 163	2 862 986

5.1.3 Political Economy

Administrative system

Politics plays an important role in determining the influence of mineral wealth on the economy. The governing structures, administrative systems and policies that are put in place affect the ability of mineral wealth to catalyse economic development. South Africa has a history of a decentralized government system. The case studies show that during the time of the Wits gold rush Johannesburg was under the administration of the Transvaal Colony. Johannesburg was considered the economic capital of the Colony, and gold

mining the corner stone of economic growth. The mineral revenues were kept in Johannesburg and used to stimulate economic growth in the area. This strategy empowered local administrative bodies and gave them enough resources to drive economic development. In the case of Ghana government system has been (and remains) heavily centralized. This has resulted mineral revenue being directed towards the country's capital and other principal cities. These areas usually take first priority when it comes to economic development. The remaining mineral revenues, and other resources, are spread thin across the nation, resulting in insufficient resources reaching the mining host communities. Unfortunately, the little resources that make their way to the host communities are squandered by local governments, instead of being used to meet basic needs due to weak local administration systems.

State Participation

In Johannesburg, the involvement of the State in the mining industry went beyond the collection of taxes and mineral royalties. During the time of the Witwatersrand gold rush, the mining law encompassed land proclamation. This law gave the State the power to reserve the right to mine what were considered as strategic minerals. During this period, gold was considered a strategic mineral. Proclamation gave the State the right to lease mineral and surface rights of privately-owned auriferous land to whichever mining company it saw fit. Mining activity took first preference over any other activity on gold bearing land. The State put in measures that enabled the gold mining industry to have a long life and reap maximum profit during its life. Although State participation violated the personal rights of landowners, it helped to stimulate the development of the Johannesburg mining industry, and developed a platform for gold mining to catalyse the economic development of Johannesburg (Cawood & Minnitt, 1998). In the case of the Ghana case studies, gold bearing land was and is still mainly owned by the traditional stools (Chiefs) of the various areas. The complexities of land ownership in Ghana make it difficult for the government to evoke State proclamation.

5.1.4 Economic Factors

The Ghanaian context of Local Economic Development is rather ambiguous. Although numerous legislation and institutions have been created and point in the direction of economic development on a local scale, they have not been clearly specified or categorized as LED tools. Although South Africa only became familiar with the concept of LED during the early 1990s, research shows that there was a great focus on LED in Johannesburg from the start of the 20th century. The mineral revenue that was generated by the Johannesburg mines was kept in the area and used to develop the local economy.

In Johannesburg, the high intensity of gold mining contributed to the creation of strong economic linkages. The gold mining industry was so big that it created a high demand for electricity, transportation and water. This demand led to the establishment of large parastatal organisations. An influx of high investment into the area resulted in the development of a local stock exchange, and economies of scale made it practical for a refinery to be built 14km east of Johannesburg. In the cases of Tarkwa and Obuasi, the gold produced was and is refined in countries outside Ghana such as South Africa, Australia and Canada. There is no value addition of gold in the country, and this deprives the Ghana of the economic benefits of value adding.

South Africa's abandonment of the gold standard also counted in favour of Johannesburg. This caused the price of gold to increase overnight (see Figure 2.1). During this period, South African gold mines were producing at peak capacity and were therefore able to generate very high revenues and profits. However, in Ghana investor confidence was declining during the 1930's, and as a result the mining industry and economy were not able to benefit from the sharp increase in the gold price.

All the mines of Johannesburg operated underground. In the Ghanaian areas of study, there is only one underground mine, which is currently not producing, and the rest of the operations are large surface mines. Surface mines employ a fraction of the labour required in underground mines. It is also very difficult for surface mining to coexist with other

economic activities that require land use because of their large footprint. The comparison between the economic conditions of the three areas is provided in Table 5.4.

Table 5.4: Comparison of Economic Factors

Factors	South Africa	Johannesburg	Ghana	Obuasi	Tarkwa
Economics					
LED Policy in place (Yes/ No)	Yes	Yes	No	No	No
Value adding local/ international	National	Local	Inter-national	International	International
Strength of linkages to mining industry	Strong	Very Strong	Weak	Moderate	Very Weak
Peak in gold price when gold standard was abandoned	Mines benefited	Mines were performing and they benefited substantially	Mining industry did not benefit.	The mining industry was dormant and did not benefit	The mining industry was dormant and did not benefit

5.1.5 Research and Development

In the past, South Africa was a leader in mining R&D. However, over the years, the country has fallen behind with R&D. Most of the deeper orebodies of the Witwatersrand cannot be mined because there is not enough knowledge about deep mining methods or deep mining technology. It is widespread knowledge that R&D is weak in Ghana. Although institutions such as the Council for Scientific and Industrial Research (CSIR) exist in the county, the funding of mining R&D remains a challenge. The country is heavily reliant on the international community for the development of small and large-scale mining best practices and technology.

5.2 Mineral Wealth Challenges

5.2.1 The Models of Mineral Wealth Challenges

According to the United Nations Economic Commission for Africa (UNECA, 2012), certain challenges influence the ability of mineral wealth to become a catalyst for economic development. These challenges have been grouped under the three key categories which are – Unfavourable (External) Market forces, Dutch Disease and Internal Economic Stress, as well as Political Problems. The UNECA model of mineral challenges is depicted in Figure 5.3.

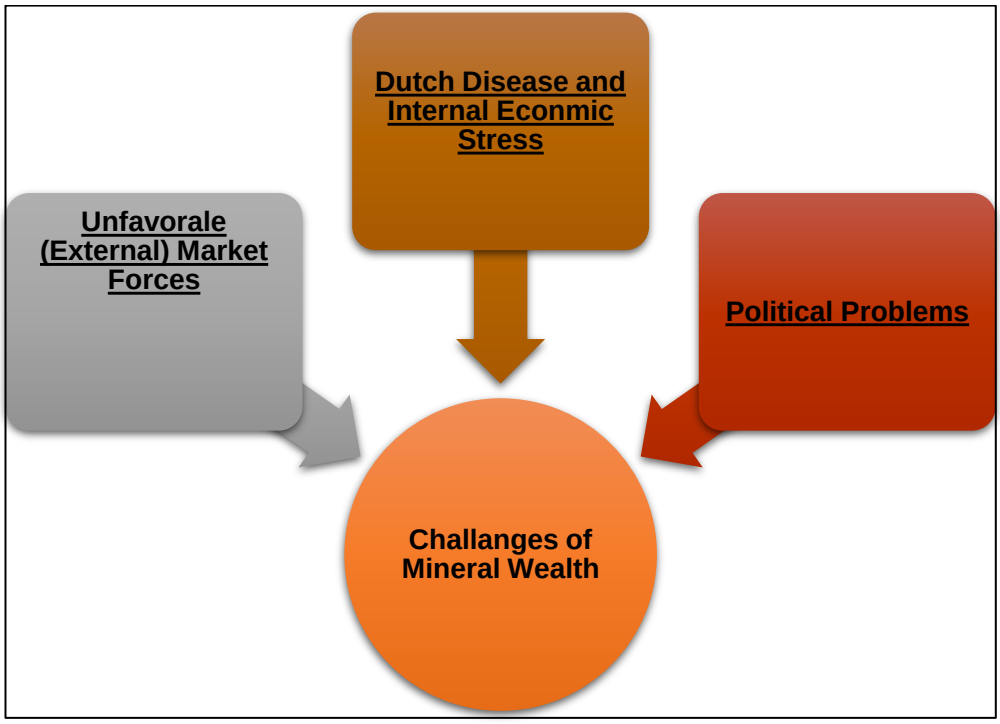

Figure 5.3: UNECA Model of Mineral Wealth Challenges (UNECA, 2002)

The challenges identified in the UNECA model were described in detail in Chapter 2. This section of the report attempts to link the critical factors that have been identified in section 5.1 to the mineral wealth challenge model of UNECA. The linkage is presented in Table 5.5. The green italic fonts indicate positive management of mineral wealth challenges and the red normal font indicates the negative management of mineral wealth challenges in the areas.

Table 5.5: UNCECA Mineral Wealth Challenges applied to the Case Studies

UNECA Mineral Wealth Challenges	Johannesburg	Obuasi	Tarkwa
Unfavourable Market forces	- *Benefited from the abandonment of the gold standard, revenues increased and large profits were made.*	- Did not benefit from the sharp increase in the gold price when the gold standard was abandoned. This was because of a drop in investor confidence caused by rumours of an impending political revolution during the 1930s.	
Dutch Disease and Internal Economic Stress	- *The government made a plan to reduce imports and the cost of living by boosting the agricultural sector, food services, and other supporting sectors.* - *LED policy exists* - *All the mines were underground operations making it possible for them to coexist with other economic activities that require land use.* - *Underground mines are labour intensive and therefore employ a large amount of labour* - *Value adding done locally a few kilometres outside Johannesburg.*	- High cost of living due to high dependence on imported goods and products. - Depreciation in currency that caused national exchange to be high resulting in high export costs. - Other sectors have been unable to compete with high mining salaries. - High input costs and wages in the gold mining sector. - No formal LED policy - Most of the mining activity have occurred on surface. Surface mines have a large footprint making it difficult to coexist with other economic activities that require land use. - Surface mines are not labour intensive. They generally employ a very small amount of labour compared to underground mines - Value adding of gold mined in Ghana has been done in other countries	
	- *Strong up, down and side economic linkages were developed* - *Extremely low disruption of communities*	- Economic linkages were established but they were very weak. - Minimal disruption of communities and alternative livelihoods.	- Economic linkages were extremely weak and virtually non-existent. - Communities and alternative livelihoods have been disrupted on a large-scale.
Political Problems	- Colonization by the Dutch and the British, governed by Dutch and British law. - Wars and union violence. - *British political and economic victory encouraged permanent settlement and mineral*	- Colonization by the British. - Mineral wealth was channelled outside the country during colonization. - Several Coup d'état occurred, causing political instability for over 30 years - Mineral rent system initiated late (in the 1960s).	

	- *revenues were kept in Johannesburg.* - *State Participation.* - *Mineral rents system existed since the 1880s.* - *Mineral revenue was managed well and kept in the country since the beginning of the Wits gold rush.* - *Government intervened to ensure longevity and long-term profitability of the mining industry* - *Decentralized government system*	- *The Economic Recovery Plan rejuvenated the mining industry in the 1980s.* - *The country only began to benefit fairly from mining revenues after the ERP was implemented.* - Centralized government system resulting in poor distribution and management of revenues. - No formal LED policies in place.

The analysis conducted in these tables shows that Johannesburg was able to conquer most of the mineral wealth challenges that have been identified by the United Nations. The comparative analysis also revealed that there are additional mineral wealth challenge factors that cannot be placed in the existing categories of the UNECA model. This introduces a gap in the UNECA model. These additional factors are identified and categorized in Table 5.6.

Table 5.6: Additional Mineral Wealth Challenges

Additional mineral wealth challenges	**Johannesburg**	**Obuasi**	**Tarkwa**
Nature	- *Favourable location, climate, topography and vegetation.* - *Very high concentration of mines in the Central Rand* - *The mines occupied small tenures*.	- Unfavourable location, climate, topography and vegetation - Few large-scale mines that occupied large tenures	
	- *Large, high grade orebodies*	- Relatively small, low grade orebody	- *Large Orebody* - Very Low grade
	- Located far from ports / harbours, waterways and trade routes	- Located far from ports / harbours, waterways and trade routes	- *Located on a trade route and close to a harbour*

Investment	- *Investment was mostly local.* - *Large amount of capital initially invested in a small space.*	- Small amount of capital invested per km^2 of mining area. - The majority of the mining Investment is foreign.	
Research and Development	- Was strong in the past, but has become very weak with time	- Very weak	- Very weak

The gaps identified in the UNECA model prompted the author to create a revised version of the mineral challenges model. This new research model introduces three new categories, which are Nature, Economic, Investment and Research and development. The categories of Unfavourable Market Forces and Dutch Disease are grouped under Economic. The research model also renamed the 'Political Concerns' category to 'Political Economy'. The research model of mineral wealth challenges is depicted in Figure 5.4.

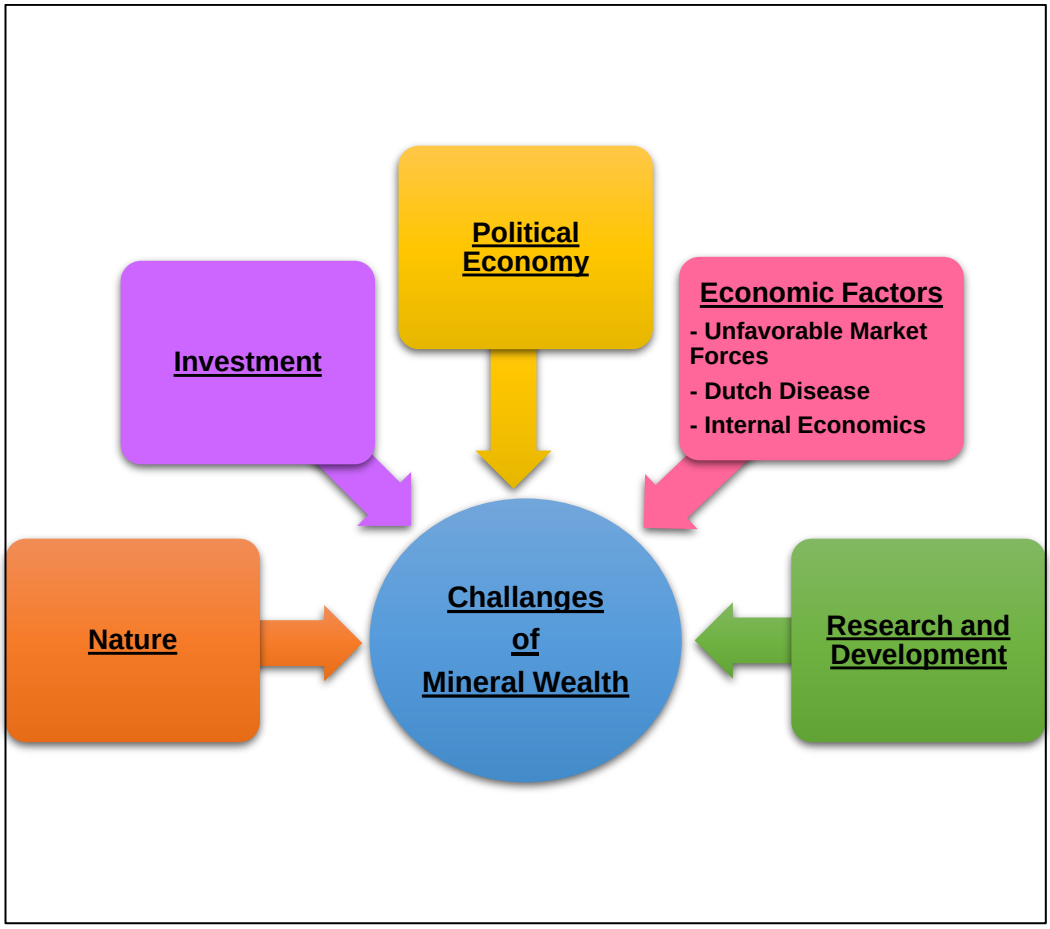

Figure 5.4: Research Model of Mineral Wealth Challenges

5.3 Conclusion

Chapter 5 compares the case studies of Johannesburg, Tarkwa and Obuasi. This chapter identifies the key factors that have influenced the ability of mining areas to use mineral wealth to catalyse sustainable economic development. The UNECA Model of Mineral Wealth Challenges was used as a base line for the three case studies. It was discovered that Johannesburg was able to manage most of the mineral wealth challenges that it faced, but the Ghanaian areas were and are still struggling with the management of these issues. The comparative analysis also revealed additional key factors that need to be considered when managing mineral wealth. These additional factors could not fit into the existing UNECA model. This gap prompted the author to develop the Research Model of Mineral

Wealth Challenges. The research model now introduces five categories of Nature, Investment, Political Economy, Economics, and Research and Development.

Chapter 6 concludes the research and gives a summary of the key findings. It also provides recommendations on what the Ghanaian and South African gold mining areas need to do in order to cope with the mineral wealth challenges that were identified in the new research model, and work towards sustainable economic development.

6 WORKING TOWARDS SUSTAINABLE MINERAL-BASED ECONOMIC DEVELOPMENT

6.1 Conclusion to Report

Two types of mining settlements can emerge from the discovery of mineral deposits; these are specialized mining towns, and trade mining towns. Mining activity has the potential to transform an area from being primarily dependent on mineral extraction (a specialized mining town), to one with a diverse and advanced economy. However, this advancement can only be achieved if the area uses the mining industry to develop linkages that will allow the economy to decouple itself form primary mining activity.

Johannesburg began as a specialized mining town and evolved into a trade mining town with a diverse economy. Over time, the area gradually decoupled its economy from the mining industry. Tarkwa and Obuasi on the other hand, struggled to create economic linkages and remained specialized mining towns. An analysis of sustainable economic development indicators has shown that Johannesburg is the most developed out of the three areas. Obuasi follows Johannesburg, and Tarkwa is the least developed of the three mining areas. This has occurred despite the fact that modern gold mining in the studied Ghanaian and South African areas began at the same time.

The mining and economic prosperity of Johannesburg is attributed to a number of historic events. The Wits Basin is the largest gold deposit ever discovered in the world, and the City of Johannesburg is situated on the outcrop of this deposit. This sparked the migration of large number foreigners who brought diverse and advanced skills into the area. The favourable climatic and political conditions encouraged the permanent settlement of the foreigners. Although the influx of foreigners led to violent political clashes, extremity only occurred for a relatively short period of the city's history. The rival governments of the Transvaal Colony eventually made peace to start the creation of a platform on which the economy of the area was built. In doing so, they worked together towards the common goal of establishing the gold mining industry as the cornerstone of economic development. Government used its political power to ensure the longevity and profitability of the mines.

This action, together with the high demand for utilities resulted in the creation of strong economic linkages. Despite having a strong economy, the City of Johannesburg faces the following challenges:

- Environmental, urbanization challenges and increased industrial action from mining labour organisations,
- Finding sustainable means of growing and developing its economy further, and
- Developing ultra-deep mining methods and technology that can tap into the remaining gold resource.

Tarkwa and Obuasi are known today only because of their gold mining activity. The current conditions of the Ghanaian mining areas were moulded by historic, political, economic and social events. Ghana was colonised by the British for 60 years, and substantial mineral wealth was channelled outside the country during this period. Although the British had colonial power, they did not have dominion over all the land. This made it difficult to claim some of the gold bearing land. The country gained independence in the 1950s, but soon after experienced a series of coup d'états. This led to 30 years of political instability and economic decline. During this period, the mining industry declined, and not a single mine was opened in the country. In the 1980s, the ruling government implemented the ERP. This revived the ailing mining sector, and attracted many multinational companies to the areas of Obuasi and Tarkwa. Favourable legislation and earth-moving technology enabled companies to access previously sterilized orebodies. This initiated what seemed like a second gold rush in the 1990s, and instantly revived the economies of Tarkwa and Obuasi. Even though the ERP re-ignited economic activity in the mining areas, the positive trend was not sustainable. Economic development lags, and economic linkages are weak in both Obuasi and Tarkwa. Johannesburg on the other hand continues to thrive beyond the mining life cycles. Mining activity has also brought several environmental challenges such as water contamination, air pollution and degradation of vegetation. The excavation of the large surface mines has caused mass displacement of several households. This has negatively affected community structures and the quality of life.

A comparison of the case studies of Johannesburg, Tarkwa and Obuasi revealed factors that influence the capability of the areas to transform mineral wealth into economic development. These factors were linked to the UNECA model of mineral wealth challenges. During the analysis, it was discovered that there were additional factors to the UNECA model that should be considered for countries like South Africa and Ghana. This prompted the development of the Research Model of Mineral Wealth Challenges. The research model introduces the five mineral wealth challenge categories of Nature, Investment, Political Economy, Economic Factors, as well as Research and Development. Johannesburg's success is not only attributed to the positive way it has managed most of these challenges, but also the size, quality and concentration of the gold ore deposits. Despite this, Johannesburg struggles with mining R&D and finding ways to grow its economy further. Tarkwa and Obuasi have struggled to manage most of the mineral wealth challenges for the past century. Management of mineral wealth only began to improve during the 1990s. Political challenges have caused the Ghanaian areas to lag behind Johannesburg in terms of reaping the benefits of mineral revenues. The advantage of this is that Tarkwa and Obuasi can learn from the experiences of Johannesburg. This will enable the mining areas to proactively prepare for the anticipated challenges of R&D starvation, environmental degradation, urbanisation and further economic development better than Johannesburg.

The research has also shown that it is not practical to expect the mineral wealth of Tarkwa and Obuasi to perform the same way as that of Johannesburg. This is mainly due to natural factors. The grade of the Johannesburg orebodies was more than 10 times higher than that of Tarkwa and Obuasi. The Johannesburg gold deposits were also concentrated in a very small area. The landform, climate and vegetation of Johannesburg made mining favourable. The mining operations were all underground. The underground mines employed an immense amount of labour, and were able to coexist with other economic activities. This was not the case in Obuasi and Tarkwa.

These differences do not change the fact that the proper management mineral wealth challenges will empower areas to achieve sustainable economic development. The period

over which sustainable economic development can be achieved depends on the production capability of the orebody. The next section of the report offers recommendations on how the three mining areas can conquer their various mineral wealth challenges, and use the mining industry to catalyse sustainable economic development.

6.2 Recommendation

Most of the populations of Obuasi and Tarkwa comprise of youth that is literate in both English and Ghanaian languages[30]. Although the opportunities offered by the large-scale mining companies require a work force that is better skilled than what is currently available, these youths can be trained and upskilled to fulfil these skills requirements. For this to be achieved, local authorities need to invest in skills development and higher education institutions such as UMaT. Even though the large-scale mining industry offers employment and procurement opportunities, these opportunities are not enough to offset the high unemployment rates in the areas of Obuasi and Tarkwa. It is therefore important for the local authorities to put effort into unmasking and developing the hidden opportunities that are offered by other sectors of the local economy. This will enable further diversification and the expansion of economic activities that are outside the mining sector. In the case of Johannesburg, there is a need to re-focus on R&D in the mining industry. The development of highly mechanised, ultra-deep mining technology will enable the area to access gold deposits that lie deep in the Witwatersrand. It will also create a bigger need to grow the secondary sector, specifically manufacturing. The three areas of study need to address and manage mineral wealth challenges for them to develop their local economies. The rest of this section makes recommendations on how these challenges can be managed in working towards the goal of sustainable economic development.

[30] Fifty-two percent of the Tarkwa population over 11 years is literate in both English and Ghanaian languages; this number is 72 % for Obuasi. (Ghana Statistical Service, 2010)

Overcoming Investment Challenges

Two points come to mind when considering the management of investment challenges. The first point concerns the sourcing of initial capital that is invested into the mining industry and the distribution of this capital. The second point looks at how the revenue that is generated is invested. Once the industry was established, most of the mining capital that was raised in Johannesburg originated from local investors. The investors permanently resided in Johannesburg; they kept the mineral revenue in the area and used it to develop the city and other sectors of the economy. In the Ghana mining areas, the majority of the investors have always been foreign. Revenue generated has been channeled outside the country and mining areas. Locals need to be encouraged to invest in the mining industry to keep the revenue within their borders. Secondly, the size of the tenure that one mining company can occupy needs to be restricted. This will give more companies the opportunity to establish mining operations in the areas. Increasing the number of mining operations will allow investment opportunities to increase. Diversification makes investment more attractive to investors. This will also increase the competitiveness of mining operations and companies and insulate the local economy against setbacks caused by the closure of one operation (e.g. AGA's Obuasi underground mine).

The second point of concern is the way in which mineral revenue is invested. This will determine the ability of a mineral resource to be transformed into sustainable assets. Local and national governments need to define investment goals for the revenues generated in Tarkwa and Obuasi. The authorities need to determine how much of the revenue should be invested, and who should invest it (i.e. private companies, government, tri-sector partnerships). They also need to determine what kind of returns they want from the investments. The options of high financial returns or less visible returns will determine what the government should invest in (e.g. local infrastructure, public goods, future funds, permanent funds etc.) and where the investment should occur (i.e. in the mining communities or in other national areas, or even abroad) (UNECA, 2002). A significant driver of investment is having a common long-term vision that will not change significantly with governments. Despite the change in regimes in South Africa, all governments united

in the goal of using the gold industry as a corner stone for economic development in Johannesburg.

Overcoming Natural Challenges

Although the natural characteristics of the orebody cannot be changed, attention can be given to improving the efficiency and productivity of the orebody. This will essentially increase the mining revenue that is generated, and possibly extend the life of the mining operations. Mining companies can optimize the mine design and improve productivity, but they also need support from government[31]. Production efficiency can be improved by doing the following:

- Designing the mine for optimal exploitation of the resource and optimal development of the surrounding area;
- Reducing working costs, developing more advanced ways of extracting the gold underground and during processing;
- Taking advantage of high mineral prices by extracting lower grade ores in a cost-effective manner during commodity price booms;
- Improving human capital by upskilling and hiring a more experienced workforce. This can improve the quantity of output per unit of input;
- Changing the mining method, and
- Adopting sustainable development principals (Neingo, 2014).

Johannesburg's Central Rand was truly an exceptional case when it came to the quality and quantity of gold resources available. Unfortunately, this is not the case for the Tarkwa and Obuasi gold deposits. The nature of the orebody makes it impossible for the Obuasi deposit to match the production performance of the Central Rand. Although Tarkwa has an extensive orebody, the grade is very low, and it requires more time, effort and resources to match the production output of the Central Rand. Ghanaian communities need to shift some of their focus to growing and developing other stronger sectors of the economy. It

[31] The way the South African government supported the cost reduction initiatives of the industry to to ensure longevity and profitability during the 20th century.

will be almost impossible to achieve significant economic growth and development if gold mining remains the primary focus of export earnings.

Overcoming Political Economy Challenges

It is important for clear communication and good cooperatives to exist between local government, mining companies and national government. This will promote the efficient communication of mineral resource based development goals and strategies (UNECA, 2002). For this to happen, local government should have a clear and simple LED plan, and all stakeholders must be aware of the plan. This will promote transparency in government institutions and give direction for economic development. According to the African Union (2009), it is also important to ensure that the LED strategies work in collaboration with national strategies to achieve the desired level of economic development.

Ghana has made good progress in working towards economic development, however, the country still has a long way to go (Mensah, et al., 2013). There is a strong need to formulate one simple and coherent policy that focuses on the development of the local economies. Ghanaian local communities rely too much on top-down economic development plans. National government employs top-down development strategies that prioritize the interests of the nation over those of local communities. This results in the nationally dispersion of mineral wealth overshadowing local distribution while the negative effects of mining are hardest felt by the local communities. Rodríguez-Pose & Tijmstra (2009) argued that top-down economic development strategies are less effective when working towards the sustainable development of a local economy. National policies that are too broad or general, not tailored to local issues, and therefore do not adequately address local challenges. Table 6.1 gives a comparison of top-down economic development strategies versus bottom-up strategies.

Table 6.1: Top down development approaches vs. bottom up LED Rodríguez-Pose and Tijmstra (2009)

Top down economic development approaches	**Bottom up economic development approaches (LED)**
A centralized system that requires the input of a few. It lies in the hands of national government. Planning is implemented in a top-down manner	A decentralized system that requires the involvement of several stakeholders. It lies in the hand of local government. Planning is implemented in a bottom-up manner
Planned and executed from a remote location	Planned and executed at a near-by and accessible local area.
Sectorial-based approaches are used to boost economic development. It usually targets to increase economic vitality in industrial sectors	Territorial based approach is used to boost economic development. Territorial approaches focus on regional and local development.
Focuses on general development strategies that benefit the nation. Revenues mainly directed to capital cities.	Focuses on development of the local community. Attracts investment and directs profit to the local area.
Focuses on the national economic potential. Strategies are tailored for the country and seldom focus on local municipalities.	Focuses on the local economic potential. Strategies are tailored to cater for the needs of the local community.

UNECA (2012) also recommended that the following practices can be adopted in working towards overcoming other challenges of the political economy:

- Relying on private companies to exploit mineral resources with exploitation regulated by government;
- Working towards stable growth in government expenditure; and
- Appointing civil society regulators to keep watch on mismanagement of mineral resources by government.

The Ghanaian government should also consider involvement that goes beyond revenues and royalties. This can be achieved by introducing State participation over uninhabited land that contains strategic minerals. This would give government full dominion to develop this land the best way it sees fit.

Overcoming Economic Challenges

Unfavorable market forces can be managed by doing the following:

- Conservatively forecasting revenue and overestimating rather than underestimating costs;
- Limiting or restricting the supply of mineral resources to prevent an oversupply that would reduce the commodity price;
- Funding activities that increase the demand of the mineral resource;
- Establishing stabilization funds[32] to protect the country's economy from the negative impacts of windfall revenues;
- Establishing hedging funds and commodity credits to safeguard and alleviate realized earnings during periods of volatile prices; and
- Diversifying the economy by moving dependence away from the export of mineral resources in the long term (UNECA, 2002).

Dutch disease can be managed by firstly acknowledging the structural changes that occur in the economy during commodity booms. The government can use a portion of the mineral profits to reimburse other sectors that have been negatively affected by the structural changes. Some of the windfall revenues that are made during commodity booms can be invested in the exploitation of new mineral wealth (i.e. Natural capital), human resource development, or the expansion of other economic sectors. The government can also attempt to reduce the speed of the economic structural changes by limiting wage increases and influxes of labour into the minerals sector. They can also nullify the appreciation of local currency (UNECA, 2002).

[32] Stabilization fund: "A monetary reserve established by a country to provide funds for maintaining the official exchange rates of its currency by equalizing the buying and selling of foreign exchange" Merriam Webster Dictionary (2016).

Overcoming R&D Challenges

Research and Development challenges can be addressed in the following way:

- Developing a national strategy allowing for active participation of all R&D role players;
- Creating an environment that allows researchers to capture their experiment processes, as well as all relevant data that was drawn, and findings that were made;
- Re-establishing and investing in more mining research institutions such as the CSIR and COMREC;
- Promoting knowledge sharing amongst research institutions and mining companies;
- Government support of R&D by implementing innovation policies or incorporating innovation in mineral policies; and
- Investing in the development of human resources (UNECA, 2002).

Innovation has the ability to increase productivity in the mining industry. It also has the potential to change the ways in which the industry regulates and manages its business. Innovation will lead to the development of safer and more efficient mining methods and create opportunities in advanced sectors of the economy. R&D will also address learning-by-doing challenges in the mining industry by increasing mechanization and automation (UNECA, 2002).

Since small-scale mining is the principal employer of the labour force in the mining industries of Obuasi and Tarkwa, it is important that this activity is regulated and administered correctly so that it can benefit the local economies. Ghana needs to look into innovations and methods of developing the small-scale mining industry. Research about environmentally friendly, productive, sustainable small-scale mining needs to be conducted to determine environmentally friendly ways in which this industry will increase its contribution to the economy.

It is not practical to expect Tarkwa and Obuasi to produce the same gold revenues as Johannesburg because the quality and quantities of the gold resources are different. However, these differences do not change the fact that the proper management of mineral wealth challenges will enable the areas to achieve a certain level of sustainable economic development. The advantage of Tarkwa and Obuasi lagging behind Johannesburg is that they can use lessons learnt from Johannesburg to improve the ways in which they manage mineral wealth. The Ghanaian areas also need to look into ways of creating sustainable alternative livelihoods as well as stronger linkages to the mining industry. In order to achieve this, Ghanaian governments that come into power need to put their differences aside and strengthen their local administrative bodies to work towards common goals of sustainable economic development.

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