

**THE PROSPECTS AND CHALLENGES FOR THE
ADOPTION OF GREEN MINING IN GHANA: A
CASE STUDY OF GOLDEN STAR RESOURCES
BOGOSO/PRESTEA MINE**

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DECLARATION

I, Lovelyna Enyonam Badu, hereby declare that this dissertation is the result of an original research undertaken by me under the supervision of Dr. Peace Medie and that no part of it has been submitted elsewhere for any other purpose. Further, references to the work of other persons or bodies have been duly acknowledged.

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DEDICATION

To my mother, who single handedly brought me up through school. Lastly, to my God Father, Mr. Patrick Attipoe, who in diverse ways assisted my mum financially in support of my education.

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LIST OF ABBREVIATIONS

CEPS	-	Customs, Excise and Preventive Service
CHS	-	Commission on Human Security
CIL	-	Coal India Limited
CIP	-	Carbon-In-Pulp
CO ₂	-	Carbon Dioxide
CSM	-	Corporate Sustainability Manager
CSR	-	Community Social Responsibility
EDR	-	Economic demonstrated resources
EPA	-	Environmental Protection Agency
EU	-	European Union
FDI	-	Foreign Direct Investment
GDP	-	Gross Domestic Product
GDP	-	Gross Domestic Product
GGE	-	Greenhouse Gas
GMC	-	Ghana Minerals Commission
GMI	-	Green Mining Initiative
GRA	-	Ghana Revenue Authority
GRI	-	Global Reporting Initiative
GSCM	-	Green supply chain management
GSD	-	Geological Survey Department
IFC	-	International Finance Company
IRS	-	Internal Revenue Service
MC	-	Mineral Commission

NDG	-	No Dirty Gold
NGO	-	Non-Governmental organization
OECD	-	Organization for Economic Co-operation and Development
PDAC	-	Prospectors and Developers Association of Canada
PNG	-	Papua New Guinea
PSR	-	Pressure-State-Response
SOE	-	State of the Environment
TNC	-	Transitional companies
TSF	-	Tailing Storage Facility
UNDP	-	United Nations Development Programme
USA	-	United States of America
WHO	-	World Health Organization

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ABSTRACT

Illegal mining appears to be one of world's major mining problems and to a large extent Ghana's greatest environmental hazard. However, small scale and large-scale mining are not excluded from this problem because current statistics point to mining industries consuming almost 20% of the world's water supplies, also when a mine closure is done haphazardly, the area becomes an environmental and safety risk for the communities that live close to the mine. Mining in general can pollute the air and drinking water, harm wildlife and habitat, and permanently scar natural landscapes and these pose a threat to world security. The government of Ghana and global environmental bodies have introduced several approaches in solving the environmental issues caused by the effects of mining. Furthermore, in 2014, a concept called Green Mining, referring to technologies, best practices and mine processes that are adopted to reduce the environmental footprints associated with the extraction and processing of minerals and metals was introduced. Green mining is being practiced in countries such as Canada and Australia and ranges from improving water consumption to lowering energy costs and ensuring a safer mine closure. This study therefore sought to assess the prospects and challenges for the adoption of Green mining in Ghana, using Golden Star Resources Bogoso/Prestea mine as a case study, and to find out measures that have been employed by Golden Star Resources to reduce the negative environmental impacts of mining. This study used the qualitative research method. It argues that Golden Star Resources to a large extent practices Green Mining and has contributed appreciably well to implementing this practice in all three mines of the company; Bogoso/Prestea and Wassa. The researcher recommends that the Government of Ghana should liaise with major stakeholders in the mining sector to create awareness on minerals exploitation in the country by both foreign and local investors. It is also imperative that the major stakeholders in the mining industry in Ghana do learn from the pacesetters of green mining;

CHAPTER ONE

INTRODUCTION

1.0 Background to the Study

In the past decade, the problems of energy and environment have taken centre stage in global discourse, with governments, local and international organizations working collaboratively to mitigate those problems. This notwithstanding, the operations of mining companies, especially, in developing countries still leave much to be desired.¹ Globalization and the growth of the middle class in most economies coupled with the development of technology have resulted in an increasing interest in mineral resources.²

However, the extraction and processing of minerals have produced mixed results. On one hand, the mining industry has contributed significantly to the socio-economic development of many countries particularly in the areas of gross foreign exchange, foreign direct investment and employment.³ According to Weber-Fahr *et al*, large-scale mining contributes about 85 percent of the world's non-fuel minerals and more than 95 percent of the world's total mineral production.⁴ In 1998, raw mineral production in North America was valued at approximately US \$ 70 billion with the industry employing close to about a million people.⁵

The mining sector in South Africa is the highest contributor to the country's economy. Gold mining alone accounts for 27.4% of the mineral revenues and employs 56 percent of the mine labour force.⁶ Likewise, the mining sector in Ghana is one of the chief contributors to the Ghanaian economy. In 2016, the sector contributed about GH¢1.6 billion to the Ghana Revenue Authority

(GRA), constituting 15.8 per cent of the GRA's total direct taxes for 2016 and making the sector the leading contributor to GRA's domestic collections. Mining operations have created severe environmental challenges (water pollution and Land degradation), health problems, and social conflicts which poses potential hazard and danger to the inhabitants of various mining communities and the international community as a whole. This phenomenon is aptly captured by Nurmi when he noted that "mining has become increasingly difficult for societal and environmental reasons all over the world. There is an increasing competition with other land uses, and water and energy are scarce in many important mining regions. People are not ready to radically reduce the use of mineral-based products, but increasingly oppose mining. The industry faces major challenges to improve its performance and image."⁷

According to Ali *et al*, the problems that confront the mining industry affects sustainable mineral production and makes it difficult for individual companies, governments and the international community to forecast the availability of various commodities.⁸ Despite the aforementioned challenges, some studies have shown that "economic growth and the reduction of negative externalities can be achieved at the same time."⁹ It is evident that fighting environmental challenges largely requires the effective and efficient use of technology.¹⁰ As such, other scholars like Olson and Rennings in their analysis, have highlighted the importance of green technology in minimizing the adverse environmental and social impacts of mining and at same time ensuring sustainability.¹¹ Others have described Green mining as technologies, best practices and mine processes that are implemented as a means to reduce the environmental impacts associated with the extraction and processing of metals and minerals. The reduction of greenhouse gases, selective mining approaches to reduce the ecological footprint, and reduction in chemical use do encompass

this process. Thus, Green mining technologies and practices offer superior performance with respect to energy efficiency, greenhouse gas emissions and the use of chemicals. It has been stated by Researchers that Green mining has enabled mining companies to cut-down operating costs and promote competitiveness. In the view of Rennings, “greentech comprises an emerging technology-oriented industry that generates economic rents, by developing and selling technologies or services that reduce or eradicate negative environmental impact, with continuous production, distribution and consumption.”¹² In spite of all the positive signals, many mining industries in developing economies especially, are yet to fully embrace these practices in the extraction and processing of minerals, hence, the need to create awareness and give serious thought to ways these challenges could be surmounted.

1.1 The Statement of the Research Problem

The mining industry is key to the development of many countries all over the world. However, heightened concerns about environmental and health issues (global warming and pollution) requires that the extraction and processing of minerals are carried out in a manner that is eco-friendly and sustainable. As a result, several efforts have been made by governments and some stakeholders in the mining industry worldwide to deploy new technologies and innovations to reduce the ill effects of mining.¹³ Generally, the operations of mining companies may pose serious threat to life and property if not properly managed. This is due to its attendant features of severe environmental, health and social dangers.¹⁴ These concerns associated with mining operations have featured prominently in discussions on local and international platforms and have led to calls from governments, international organizations and environmental groups for a more environmentally friendly and sustainable mechanisms that will minimize their impact on the

ecosystem. Consequently, several mining companies in the country claim to have reacted to these calls by establishing and carrying out several measures (Green mining mechanisms) to curtail the negative environmental and health effects of their operations.¹⁵ As to whether or not these measures have or are adequate to minimize the adverse effects of mining is an issue worth investigation.

The relevance of Green mining cannot be downplayed since it provides the means of attaining sustainability as well as generating wealth and economic growth.¹⁶ The adoption of Green mining has increasingly become an important mechanism for mining companies all over the world.¹⁷ This is because it enables the companies to reduce their environmental footprint associated with the extraction and processing of minerals thereby improving the industry's reputation.¹⁸

Despite the prospects for Green mining in reducing the negative environmental impacts and ensuring sustainability, it is still a grey area in the Ghanaian context. The existing literature (Jacquet & Mans, 2018; Sandstorm, 2014; Enzensberger *et al*, 2003; Weber-Fahr *et al*, 2001) in the area are largely dominated by studies from industrialized countries and employed the views of the policymakers'¹⁹ evaluation on "effectiveness of support mechanisms in the Green technology landscapes."²⁰ It is against this backdrop that this research seeks to explore Green mining approaches and examines how Green mining could best contribute to protecting the environment and ensuring economic sustainability in Ghana. This would identify how the environmental and health challenges posed by mining activities in Ghana could be addressed through Green mining approaches.

1.3 Objective of the Study

- To identify Green mining awareness strategies among stakeholders in the mining industry
- To ascertain the prospect and challenges of Green mining in Ghana.
- To find out the measures that have been employed by Golden Star Resources to reduce the negative environmental impacts of mining
- To indorse policy directives which could be implemented to promote the use of Green mining mechanisms in the mining industry in Ghana to reduce the negative environmental impacts and ensure sustainability.

1.4 Research Questions

- To what extent have stakeholders adopted Green mining awareness strategies
- What are the prospects and challenges for the adoption of Green mining in Ghana?
- How has the adoption of Green mining in Golden Star Resources helped in reducing the negative environmental impacts?
- What measures and policy directives could be implemented to promote the use of Green mining mechanisms and ensure sustainability?

1.5 Scope of the Study

Despite the fact that there are many mining companies in Ghana, this study focuses on Golden Star Resources. Golden Star is an established gold mining company with two producing mines in Prestea and Wassa in the Western Region of Ghana. The researcher's choice of this company was informed by the fact it has the largest land package of any company operating in Ghana, including

the major gold producers. As the winner of the Prospectors and Developers Association of Canada (PDAC) 2018 Environmental and Social Responsibility Award, Golden Star has shown great commitment in protecting and preserving the environment. The study seeks to find out the Green mining mechanisms adopted by Golden star as well as the challenges they face in implementing such mechanisms. This study will examine the operations of Golden star from 2010 to 2017. This is because the duration under investigation is the peak period of operation of Golden Star Resources.

1.6 Rationale of the Study

The contributions of this study are manifold. First the concept of Green mining has only received little attention in the Ghanaian literature. This study will enhance our understanding of the concept and create an awareness of its importance in helping to reduce the environmental footprint and health hazards associated with mining whiles at the same time promoting environmental sustainability. Additionally, the study seeks to investigate the activities of mining companies in Ghana to ascertain whether they adhere to Green mining regulations as well as recommend policy directives to improve the mining activities in the country with a specific focus on Golden Star Resources in Prestea and Wassa. Thus, the study aims at identifying innovative ways of reducing the environmental and health dangers posed by mining activities in Ghana. Lastly, the findings and recommendations will serve as a reference material to other mining companies and stakeholders in the mining industry.

1.7 Hypothesis

The adoption of green mining has led to significant impact on the environment in Ghana as its introduction has been carried out by some mining companies.

1.8 Conceptual Framework

This Framework is guided by the concept of human security. What exist is a plethora of scholarly definitions.²¹ In this section, an attempt is made to carve an operational definition of the concept in the context of this study after an extensive review of the state of the art on the subject matter. According to Baldwin (1997:12-18), the definition of security should provide answers to such questions as “for whom, for which values, how much security, from which threats, by what means, at what cost, and in what period?” Generally, security scholars hold divergent views as to whether Human security should be considered as a concept or an ordinary term. Whiles scholars like Amouyel, (2006) and Krause (2005) view it as a “concept” other like Attuquayefio (2012); Tadjbakhsh (2005)²² either refer to it as a new theory, a world view or a policy framework. It is pertinent to note that this study largely employs the views of the scholars who see Human security as a concept. The UNDP, in its 1994 Human Development Report provided what is considered by many scholars as a classical definition of the concept of Human security.²³ According to the report, the proponents of traditional security did not pay much attention to security concerns of the ordinary people,²⁴ and as such depicted. Human security as regarding “safety from such chronic threats as hunger, disease and repression” and the “protection from sudden and hurtful disruptions in the patterns of daily life”.²⁵ The report enumerated seven important dimensions of Human security which include Personal security (protection from violence, torture, criminal attacks etc from the state, sub-state factors and non-state actors.); Community security (sustaining traditional

relationship values and ensuring that the rights and freedoms of ethnic minorities are protected; Political Security (ensuring that people's rights and liberties are safeguarded and their freedoms granted in a political milieu devoid of oppression); Food security (ensuring that people have access to basic food); Health security (protection from diseases and ensuring access to good health care); Economic security (basic income for individuals at all times to at least sustain their daily lives) and Environmental security (protection from the negative effects of the environment).

It further states that the protection or enforcement of these dimensions is crucial to realizing the individuals' dignity as human beings and members of a society. Thakur (1997:45) extended the scope and components of the concept as he noted that Human security is "anything which degrades [the] quality of life – demographic pressures, diminished access to or stock of resources, and so on – is a security threat. Conversely, anything which can upgrade their quality of life – economic growth, improved access to resources, social and political empowerment, and so on – is an enhancement of Human security."²⁶ According to the Commission on Human security (CHS) "...Human security means protecting fundamental freedoms – freedoms that are the essence of life. It means protecting people from critical (severe) and pervasive (widespread) threats and situations. It means using processes that build on people's strengths and aspirations. It means creating political, social, environmental, economic, military and cultural systems that together give people the building blocks of survival, livelihood and dignity." The protection and promotion of human dignity as an important feature of Human security. According to him, mechanisms should be put in place to ensure that people live a dignified life which is a right they are entitled to. Here, the provision of basic needs is necessary in that regard.²⁷ The conceptualizations of Human security have shifted focus from traditional "state-centric" notions to a more "human-centric"

focus. The state is no longer the only referent object as far as Human security is concerned. The concept comprehensively covers all the dangers that threaten human survival, daily life and dignity, and the violations of Human Rights. The effect of environmental degradation is very essential to this study with regards to human security.²⁸

While there is no generally accepted definition of the concept; something of a consensus has emerged in the literature. The underlying focus of Human security is to protect states sovereignty in general and specifically safeguard the wellbeing of humans against security threats.²⁹ Security threats refers to anything that poses danger to the very existence of individuals-thus survival. The things that threaten the survival of the individual include fear, want, violence and the threats to dignity. As such, human security deals with anything that guarantee that people do not want, or have fear of violence and at the same time ensures that people are free to live dignified lives.

This concept has been criticized by many scholars for several reasons. For example, some have opined that, the “existing definitions of Human security tend to be extraordinarily expansive and vague, encompassing everything from physical security to psychological well-being, which provides policymakers with little guidance in the prioritization of competing policy goals and academics little sense of what, exactly, is to be studied.”³⁰ Likewise, others have explained that the moralistic view that underpins recent conceptualizations of Human security makes it “unattainable and unrealistic.”³¹ Scholars who share the realist school of thought have also criticized the concept based on the neglect of the role of the state as a provider of security. On this point, Buzan argues that states are a “necessary condition for individual security because without the state it not clear what other agency is to act on behalf of individuals”³² Proponents of Human

security have dismissed these claims by acknowledging that “human security complements state security.”³³ Drawing on the various scholarly perspectives on Human security, this study is underlined by a general acceptance of the definition of Human security as any activity that threatens human survival and makes it difficult for people to live a dignified life which includes the negative environmental impacts and health hazards linked with the extraction and processing of minerals. Despite the criticisms, the concept of Human security is relevant to this study because the environmental footprint and health hazards associated with mining helps explain how threat to human life, and explains how human security could help in safeguarding human lives

1.9 Literature Review

The mining industry in Africa is closely related to the livelihood of people, especially those in and around mining areas. The effect of Green mining has been an overriding factor in the consideration of mining locations in recent times. Kitula in his studies did underscore the need for the mining industry in Tanzania and around the Geita District that, green mining activities has destroyed a vast amount of the water bodies, where indigenes largely depend on for their livelihood.³⁴ The study does examine how the people have also gained a source of livelihood from green mining activities while examining its detrimental effects on the very environment in which the people do live. Kitula’s study is very relevant to this study because it does examine both sides of human security; from the angle of the state to the individual, and how both have played a role in shaping the security of the people; human security.³⁵ The study does extensively discuss the challenges of Green Mining, while examining its prospects. These activities have largely affected not just the people in and around the Geita environs, but also grossly damaged some farms and local river bodies. Kitula’s analysis is very noteworthy because it does examine how green mining has

affected human security from both the individual and state levels. Green Mining has been assessed by some Scholars in terms of their success to human security. Security as a concept in international relations refers to the interactions of both human and state needs required to successfully thrive in any given dispensation. Thus, security encompasses both human security and the security of the state.³⁶ Nurmi argument examines how green mining can be holistically sustained through well-regulated practises. In this analysis, the researcher does recommend the need for green mining to be sustained through regulating production for internationally accepted practises such as the need to gain approval from the relevant state institutions for concessions, as well as equipment for production. According to this study, the prospects of green mining cannot be underestimated in the contemporary dispensation in the light of job creation and the social corporate responsibilities of green mining companies.³⁷ The relationship between mining and poverty reduction in his analysis by discussing the need for local entrepreneurs to invest in the very towns and cities they do undertake their mining activities. Such a measure, according to the researcher, would give the mining industry better prospects, as well as help indigenes to develop their potentials in other to thrive in today's green environment.³⁸ The role played by these green mining companies are however not without interference. Thus, these arguments are noteworthy because it addresses the challenges and prospect of 'Green mining under the most bizarre conditions. Another argument brought by these scholars is that, Green mining is not an alternative for the conventional methods of mining. The researcher does discuss the need to separate green mining from other mining practises which may be unhealthy for the indigenes of these mining communities and their families.³⁹ He refers this as the 'bracket box', a term used to describe the safety net of the industry practise. This literature is important to the study because it demonstrates how green mining does

impact people, and further affirms that the practise of green mining is not an avenue for exploiting the needs of people.

1.10 Sources of Data

Data collection is vital in determining the success of a research.⁴⁰ The study used two major sources of data-primary and secondary sources. The primary data was gathered from field interviews using interview guides prepared by the researcher to elicit relevant information on the subject matter. The semi-structured interview will be adopted in the collection of primary data. Thus, Semi-structured interviews are neither restrictive like close-ended questions, nor is it so open to mishap like unstructured interviews. It provides the researcher with the opportunity to have an in-depth investigation of the phenomenon and explore new dimensions which were not taken into account initially. Additionally, the opportunity to ask further questions makes room for clarification and better understanding of issues. An eclectic approach will be adopted in the gathering of secondary data. The researcher will review journals, articles, books and documents that are relevant to the topic under study.

1.11 Research Methodology

This section provides an overview of the methods used for the study and how data was collected and analyzed. The research is descriptive in nature and covers communities where Golden Star Resources operates in Bogoso/Prestea. Generally, there are two main modes of scientific enquiry; quantitative and qualitative methods of inquiry. This research does make use of the qualitative method of data collection and interpretation. This approach is a “systematic empirical enquiry into meaning.”⁴¹ Strauss & Corbin defines the approach as “any kind of research that produces findings

not arrived at by means of statistical procedures or other means of quantification.”⁴² To Denzin & Lincoln (2008:4), qualitative research involves “an interpretive naturalistic approach to the world.”⁴³ This method will be adopted because of its ability to provide sound explanations, clarification and interpretation to research data.⁴⁴ Thus, the approach allows for a deeper examination and a more intimate view of the phenomenon under investigation. A survey will be carried out on experts and resource persons from Golden Star who have great insight into mining techniques and best practices by the company. This was done by administering questionnaires on topic.

1.11.1 Population of the Study

The target population of this study include the abled staff members within the mining industry of Ghana with much focus on those within Golden Star. The study considered staff with significant knowledge and information on green mining in Ghana. A population is a complete set of elements (persons or objects) that possess some common characteristic defined by the sampling criteria established by the researcher. The researcher targets the head office of the company in the Greater Accra Region. Therefore, the researcher includes staff members with significant information for the purpose of achieving the objective of the study.

1.11.2 Sample size and Justification

For the purpose of this study, the purposive and convenience sampling techniques was used to select the participants for the study. The purposive sampling technique helped the researcher to purposely select respondents who have adequate knowledge in the study area. Purposive sampling is a technique widely used in qualitative research for the identification and selection of

information-rich cases for the most effective use of limited resources (Given, 2008). This involves identifying and selecting individuals or groups of individuals that are especially knowledgeable about or experienced with a phenomenon of interest (Cresswell & Clark, 2011). The convenience sampling method was used by the researcher, to select respondents who were readily available and willing to participate in the study.

According to Saunders, Lewis and Thornhill (2012) there are no other criteria to this type of sampling method except that people be available and willing to participate. For the purpose of our study, out of all departments within Golden star Ltd, the research sampled only the field experts to aid in information gathering. This sample represents a reliable portion of the population and highly significant for achieving the objectives of the study. From Golden Star an interview was administered to the sampled experts with significant amount of knowledge and information on the study area. The study employs 10 client respondents of the Golden star.

1.11.3 Data Collection and Data Collection Instrument

Interviews are the most common methods of data collection used in qualitative research and used to explore the views, experiences, beliefs and motivations of individual participants (Gill, Stewart, Treasure & Chadwick, 2008). The study utilized the interviews as its main instrument for the collection of data. The interview was used to collect data from respondents from the Golden star. Interview was employed because most respondents from the experts complained of time. For this reason, the researcher prepared an interview guide and interviewed respondents in the comfort of their various offices. Open-ended interviews guides are considered most appropriate where little

is already known about the study phenomenon or where detailed insights are required from individual participants.

For the purpose of achieving the second and third objectives of this study, the research adopts a comprehensive interview guide to aid in the collection and for gathering data. The interview guide is divided into two sections. Section A, focuses on the demographic characteristics of the respondents such as gender, job title etc. Section B, seeks:

- To what extent have stakeholders adopted Green mining awareness strategies
- What are the prospects and challenges for the adoption of Green mining in Ghana?
- How has the adoption of Green mining in Golden Star Resources helped in reducing the negative environmental impacts?
- What measures and policy directives could be implemented to promote the use of Green mining mechanisms and ensure sustainability?

1.11.4 Data Analysis and Presentation

In analyzing and presenting data obtained from the respondents for this study, the study made use of thematic analysis. Thematic analysis is one of the most common forms of analysis in qualitative research which emphasis on pinpointing, examining and recording patterns (or “themes”) within data (Guest, 2012). Information received from the respondents were thus analysed and presented under them to clearly provide the necessary understanding to the study. Themes are patterns across data sets that are important to the description of a phenomenon and are associated to a specific research question, thus the themes become the categories for analysis (Braun & Clarke, 2006). The

data gathered from the respondents and result obtained from running the analysis were presented using descriptive statistics such as tables, graphs and charts.

The collected data were statistically analysed, using the Statistical Package for Social Sciences software (SPSS). Representations like tables and charts were used to ensure easy and quick interpretation of data. Responses were expressed in percentages. Data from the completed questionnaires were checked for consistency. The items were grouped based on the responses given by the respondents and were coded for easy usage of the Statistical Package for Social Sciences (SPSS) software. This method was used because it is the best instrument to identify, compare, describe and reach a conclusion.

1.12 Ethical Considerations

This section considers the ethical principles underlying the research. The following ethical principles were taken into consideration in the data gathering process of the study. First a letter was taken from the University of Ghana, Legon Centre for International Affairs and Diplomacy, and sent to the Chief Executive Officer (CEO) and the other various heads of organizations and firms for approval for data to be collected.

Respondents interviewed were administered to, were assured of their confidentiality by ensuring that their names and personal details were not included in the questionnaire. Also participation in the research was made voluntary. No respondent was coerced to engage in the study. Respondents were also assured that the information gathered would be used purely for academic purposes.

1.13 Limitations of the Study

The limitation of this study was in finding individuals who had the required knowledge to give valuable contributions during interview. Also, some of the interviewees were reluctant to grant us the interview because they were of the view that they had been interviewed severally by people, yet their communities still suffered the same plight. These individuals were assured that the interviews carried out were purely for academic purposes however, the findings could serve as a guide for development.

1.14 Arrangement of Chapters

The study is divided into four (4) chapters. Chapter one constitutes the introduction and comprises the background to the Research Problem, statement of the problem, Conceptual framework, research questions, research objectives, significance/Rationale of the study and the scope of the study. Chapter Two will encompass the literature review aspect of the study; it includes the views of different authors on green mining in developed and developing countries and its advantages of reducing the negative effects of mining and ensuring sustainability. The Chapter three covers the methodology as well as the data analysis and discussion. Lastly, chapter four presents the summary of findings, conclusion and recommendations.

Endnotes

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CHAPTER TWO

THE EFFECTS OF MINING ON ENSURING SUSTAINABILITY

2.0 Introduction

The objective of this chapter is to review mining practices from both developed and developing nations and examine their advantages in reducing the negative effects of mining through green mining practices. The prospects of Green mining thus, will be examined in the light of contending issues within the mining industry which do impact on the livelihood of society in terms of the security of the people.

2.1 A Review of Mining Practices Globally

In 1860-1863 there were more Canadian and British prospectors involved in the Cariboo Gold Rush. The commercial centre for the Cariboo rush was Barkerville, named after William Barker, an English seaman who found gold in nearby Williams Creek in 1862. By 1865 the surface placer gold was almost gone. Barkerville was practically wiped out by fire in 1868. In response to the Cariboo Gold Rush, governor James Douglas built, at great expense, a 650-km road from Yale into the rugged interior of the Cariboo Mountains.¹ This provided an important transportation route for further development of the mainland colony. From 1858 to 1863, gold fever invaded the interior of British Columbia. Two gold rushes, one after the other, brought thousands of prospectors and adventurers into what was previously native fur-trading territory. There were inevitable conflicts with the native peoples whose lives were irreversibly changed. The type of mining practiced in these gold rushes, and also in the later Klondike Gold Rush, was known as placer mining. This is the process of washing loose sand or gravel for gold or other minerals. This is sometimes referred

to as "free" gold since expensive technology and capital investment were not required to mine it. To pan for gold, a prospector needed only simple tools to sift the precious dust from the banks of the river. The first flood of miners, the Fraser River Gold Rush, brought over 30,000 people to the shores of the Fraser from Hope to Lillooet in 1858. Most of the gold seekers were Americans looking for new opportunities after the California gold rush had run its course. In order to prevent this American invasion from threatening British sovereignty in the area, the mainland district of New Caledonia was declared to be a colony in 1858. Mining activities are not new and indeed may have started in Neolithic (Chalcolithic) times to obtain the first metals for tool fabrication.²

In the Classic Greece and in the Roman Empire, many mines were exploited for production of iron, lead, copper, gold, and other metals. Many of those old mines are still known, and some have been operated over several centuries or were rediscovered. With time, mining has expanded and increasing amounts of fossil and metals were extracted in quantities generally commensurate with man power available and thus with human population over the centuries. With technological developments, especially with explosives and machinery, mining could expand further on the 19th century and sky rocketed during the 20th century. In the last quarter of the 20th century, new and harsh environments, such as ice covered regions and the deep sea floor, started to be mined for oil, natural gas, and metals. This trend will continue and new frontiers might be trespassed soon.³ The comparative importance of mining and contribution to the world Gross Domestic Product (GDP) during the last century shows an increase by a factor of 27 in ores and minerals production, and by a factor of eight in total materials extraction, while GDP raised 23fold.⁴

Green Mining activities are very diverse and may have different ecological footprints. Past mining activities left such imprints in the environment, but two issues in particular are of major and worldwide importance: mine tailings and acid mine drainage. Tailings in general are voluminous and contain toxic elements that may be released and introduced in the biogeosphere. This mining legacy was accumulated over centuries but only in the last quarter of the 20th century its environmental and human health impacts were finally recognized. Since then, there has been a significant development of legislation for environmental and sanitary protection, and some actions were started to deal with industrial legacy through clean up, remediation, and rehabilitation projects.⁵ These remediation actions started in USA with the Superfund project in 1980 and so far have been implemented mainly in North America and West Europe. As a side effect of environmental legislation development and increased costs of waste management, mining moved from developed countries to other regions. Green mining impacts, including waste streams and social impacts, were, therefore, generally transferred from developed and densely inhabited regions to other regions. Green mining entails a careful balance of resources, and adapting new equipment and altering the supply chain to accommodate more sustainable processes can be costly. However, companies are beginning to see value in taking the risk.

Joshua Kirkey, describes the main barrier for implementing green mining technologies is the need for industry to overcome risks associated with unknown practices and technologies.⁶ Overcoming these risks is what the Green Mining Initiative (GMI) is addressing by assessing the merits of using an environmental technology verification program to validate environmental claims of new technologies to raise confidence of the industry to implement the technology. According to Kirkey, "Green mining is defined as technologies, best practices and mine processes that are implemented

as a means to reduce the environmental impacts associated with the extraction and processing of metals and minerals". Examples include the reduction of greenhouse gases, selective mining approaches to reduce the ecological footprint, and reduction in chemical use. Green mining technologies and practices offer superior performance with respect to energy efficiency, greenhouse gas emissions and the use of chemicals. Brown also says that green mining technologies "help reduce operating costs for the mining industry and improve its competitiveness."⁷ The mining industry is a gigantic energy consumer, requiring a huge energy input for daily processes to commence enough energy is needed to operate heavy machinery to meet demands. Fortunately, the mining industry is committing itself to decreasing current energy use by employing efficient energy utilization plans that can drastically cut the amount of electricity mining companies' use without reducing productivity.

Hutchinson highlights one of the most recent successes for the GMI where an automated mine ventilation system was installed in an underground mine in greater Sudbury, Ontario. This initiative resulted in a reduction of up to 40% of the energy consumption, reduced greenhouse gas emissions, and a saving in costs of up to \$4 million per year. Current statistics point to mining industries eating up almost 20% of the world's water supplies.⁸ However, mining industries are not solely dependent on electricity and energy to carry out their tasks they also need ample supplies of water. Some current statistics point to mining industries eating up almost 20% of the world's water supplies almost every stage of the mining process requires a tremendous volume of water. Clearly, there is an urgency to cut back on current water usage to reduce the environmental footprint that mining creates. One of the key ways that has been devised to rectify this is to employ real-time calculations on water usage. Currently, many companies tend to overuse water because

they merely utilize averages and estimates in measuring how much water is needed. The trend has been to use precise water requirement calculations to end this wasteful habit. At the end of the utility of a mine, it is eventually closed off and the area is then restored by the company.⁹

However, when mine closure is done haphazardly, the area can become an environmental and safety risk for the communities that live close to the mine. As a consequence, one of the green mining trends that are being looked at for 2014 is the development of smart and effective closure and rehabilitation plans that will rectify whatever environmental footprint the mine has had over the course of its operation. These plans have aggressive environmental rehabilitation at their heart and involves soil recovery and the replanting of trees. Burton also describes a GMI development currently in operation in mine sites in Canada, where the use of organic wastes to rehabilitate mining lands has recently been implemented, whereupon energy crops such as corn and canola can be grown for bio-energy production.¹⁰ Eventually, the hope is to have the entire ecosystem reinstated after being disturbed by mining activities. In carrying out such an initiative, the mining company should always involve the local residents. Indeed, community engagement is a burgeoning trend for 2014 since it fixes two of the largest problems for the mining industry firstly, it eases the local tensions these companies face, which means that their daily activities will be smoother and less susceptible to delays. More importantly, however, local communities are more knowledgeable and sensitive towards the environment and engaging with them will educate mining companies about how best to carry out sustainability initiatives. To support careful mine closure initiatives, several countries have developed legislation that specifically stipulates the requirements that companies should accomplish when beginning the process of closing off their mines. The aim is for green mine closure initiatives to be the industry standard in the future.

Gold is a lustrous, yellow metal which is malleable and relatively chemically inert. Throughout human history, gold has enjoyed a special place as a preferred metal for jewellery and signifying wealth and power with widespread gold use by the ancient Egyptians and across Europe and Asia. After the discovery of gold in California in 1848 and eastern Australia in 1851, massive gold rushes ensued which saw hundreds of thousands of people flock to the areas to strike it rich. The biggest boom was to come from the discovery of the Witwatersrand Basin in northern South Africa in 1886. Mining was a central factor in the rapid economic development of these otherwise fledgling colonies.

By the mid-20th century, however, the role and importance of gold had substantially declined and its production was relatively minor throughout the world (except for South Africa, which still dominated). In the 1970s, two key events propelled gold to a new and even bigger boom: the deregulation of the gold price and the development of carbon-in-pulp (CIP) process technology. These two outcomes led to a major global revival of the gold mining industry, since lower grade ores could be readily processed using CIP technology and the sustained higher prices ensured profitable operations.

At the start of the 21st century, gold mining was a major economic activity for Australia, USA, South Africa (but declining), and many countries around the world. Global production over the 2000s has been somewhat stagnant, averaging around 2,500 tonnes per year (or about 80.4 million ounces or 'oz'1). The ongoing rise in demand (particularly from India, but also China) as well as global financial uncertainty has been a major factor in the continuing rise in the gold price, reaching record highs of some \$48,000 per kilogram (i.e. ~\$1,500/oz) in early 2011 which is helping

to reverse the trend of stagnant production. Australia remains a major global gold producer, with production of ~261 tonnes in 2010 (ABARE, var.a), and is ranked second behind China with ~345 tonnes (USGS, var.a). The USA held third place in 2010 with ~230 tonnes, while South Africa and Russia both produced ~190 tonnes. A perceived advantage of Australia's gold industry is extensive gold mineral resources and highly prospective regions for new discoveries or additions to existing deposits or mines.

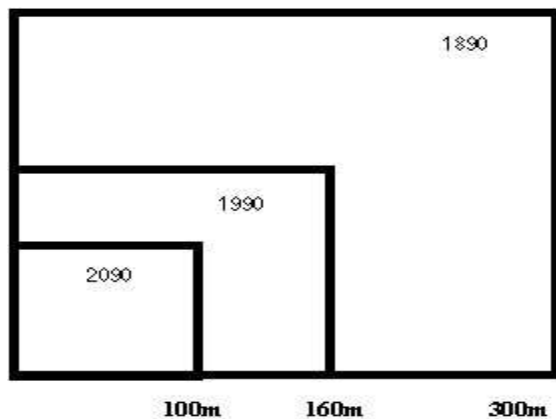
For some regions around the world, especially developing nations, small scale and artisanal mining can be an important source of gold. Whilst it supports livelihoods and communities, it is not without significant environmental impacts and health impacts for miners. Given that this activity is extremely limited in Australia, this report will not cover this part of the global, gold industry although small scale and artisanal gold mining remains a crucial nexus.

2.1.2 Australia's Green Mining: Advantages for a Sustainable Minerals Sector

Australia is a destination where green mining has taken the hallmark of the mining industry. In addition to its advantages of a favourable geological endowment throughout most of its large landmass and a healthy balance of economic demonstrated resources (EDR), Australia has the critical mass of minerals industry capital and expertise necessary to foster future developments. A further major advantage is its low population density that leaves the mineral resources and prospective geological endowment relatively free from competing land uses. Compared to most other developed countries, these circumstances favor the long-term sustainability of the Australian minerals industry.¹¹ Nevertheless, unsettled native title issues, together with single land use for conservation that denies exploration and mining, has created uncertainty and reduced access-and

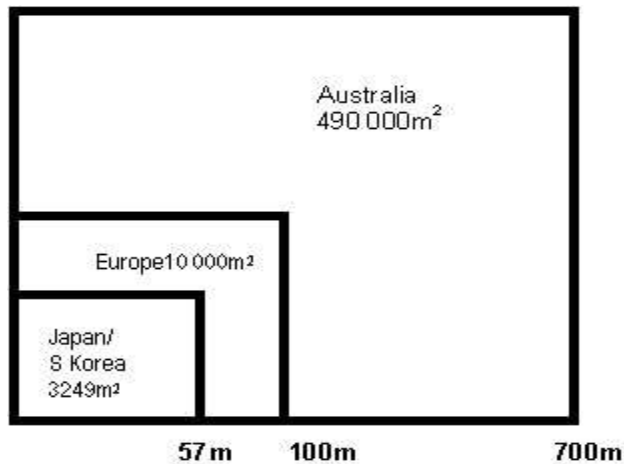
thus exploration. Whereas in 1890 the global population then had a 300m x 300m support square of land per person, in 1990 the support square was only 160m x 160m per person.¹² The support square of land per person refers to the ration of man by land size. This average support area must provide the natural resources, living space, conservation and recreation area as well as accommodating the storage of wastes and scrap for recycling or emplacement. Australia, like Canada, enjoys a support area of about 700m x 700m per person, which is 50 times larger than that of Europe and 150 times larger than that of Japan and Korea.

Figure (1a)Australia's projected decrease in size of support square per person (1890 to 2090)



Source: (Hancock 1995 after Skinner 1988)

Figure 2: Comparison of size of support squares in year 2000



Source: (Hancock 1995 after Skinner 1988)

The "Pressure State-Response (PSR)" System is a framework proposed for environmental indicators of sustainable development. The "Pressure State- Response" appeared in "Figure 2" has been received by OECD nations for State of the Environment (SOE) revealing. It is vital to economic improvement approaches and motivation. Human exercises, for example, mineral generation are seen just as weights on the earth.¹³ The minerals segment all around, and especially in created nations, is being driven towards a more maintainable improvement by the accompanying rising methods of insight, network intrigue and government activities, and in addition its own particular enthusiasm for managing beneficial generation and apparently contributing to supportable advancement. Canada and Australia, for reasons of atmosphere and past events, are further particularly advantaged by having the vast majority of their populace focused in urban territories on their southwestern, southern and eastern edges leaving more than 90 per cent of the territory meagerly populated. Potential and known mineral assets are in this way substantially more open, that is less subject to contending land-use, than in the all the more thickly and all the more

equally populated created and creating nations.¹⁴ Australia, similar to Canada has a created economy and a hearty majority rules system. It gives huge numbers of the contributions to its mining and mineral handling and suits the asset rents and other riches that streams from the business without huge negative impacts. As a created nation with an educated and progressively ecologically cognizant fair society, Australia has elevated requirements and directions that effectively oblige noteworthy natural harm from display day mine advancement.¹⁵ Australia is along these lines in a substantially more ideal position topographically, socially, naturally and monetarily than most nations to oblige and advantage from its minerals division as a piece of feasible improvement. It accomplishes more great and less mischief in Australia than in many nations, especially thickly populated nations or creating nations where the economy benefits nearly nothing and asset rents debilitate the advancement of different businesses. Overall rivalry to draw in capital for new mine, smelter and refinery advancement has expanded with the finish of the Cold War.

Nations as various as Guyana, Greenland, Namibia, Kirghizstan and Vietnam are effectively charming outside organizations to put resources into their mineral ventures.¹⁶ Australia is along these lines in a substantially more ideal position topographically, socially, naturally and monetarily than most nations to oblige and advantage from its minerals division as a piece of feasible improvement.

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smelter and refinery advancement has expanded with the finish of the Cold War. Nations as various as Guyana, Greenland, Namibia, Kirghizstan and Vietnam are effectively charming outside organizations to put resources into their mineral ventures. This has been by discount modification of mining and mineral enactment to encourage access to assets and long haul legally binding plans to lessen sovereign hazard. The numerous nations that are quickly building up their mineral segments give new rivalry to Australian fares and for pulling in investigation and improvement capital. The convincing inquiry for Australia isn't one of shortage of minerals in the ground, yet how it contrasts and different nations in by and large potential for interest in investigation, improvement and generation.

Notwithstanding enhancing the venture and working atmosphere while keeping up nature of condition and open endorsement, Australia must keep up an abnormal state of EDR and grow downstream added esteem items to maintain future fare salary. The quality and amount of Australia's EDR ought to be moderately simple to keep up, given the exceedingly imminent geography and inhabitant investigation aptitude gave a superior level of access for investigation can be restored, and the level of sovereign hazard lessened to that in most other real mineral-creating countries.¹⁷ To accomplish this it is fundamental that there be changes in people in general's impression of minerals, mining and the business, and also the business and government reactions to manageable improvement and indigenious and non-Indigenious people group concern and desires. Keeping up a sound EDR bank adjust will require a long haul interest in mapping and assessing the crustal zone to profundities of 15 to 20 km, since future mineral travelers will support those nations where standard investigation data is accessible to encourage discovering substantial scale, high-review assets. In Australia this implies applying inventive innovation for investigation

underneath the mantle of the as a rule unmineralized mantle that covers the imminent more seasoned shakes over the vast majority of the mainland.¹⁸

The potential for Australia to incorporate its minerals segment into the more extensive maintainable advancement of Australia is noteworthy. This potential is being acknowledged with some mining improvements as at Orange, Central West NSW, where the world class copper-gold Cadia-Ridgeway mine advancement exhibits such coordination socially, monetarily and ecologically at the neighborhood and provincial level. Accomplishing amicable and manageable improvement broadly will require a more extensive view and a further social move by the real organizations, a more educated network discernment and a government that will seek after an arrangement of supportable advancement for the minerals section.

Mining has been and keeps on being a noteworthy supporter of the monetary development of the greater part of the created and creating nations. India positions among top five worldwide players regarding creation of a few essential minerals. A high ecological cost related with long stretches “of unregulated mining and mineral-handling” action made it mindful that it needs to strike a harmony between mineral improvements from one perspective and the greening of nature on the other.¹⁹ Though the environmental burden the inventory network in mining division have built up, the usage of innovations, however these are not free from challenges. Natural issues related with waste and emanations created from different store network exercises have constrained associations, confronting focused, administrative and network weights, “to move towards greening their supply chains”. In any case, the greater part of the received green arrangements, particularly in creating nations, stay to be the customary summon and-control solutions. Dissimilar to the

conventional natural administration, the idea of green store network accepts full accountability of a firm towards its items from the extraction or obtaining of crude materials up to definite utilize and transfer of items. All phases of an item's life cycle will impact a production network's ecological weight, from asset extraction, to assembling, utilize and reuse, last reusing, or transfer.²⁰ Various ecological administration practices, for example, affirmation and cleaner generation have been actualized by different ventures. As a more efficient and incorporated procedure, green inventory network administration (GSCM) has risen as an essential new advancement that enables associations to create 'win-win' techniques that accomplish benefit and piece of the overall industry goals by bringing down their natural dangers and effects, while raising their biological effectiveness.²¹ “Almost every industry has been hit by green fever”. The mining business is no special case. Mining businesses perform different exercises, for example, “extraction of minerals”, preparing of minerals and transportation of these minerals to commercial center.

2.2 The Effects of Mining on the Environment

Long stretches of unregulated mining and mineral handling exercises like boring, impacting, pulverizing and other related exercises will not come “without high natural expenses”. In correlation with different segments, “the potential social” and ecological issues related with mining and mineral preparing activities are both critical and complex to oversee. Be that as it may, revelation, extraction and preparing of mineral assets is generally viewed as a standout amongst the most earth and socially problematic exercises embraced by business. As it is connected with low speculation limit and poor working conditions, which upholds utilization of conventional advances and untalented labor, which eventually contrarily influences profitability and upkeep of gear. This outcomes in utilization of more vitality and age of more waste making it most

contaminating area. The negative effect of mining on wellbeing, air, water, air, plants and creatures, and different parts of society can be lessened via cautious arranging and execution of mining exercises. It is fundamental to strike a harmony between mineral improvements from one viewpoint and the reclamation of the earth on the other. Mining in raw Minerals are the essential crude materials which add to the development of both creating and created nations. Sensible use of mineral assets advances the financial improvement of a country and its kin. India is rich with different mineral recourses, which incorporate petroleum products, ferrous and non-ferrous metals and modern minerals. All around, India positions among the best five players regarding generation of a few essential minerals. Since 1947, India's mining industry has demonstrated fast development. In the preplan period preceding 1950, India delivered 24 sorts of minerals with an aggregate estimation of US\$23 million. Today, it produces 90 minerals, with an anticipated aggregate an incentive to contact over \$30 representing around 2.5% of the GDP in the following four years.²² Open segment mines contain 91 percent of the country's aggregate mineral esteem, despite the fact that 80 percent of mines are exclusive. For instance, the development in Indian mining ventures because of reasonable arrangement and speculation atmosphere upheld by positive market request has increased the unfavorable effects on condition. Effect on condition by mining with suitable innovation, crude extraction systems, a hesitance to design and a nonchalance towards ecological issues of mining enterprises have prompted inefficient mining, poor mineral recuperation, the age of mass mine waste, occasional shortage of ground water, exceptional harm to scenes, adjustments to seepage designs and various natural dangers. Residue delivered from shooting task in surface mines and from developments of overwhelming vehicle on pull streets additionally add to air contamination. Water Quality The real effects are water contamination because of disintegration, oil and oil, sullyng of water bodies because of release of mine water,

contamination from household and sewage effluents, sedimentation of waterway and other put away water bodies, leachates from wash-off from dumps, strong waste transfer destinations, broken rocks, lethal squanders, saltiness from mine flames, corrosive mine seepage.

2.2.3 The Cumulative Effects of Mining on the Environment

An aggregate impact of green mining has the mining exercises like, boring, impacting, pulverizing and material transportation, produces tremendous commotion and vibrations in the mining areas do sometimes result in hearing misfortune, wellbeing related issues and loss of execution. There are also significant effects of mining on ecology, and thus as a result, huge regions of land are debased and existing biological communities are supplanted by unwanted squanders. The mineral extraction process definitely adjusts the physical and organic nature of a mined zone. Strip-mining, normally rehearsed to recuperate coal holds, wrecks vegetation, causes broad soil harm and obliteration and modifies microbial networks. During the time spent expelling wanted mineral material, the first vegetation is definitely annihilated and soil is lost or covered. Green administration hones in the mining business have numerous potential outcomes to lessen the natural weight where mining exercises exist. For instance; advancement of the ecological execution through great housekeeping and aggregate quality administration, fitting end-of-pipe systems, reusing of waste and non-inexhaustible items, substitution of, or a prohibition on the utilization of earth antagonistic items, or by incremental and more radical mechanical innovations.²³ However the usage of these advances do confront a few difficulties. Little Scale mine proprietors of industrializing nations like India do not have the specialized or budgetary abilities for appropriate misuse, mining improvement, mineral extraction, or handling. They additionally regularly need adequate mechanical hardware and sufficient upkeep offices which

decreases yield per unit info and expands squander generation. Thus, little scale mines are not subjected to direction as quite a bit of little scale mining exercises are completed illicitly, and therefore hard to screen and control. In Ghana little scale mines especially the simple little ones, regularly don't fret over eco-accommodating tasks, and thus, green mining is an alternate route. They do destroy the "vegetation and trees", especially at and close to the region of mining task. Some mining companies do not even take any step to regenerate environmental status in order to create sustainable alternatives. Mining companies have often pressured local people to object to proposals for increased green mining sustainability measures, fighting that it would diminish work openings at occupant mines. This has been the case in New Delhi in India.

Because a few tasks are exceedingly simple, undesirable and risky practices, carelessness towards natural debasement wins all through the region. Unlike Ghana's Green mining sector, the Indian was shut to outside financial specialists till 1994, finding a way to change the segment to pull in higher volumes of Foreign Direct Investment. It is asserted that in the look for new wellsprings of capital work and crude materials, TNCs (transnational organizations) migrate their organizations where ecological directions are lax.²⁴ In India, debasement and an absence of political will likewise assume its part in non-execution of these and related contamination control measures. In Ghana, the absence of direct impetuses in the minerals business, and administrative expenses can't be passed on to purchasers since global metal costs are resolved in closeout advertises and can't be controlled by the producers.²⁵ The approach of expecting firms to lessen contamination at source by the Ghana Minerals Commission is indeed laudable. However, it does not involve changing their generation innovation and association, however ignores the likelihood that organizations may as of now be looking for better approaches to enhance metal recuperation, reagent utilize, vitality

effectiveness, water protection, et cetera as a component of their corporate procedures to expand aggressiveness.

2.3 Green Mining and the Technological Shift

Numerous mines in Ghana are either not mindful of the present variant of advances or neglect to distinguish the territories where these cutting edge innovations could be used for green mining. If conceivable outcomes for the trend setting innovations have been recognized, at a portion of the mines, deficiency of aptitude is experienced. Lack of administration in a large portion of the mining organizations in the developed and developing nations are less worried over natural issues and hesitant to distribute satisfactory money related, mechanical and HR to actualize the green administration practices. There is additionally an unavoidable measure of aversion by top administration towards usage of green administration hones as it includes enormous measure of documentation work and a genuine resistance revealed amid ecological examining process.²⁶ Lack of inadequate awareness regarding the effect of mining on the environment among citizen, what's more, administration is aggravated by the low levels of proficiency and the poor broad communications concern. Controllers are regularly extremely restricted by absence of satisfactory and usable data as additionally lucidity and definition on a few viewpoints relating to mining operation. This makes the important holes for illicit tasks to capacity and prosper unchecked. Another difficult issue in such manner is the organization kept up by the administration offices and the general non-accessibility of data on naturally touchy issues. Administrations are regularly ignorant of the open doors for cost reserve funds in the regions of waste lessening or end of contamination, vitality proficiency and moderation of mishaps.²⁷ The hindrances that have been distinguished and talked about before can enable administrators to assess how much these

boundaries are available in their association. Additionally, it is sensible to consider that all obstructions may not be similarly material to every last association. At present the Green mining industry in Ghana is faced by these boundaries stay substantial polluters, or, best case scenario, stale as far as natural execution. Local governments must assume an extended part in scattering profitable data and innovation to mines.²⁸ Governments has likewise an essential part to play in giving preparing openings and in guaranteeing that security and wellbeing directions are fitting and are watched

2.4 Prospects of Green Mining in Ghana

Mining provides a wide variety of the materials Ghana depend on to assemble frameworks and instruments of day by day utilize and get a lot of vitality to supply farming with manures that empower the majority of nourishments created. However, without an effective enforcement of green mining practices to safeguard environmentally unfriendly mining practices, the mining industry could pose a risk to society. Over the last decades of Green mining, arrivals of materials into the earth, which happen in each phase from extraction, to utilize, and to squander transfer causing natural and human wellbeing impacts, expanded at a more noteworthy rate due to overburden evacuated to achieve the metal minerals.²⁹ The amount of waste created to deliver the 12 noteworthy metals and items was figured to be, in normal, four times the heaviness of the metals removed. In all actuality, the squanders stream increments speedier than the product extraction because of declining metal evaluations and need to tap further metal stores. In the meantime, mining is the human action that has been all the more irritating to condition and connected to expansive social effects and imbalances.³⁰ Several mining divisions, from phosphate to uranium, are checked on and their present effects and difficulties are examined. The mining heritage and

natural challenges, and the future mining discussed in relationship with environmental health and sustainable development. Green mining ventures give huge numbers of the crude materials for hardware we utilize day by day, from aluminum jars up to electronic chips of phones and PCs. The regular mining practice until the point when as of late could be outlined in a couple of ventures: from acquiring a permit, the metal is dug, metal sold, and, once the deposit is depleted, walk-away and begin another mine somewhere else. All the same, the mining industry is among the human exercises with amplest natural and social effects.³¹ In Ghana, the Green mining sector is usually returned to feature mining systems, their belongings, and current difficulties. Digging for base metals and vitality fills (oil, gas, coal, and uranium) requires vast ventures, and it is capital serious, being done generally by major corporate organizations.³² The heritage of radium and uranium mines in Europe is utilized to show old mining rehearses, their ecological and social effects, and different expenses. New mining ventures are required today to fuse exercises from past mining exercises and meet societal and advancement needs in a more productive and less harming path to the earth.³³ The prospects of Green mining in Ghana has been of significant debate due to the emergence of rampant Chinese mining companies in the country who have exploited a significant proportion of the industry. Though there has been stringent measures put in place by the government, the corrupt institutions of government have often led to illegal operations of Green mining practices by both local and foreign nationals. It is however a significant setback where Green mining activities has led to the degradation of lands and river bodies. In the light of these developments, the Green mining industry is set to rise by 2020 according to the Ghana Minerals Commission (GMC), if robust measures are put in place to mitigate corruption in the acquisition of mining concessions as well as Green mining practices in the country. According to the Ghana Minerals Commission, if these measures are taken, the prospects of green mining would take a

significant jump by the year 2020.³⁴ According to research by the Minnesota Green Mining Center, crude materials do add to the development of both industrialized and industrializing nations. The reasonable use of mineral assets advances the monetary improvement of a country and its kin. For instance, India is rich with different mineral assets, which incorporate non-renewable energy sources, ferrous and non-ferrous metals and modern minerals. All inclusive, India positions among the main five players as far as generation of a few essential minerals. Since 1947, India's mining industry has demonstrated fast development. In the preplan period before 1950, India delivered 24 kinds of minerals with an aggregate estimation of US\$23 million. Today, it produces 90 minerals, with an anticipated aggregate an incentive to contact over \$30 billion (about Rs. 1,27,662 crore) representing around 2.5% of the GDP in the following four years [3]. Open division mines involve 91 percent of the country's aggregate mineral esteem, despite the fact that 80 percent of mines are exclusive.⁸¹ By 1996-97, India had 3,488 mines. Out of these, 563 were coal, 654 were metals and 2,271 were non-metals. The development in Indian Green mining businesses because of reasonable strategy and speculation atmosphere upheld by good market request has strengthened the antagonistic effects on condition. In Ghana, the absence of suitable innovation, crude extraction procedures, a hesitance to plan and negligence towards ecological issues of mining enterprises have prompted inefficient mining, poor mineral recuperation, the age of mass mine waste, regular shortage of ground water, uncommon harm to scenes, modifications to seepage designs and various natural dangers including dust delivered from shooting task in surface mines and developments of overwhelming vehicle on pull streets likewise add to air contamination. The real effects are water contamination because of disintegration, oil and oil, sullyng of water bodies because of release of mine water, contamination from local and sewage effluents, and sedimentation of waterway and other put away water bodies have not been the best in the Green mining practice in Ghana but

creates significant room for improvement if lessons are learnt from the Chinese model. Clamor and vibration total impact of the mining exercises like penetrating, impacting, pulverizing and material transportation, produces tremendous commotion and vibrations in the mining territory driving which brings about hearing misfortune, other wellbeing related issues and loss of execution.

The measure of little scale firm mine proprietors of creating nations like Ghana do not have the specialized or budgetary capacities for legitimate abuse, mining improvement, mineral extraction, or handling. They additionally need adequate mechanical hardware and satisfactory upkeep offices which diminishes yield per unit information and builds squander generation. Little scale mines are not subjected to control under mines as quite a bit of little scale mining exercises are done illicitly. It is in this way hard to screen and control little scale mines especially the simple little ones. They ordinarily don't make a fuss over eco-accommodating activities however don't just decimate the vegetation and the trees, especially at and close to the region of mining task, yet additionally find a way to recover ecological status or make greeneries. According to research by the Storton Institute, if such measures are taken, the Green mining industry would significantly improve by the year 2020.

Africa is nearly an uncommon mining blast. This blast is pulling in several billions of dollars in outside venture and will result in substantial economic growth and development, but it also carries big risks for developing countries to preserve its societies and the environment. According to Steinberk Research Institut, Africa contains around 30% of the world's mineral assets including the biggest known stores of an extensive variety of deliberately vital minerals. However with under

5% of worldwide mineral abuse having happened in Ghana and a few sections of Africa, extensive parts of the mainland being topographically unexplored, the potential for development is huge. Africa's mineral riches is presently pulling in a rush of remote speculation.³⁵

Chinese interest in African mining quadrupled from 2000 to 2009, from US\$25.7 billion to US\$103.4 billion every year. Chinese venture is soaring, so too is speculation from the other BRIC nations (Brazil, Russia, and India) and western nations (particularly Canada and Australia), with venture becoming similarly quick in relative terms. For example, in excess of 230 Australian mining organizations are associated with more than 600 activities in mining investigation, extraction, and handling crosswise over in excess of 42 African nations. In the light of this development, there is the need to encourage African Entrepreneurs to invest in the continent to compete with such global trends. There is the need for Ghana to encourage the private sector to put up globally competitive measures in order to encourage local investors to adequately compete.³⁶ According to Ghana Minerals Commission, the institutional set up also has to be strengthened in order to mitigate any unfettered practices that could grossly affect river bodies and the environment. Any upsurge in Green mineral exploration in Ghana must be connected to major infrastructural ventures, including streets and railroads to move items from mine to smelters, and additionally delivering ports for send out, and hydro-electric dams. This would ensure that the mining and infrastructural investment will create new optimism in Ghana and other developing nations, and achieve financial advancement and neediness lightening. African nations unquestionably have worries about these issues, however many are beginning to create good administration ability to manage the scale and speed of the present rush of ventures. In-coordinate impacts are a result of outside framework, contamination, synergistic improvements, and populace

relocation. Regarding direct negative effects on the common habitat, mines can straightforwardly evacuate, part, or corrupt characteristic territory, with the influenced zone. A related concern is the apparition of minimizing, scaling down, of guarded zones. For example, in the Republic of Guinea, the Mount Nimba Biosphere Reserve, a World Heritage Site, was scaled back by 1,550 ha to take into account press mineral prospecting.³⁷ Further, about 44% of Africa's significant metal mines are inside or inside 10 km of an ensured territory, extensively more than the 25% in both Asia and South America. The quick, moderately nearby natural effects of mining as such might be predominated by the possibly undeniably far reaching effects of mining foundation and financial change.

The development of streets and rail-courses driven to some degree by extractive ventures stays one of the greatest dangers to common environments and untamed life populations. By creating and improving infrastructural networks, Green mining could have major impacts on the spatial patterns of rural development in developing countries like Ghana. Mining streets will empower real developments of populaces into up to this point scantily populated areas and could build weights from arrive clearing and chasing for nearby consumption.⁸⁴ Further, as streets cut into beforehand blocked off timber lands, they could make ready for an influx of business supply of major urban focuses and outside work. The prospects of Green mining in developing nations thus, cannot be separated from the lapses in institutional gaps which is needed for the development of the industry in order to improve human lives and bring about a greater transformation of both infrastructural and human development. In the light of these there is the need for green mining practices to be well enforced. These measures have largely facilitated best practices in the Green mining industry from both developed and developing nations, in terms of a reduction in the

negative effects of mining to ensure sustainability. The prevailing employments of gold keep on being adornments and capacity of budgetary esteem, with the two uses loaning themselves to long item life and simple reusing. A minor extent of gold is utilized gadgets, dentistry and different territories. This makes gold extremely one of a kind in contrast with all of her mineral and metal products, which have utilitarian employments.

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CHAPTER THREE

ANALYSIS AND PRESENTATION OF RESULTS

3.0 Introduction

This chapter presents an in-depth analysis of Green mining awareness strategies among stakeholders in the mining industry in order to ascertain the prospects and challenges of Green mining in Ghana and on the Ghanaian economy, while examining how adopted measures have been employed by Golden Star Resources to reduce the negative environmental impacts of mining. It also seeks to endorse policy directives which could be implemented to promote the use of Green Mining mechanisms in the mining industry in Ghana. The study adopted an interview guide as its research instrument. The interview guides were therefore developed for respondents of all categories to provide answers to them. Both open and close ended questions were provided for the convenience and free will of expression to participants in the study.

It is important to establish that a total of fifty-five (55) respondents earmarked for the study participated in the study resulting in an overwhelming 100% response rate aiding in an in-depth analysis and a more representative conclusion. Results of the data gathered for the study were analyzed descriptively.

The results obtained of the study are analyzed under the following headings;

- Demographic Characteristics of Respondents
- Mining awareness, prospects and challenges of green mining
- Measure employed to reduce negative environmental impact of mining by Golden Star Resources

- Policy to promote green mining mechanism and sustainability.

3.1 Demographic characteristics

The demographic characteristics of respondents consist of the profile of the company's used for the study. Information was solicited from these companies to arrive at a meaningful conclusion. Additionally, the categories and characteristics of sampled respondents are also considered.

3.1.1 Profile of companies

3.1.1.1 Golden Star Resources

Golden Star Resources is a mining company with two producing mines in Ghana; Wassa and Bogoso/Prestea. Golden Star is listed on the American Stock Exchange, the Toronto Stock Exchange and the Ghana Stock Exchange. In 2017 Golden Star was named Mining company of the year at the Ghana Mining Industry Awards. This award recognizes an organization that has achieved the highest aggregate performance results in the categories of environmental management, occupational health and safety, corporate social investment, innovation and local content. Also, it has been awarded the 2018 Environmental and Social Responsibility Award by the Prospectors and Developers Association of Canada (PDAC). PDAC is a Canadian International body that has a mission to globally promote responsible, vibrant and sustainable mineral sector.

3.1.1.2 The Ghana Minerals Commission

The Ghana Minerals Commission, also known as the Minerals Commission is a quasi-government institution; an agency established under Article 269 of the 1992 Constitution and the Minerals Commission Act 1993, Act 450. As a government agency under the Ministry of Lands and

Resources, the Minerals Commission fills in as the fundamental limited time and administrative body for the management of mineral resources, as well as the coordination and implementation of policies relating to mining in Ghana.¹ It was thus, established to regulate the exploration of minerals in Ghana, in order to allay the fears of exploitation of the nation's precious mineral resources as well as safeguard exploration to protect indigenes and workers from harmful mining practices. The Minerals Commission seeks to accomplish sustainable mining through the development of a solidly knowledge-based, self-led organization, which recognizes that mining investment would only take under win-win circumstances; that such investments ought to be a zero-sum. Thus, the Minerals Commission as the fundamental special and administrative body for the minerals area in Ghana is in charge of "the control and administration of the usage of the mineral assets of Ghana and the coordination and execution of approaches identifying with mining. It likewise guarantees consistence with Ghana's Mining and Mineral Laws and Regulation through successful observing. The Commission endeavors to make Ghana the main goal of mining area interest in Africa through the production of an amiable air in which all partners fill in as accomplices in a sheltered domain to accomplish one shared objective: practical through mining. The commission seeks to accomplish this key objective through the development of a solidly knowledge-based, self-led organization, which recognizes that mining investment would take place and be sustained only if it is under mutual gains.

3.1.1.3 The Ghana Chamber of Mines

The Ghana Chamber of Mines with its core values as honesty, Transparency, Good Governance, Good Corporate Citizenship, Unity and Commitment exists as a body to represent the mining industry in Ghana using the resources and capabilities of its members to address issues that bother

its members, their communities and their dealings with the government. The Chamber of Mines is a voluntary association of Private firms with interest in the mining sector. Its capacity covers 3 areas; the Government, the mining companies, and the communities. The Ghana Chamber of Mines is the main minerals industry association in Ghana and is said to represent the collective interests of companies involved in mineral exploration, production and processing in Ghana.

The Ghana Chamber of Mines supports Green Mining in Ghana by ensuring that all mining companies in Ghana who wish to be a part of this association satisfy a number of requirements which come as a code of conduct for one to fulfill before becoming a member. Also the Ghana Chamber of Mines has a great relationship with the Minerals Commission. This relationship is a partnership in which these two organizations conduct Audit services in the areas of Mining, Environment & Machinery. Here mining refers to the process of mining, Machinery deals with the safety of the whole mining equipment's and Environment deals with issues concerning the environment.

Its activities are entirely funded by its member companies, which produce over 60 per cent of Ghana's mineral output. The Chamber has represented the industry's interests since 1928. The first offices of the West Africa Chamber of Mines were set up in 1903 with the chief target of progressing and ensuring the mining interests of the investors. The Chamber was made out of executives of the Mining Companies in London who, among different capacities, had capacity to advance or contradict any authoritative measures or request of government and managerial bodies in the settlement on numerous issues, which straightforwardly influenced mining interests. On sixth June 1928, the Gold Coast Chamber of Mines was joined as a privately owned business and

worked at Tarkwa in the Western Region. On Ghana's fulfillment of freedom on sixth March 1957, the name of the Chamber was adjusted to the Ghana Chamber of Mines. By an exceptional determination on sixth May 1960, the type of the objects of the Chamber was likewise modified, and on fourteenth February 1964, the Chamber was changed over under the Companies Code 1963 (Act 179) into a Company Limited by Guarantee. In 1967, the enrolled workplaces of the Chamber moved to the national capital, Accra.

3.1.1.4 Environmental Protection Agency

The Environmental Protection Agency was formerly established on 30th December 1994(Act 490) to promote self-regulation continuous environmental performance, encourage efficient utilization of resources, encourage good housekeeping, encourage pollution reduction beyond compliance, and promote adoption of clean-technologies. The EPA is charged with creating incentives, the promotion of corporate image, and the promotion of compliance with environmental regulations. The Environmental protection agency since 1999 has considered environmental disclosure as a policy tool to disclose findings from this analysis to the General public.

3.2 Categories of respondent

The response rate for the study had varying respondents. These respondents were categorized into; regulators, industry players and other related parties. The regulators were made up of respondents from the Ghana Chamber of Mines, The Environmental Protection Agency and The Minerals Commission. The study interviewed a respondent from each respective body and their portfolios included the Head of Research, Head of Mining and the Monitory, Evaluation and Planning Officer respectively.

Additionally, the industry players where respondent from the study case: that is the Golden star Resources, Bogoso. With this, the study interview respondents who had adequate knowledge to help achieve the purpose of the study. There were three respondents in all from the company which included the Acting General Manager, the Environmental Protection Manager and Corporate and Sustainability Manager.

Finally, other related parties interview were respondents within the study location and other experts who were affect by the operation of the mining activities. These included the Chief of Bogoso, the Chief of Bepo and an expert in the field of Mining from Finland. Also a focus groups discussion was employed. This was done in sections; with the first composed of 10 respondents (young men ranging from the age 16 to 35), the second of 12 respondents (market women ranging from the age 23 to 45) and a third group of 8 (both men and women). Other groups were a group of 4 young men (age range of 35-40) and a group of 5 young men (age range of 25-30). Away from the focus group discussion, the researcher had a one-on-one interview with seven people. Three ladies and four gentlemen within the age range of 25 to 30).

3.3 Mining awareness, prospects and challenges of green mining

3.3.1 The Role of the Environmental Protection Agency (EPA)

From the results it was revealed that the Environmental Protection Agency before the inception of the 'Akoben' used the "Carrot and Stick" method in promoting environmentally safe mining. This method was not efficient and sufficient enough to place mining companies in keeping up to standard. The 'Akoben principle' in 2010 stood for alertness and readiness in fighting for the

environment.² It is an environmental performance rating and disclosure initiative of the Environmental Protection Agency (EPA), and the Government of Ghana. The Akoben programme compared the environmental quality parameters of mines against a set of standards. Also, water quality parameters under this method, was compared to best international standards to measure its effectiveness. Under the 'Akoben initiative', the environmental performance of mining and manufacturing operations are assessed using a five-color rating scheme; Red, Gold, Green, Blue and Orange. According to a respondent this initiative is to help all stakeholders. This he said as highlighted below

The Mining sector in Ghana is influenced by other significant stakeholders besides the various governments and quasi-governmental agencies. Such has been the role of the Ghana Chamber of Mines and other Non-Governmental Organizations (NGO's) like the Alliance for Global Sanitation. These other stakeholders do serve as a mechanism for fostering both the enforcement of regulations and by laws for green mining in Ghana to foster sustainable development. These stakeholders receive funding from both national and international stakeholders who are often interested in safe environmental practices geared at keeping the water bodies and air free from chemical pollution.

Further, according to the respondent from EPA, Ghana being a third world country doesn't mean Mining policies and policies governing mining are inferior or not to the standard of the foreign ones.³ The EPA does ensure that, best practices such as the tailings pits and waste rock dams are done the same way as is expected by international standard. Preparation of tailings dams are done the same way; vegetation, top soil and trees. The EPA also ensures that Cyanide tailings are well lined. The seven core principles used are; legal requirements, toxic releases and hazardous spills, best mining practices, environmental monitoring reporting, environmental best practices, compliance and management, and community social responsibility. Under the 'Akoben method', the EPA does examine reclamation bond, environmental management plan, and hydro-carbon and cyanide spill. The colouring Red stands for poor, Orange stands for satisfactory, Blue stands for

Good, Green stands for very good, and Gold stands for excellent. Mining companies also benefit from the Akoben Initiative because the analysis provides various analysis on water and energy consumption and hence the EPA can recommend ways to them to reduce the eater and fuel consumption if its usage is on the high. These analyses are good because they help the EPA to recommend to the mines better ways to stuff and how much they are incurring loss and how can that be worked. Public disclosure also allows for the EPA to publish the results for investors to know what the red flags for the mines are and this deters investors from agreeing to invest in the mines.⁴ This serves as a deterrent to the mines and causes them to keep in shape. The Environmental Protection Agency promotes sustainable mining for future generations to come and meet an environment that can enable them to mine. Minerals are non-renewable; hence the EPA believes that mining should be done sustainably. Thus, the Environmental Protection Agency is looking at getting real time monitoring capacities soon. It hopes to secure satellite facilities to help monitor mining activities even from their offices in Accra.

3.3.2 Increasing Environmental Constraints: Adopting the Australian Antidote

There is maybe no other modern undertaking that has had such a significant impact on the Australian country as gold monetarily, naturally, politically, and socially. Despite the fact that there had been various perceptions of the nearness of gold in numerous regions of eastern Australia previously “1850, they were not considered of any consequence by their discoverers”. There is the need for a country like Ghana to learn from the Australian Mining sector, especially pertaining to green mining practices; there is a need to perhaps, adopt the Australian antidote. Though Australia has also stoked concerns in its mining sector over the years with respect to environmental constraints, the approaches adopted by the Government of Australia as well as other stakeholders

have been profitable. The colossal Californian dash for unheard of wealth, which began in 1848, made a sudden and exceptional enthusiasm for Gold in Australia.

In February 1851 close to Bathurst, west of Sydney, gold was found in payable amounts: Australia's brilliant age had started. Prospecting significantly quickened, and gold was found in focal Victoria by July 1851. Before the finish of 1851, the surge was going all out and gold was streaming openly all through the "Victorian and New South Wales" provinces. For a considerable lot of the next years, proceeding with cycles of blast and bust have described the gold business crosswise over Australia, including wars, depressions also, troublesome markets. Various books and monographs recount the narrative of the 1850's dash for unheard of wealth and its movement all through Australia into the mid 1900's. Just a short history is given in this for fulfillment in reference to the creation and assets information, along these lines empowering key occasions to be recognized.⁵ There are various major natural imperatives confronting the mining business in Ghana, and there is the need to examine the main issues. All the same, if inspected accurately, these issues speak to huge boundaries to "future" extensions of the "gold mining" division and can now and then influence progressing tasks at existing mines. Present day mining produces monstrous measures of tailings and waste shake that requires pro-active arranging and administration.

At a few mines, riverine tailings transfer is utilized at the Tolukuma and Porgera ventures, Papua New Guinea (PNG), and this has caused major ecological and social effects. Few mines likewise utilize marine tailings transfer, which additionally causes critical "impacts including" the previous "Misima (PNG)" and "Minahasa (Indonesia)" gold mines, and in addition working mines at "Lihir

(PNG)", "Simberi (PNG)" and "Batu Hijau (Indonesia)". In created nations, (for example, Australia, Canada, USA), natural controllers have noteworthy impact over mining activities however there are regularly significant concerns raised by nearby networks over issues, for example, dust, clamor, groundwater impacts and so forth. With declining metal evaluations all inclusive, mine waste administration will keep on being an essential issue in the progressing reasonability and size of the gold mining sector. Mining devours a noteworthy amount of water, and its expanding scale likewise connections to catchment impacts on water assets.

In parched or semi-arid locales of the world, particularly, Australia, USA and the South Africa, the “security of water” supplies can be a requirement or significantly boundary to extend advancement.⁶ “Although most gold mining happens in brownfields locales” (where there is a background marked by past mining), progressively new undertakings are being inspected or created in territories of high protection or social esteem. Numerous people group trust that there is no similarity between gold mining in such regions, and this regularly prompts significant social contention. Accordingly, arrive utilize arrangements can oblige or even deny gold mining.

Green is “energy intensive, with the primary sources being diesel or trucks and electricity for process plant. This means that gold leads to significant green house gas emissions, principally carbon dioxide” (CO₂).⁷ Synthetic concoctions: “the utilization of cyanide is broad in large scale gold mining, while mercury is generally utilized as a part of high quality or small-scale mining”. Due to significant “tailings dam” disappointments, “which prompted broad cyanide sullying of streams (e.g. Baia Mare, Romania; Omai, Guyana)”, the gold segment has set up the Cyanide Code to guarantee that “cyanide is transported”, utilized and overseen securely. Interestingly, some

respectful society and ecological gatherings contend that cyanide ought to be totally restricted because of its poisonous quality and inborn natural dangers. These limitations “can be extremely intense at existing gold mines, or even proposed gold mines, and the expanding accessibility of data is helping neighborhood networks to end up more educated about the dangers and also the advantages of gold mining”. There is maybe no other modern undertaking that has had such a significant impact on the Australian country as gold monetarily, naturally, politically and socially. “Although there had been various perceptions of the nearness of gold in numerous parts of eastern Australia before 1850, they were not considered of any outcome by their discoverers.”⁸ The awesome “Californian” dash for unheard of wealth, which began in 1848, made a sudden and extraordinary enthusiasm for gold in Australia. In February 1851 close Bathurst, west of Sydney, gold was found in payable amounts: Australia's brilliant age had started. Prospecting incredibly quickened and gold was found in focal Victoria by July 1851. Before the finish of 1851, the surge was going full speed ahead and gold was streaming openly all through the New South Wales and Victorian provinces. For a significant number of the next years, proceeding with cycles of blast and bust have described the gold business crosswise over Australia, including disputes, dejections and troublesome markets.

Various books also, monographs recount the tale of the 1850's dash for unheard of wealth and its movement all through “Australia into the mid 1900's. Just a short history is given in this for fulfillment in reference to the creation and assets information, in this manner empowering key occasions to be recognized”. The main Australian gold disclosure that prompted genuine mining activities is accepted to be the Victoria mine (initially dug for copper), around 18 km upper east of Adelaide (Horn and Fradd, 1986).⁹ It was found on 4 April 1846 yet immediately demonstrated

disillusioning, just delivering 0.75 kg (i.e. 24 oz). “Despite the fact that there were various different events announced around south-east Australia before the finish of 1850, similar to the Victoria mine, they had been of little essentialness (or this was missed) and did not pull in monetary attention”. Throughout ongoing mankind's history, mining has delighted in an uncommon part as a favored metal for gems and meaning riches and influence with far reaching gold use by different antiquated social orders, crosswise over Europe and Asia. The ownership of minerals, for example, gold was in this way firmly guaranteed that “the state had control of riches and influence”. This restraining infrastructure was broken when gold was found in California in the United

United States of America (USA) in the year 1848 and, at the time was 'whoever finds the goods first should be able to keep them', this prompt a populace flood in 1849 with migrants wanting “to strike it rich”. “In 1851, gold was found in eastern Australia and the world saw another real dash for unheard of wealth a huge number of individuals ran from Europe, including some from China, to strike it wealthy in Australia. In 1886, gold was found in northern South Africa, a territory to wind up known as the Witwatersrand Basin, and this district commanded worldwide gold generation for the following century.”¹⁰ “Gold was a focal factor in the quick financial improvement of these generally juvenile provinces, and clashes, for example, the second Boer War in South Africa (1899-1902)”. Following the Boer War, “South Africa rose to worldwide strength of gold creation and remained the world's driving yearly maker until the point that 2007 when China assumed control the mantle of world's biggest maker”. “South African generation became quickly after the Boer War, ascending to 289.2 t by 1916 and rising steadily to a pinnacle of 448.1 t in 1941, averaging 370 t/year all through the 1930-40s” (Hartnady, 2009; Mudd, 2007). “After World War 2, be that as it may, gold creation organized wonderful development and flooded to

another pinnacle of 1,000 t in 1970 predominantly because of the improvement of profound new fields at Carletonville, Klerksdorp, Free State and Evander” (Hartnady, 2009). Since “this high point the decrease in South African gold creation has been terminal and in 2010 was just 190 t (USGS, var. a). Over a time of around 125 years, South African generation has totalled exactly 51,500 tons around three times its closest opponent, the United States, with somewhere in the range of 17,400 tons.”¹¹ All through most by far of the twentieth century, By the 1970s, “the US Bureau of Mines” had built up another strategy for utilizing cyanide to drain gold. “The procedure included the utilization of carbon to adsorb cyanide gold buildings suspended in a mash, and ended up known as carbon-in-pulp or CIP”. “The appearance of CIP was a leap forward for gold preparing, as it was an extremely powerful and solid gold extraction process, could acquire high recuperations and was for the most part obtuse to water quality permitting even very saline salt waters to be used.” The utilization of CIP permits second rate metals to be handled and in addition the rise of load draining for gold (Close, 2002; Mudd, 2007). “Around an indistinguishable time from the advancement of CIP process innovation (and its nearby variations), the gold value started to rise. Generally, the gold coast had been consistent and kept up by governments”. In any case, in 1968, this money related framework was coming up short and private gold costs.¹² Consolidated, the development of CIP innovation and the rising gold cost prompted a surprising resurgence in gold investigation and mining overall drove by nations like Australia, Canada, the United States and progressively center pay nations, for example, Peru, Ghana and most as of late China, rising as the Globe pioneer from 2007.

Rich Coolgardie and Kalgoorlie fields in focal Western Australia in 1892 and 1893, respectively at now time Australian generation ascended “from around 40 t/year more than 1889-1892 to

achieve another record high of 119.4 t by 1903, of which approximately 53.7% originated from Western Australia.” “By the turn of the century at 1900 all states had dynamic gold mining and prospecting of different scales.” The then "gold boom" was being driven on the whole by the “Coolgardie Kalgoorlie fields.” As opposed to different states, “the Western Australian” dash for unheard of wealth was portrayed by an extremely minor measure of “alluvial gold with most gold rapidly being commanded by hand shake mining and processing (e.g. see information in WADM, var.)” “More than 1894 to 1896 a sum of 960 new WA based mining and prospecting organizations were glided on the London stock trade (Woodall and Travis, 1979).” “The Western Australian surge quickly expanded Australia's gold yield to record levels by 1903, yet generally Australian generation started a consistent decay from this time.¹³ The time of World War 1 in Europe, from 1914 to 1918, gained additionally ground for the gold business troublesome”. Issues confronting numerous mines included declining mineral evaluations, keeping up a gifted work supply, expanded creation costs and a static gold cost (yet declining in genuine terms). This constrained numerous mines to near to the mid 1920's (Travis and Marston, 1990). Australia came to a near historic low underway of 13.3 t in 1929 (all through the 1920's creation floated around 20 t/year). A minor resurgence in gold mining started in 1932, because of the multiplying of the gold cost, and achieved 51.2 t in 1939, yet this was not maintained as World War 2 caused real difficulties over the area. In the 1950's the Commonwealth government presented a gold mining endowment plot, without which a few mines would have confronted untimely conclusion (Travis and Marston, 1990). Generation all through the 1940's to 1970's for the most part run “between 15-30 t/year, including another near historic low of 15.6 t in 1976”. The revelation of major new gold stores (or fields) was generally moderate all through the greater part of the 1900's until the 1970's. In 1971, geologists of BHP and Newmont found the huge and remote Telfer stores in

northern Western Australia (Royle, 1990). In 1980, following up on prior geographical investigations more than “197678 by the Western Australian Geological Survey and Alwest Pty Ltd, Reynolds Australia Pty Ltd affirmed the unexpected disclosure of the extensive Boddington gold stores south-east of Perth” (El Ansary and Collings, 1990). Starting now and into the foreseeable future the gold business has maintained an astounding “turnaround”.¹⁴

“The creation of carbon-in-pulp (CIP) cyanide processing innovation in the USA (and additionally its firmly related variation of carbon in leach or CIL) encouraged the advancement of substantial, poor quality stores through open cut mining (or underground mining, or even both sometimes) (Close, 2002; Huleatt and Jaques, 2005; La Brooy et al., 1994; O'Malley, 1988).” This concurred with a managed increment in “the genuine cost of gold, which moved from some US\$1,000/kg (US\$30/ounce) to reach as high as US\$26,000/kg (US\$800/ounce), settling around US\$10,000-14,500/kg (US\$300/450/ounce) (e.g. (Kelly et al., 2010; Morgan, 1993).” “These two elements consolidated to encourage a noteworthy resurgence in investigation and creation crosswise over Australia, driven by Western Australia however with Queensland, New South Wales and the Northern Territory additionally making critical commitments sketched out, regularly just by re-visiting old mines and portraying the low grade mineral around beforehand mined higher review lodes.”¹⁵ Between “1979 and 1988 there were 16 noteworthy gold stores outlined which contained no less than 10 t, including the Boddington Hedges field of south west WA at 93.5 t and the Kambalda St Ives field at 117.9 t (Woodall, 1990)”. “Australian gold generation in 1989 had flooded to 204 t, settled at around 280-310 t/year more than 1996-2003, with a record of 313.6 t in 1997”. Creation all through “the 2000s has been around 250 t/year.” “A noteworthy level of gold is currently additionally created as a co-product or by-product, especially with copper”. “In view

of known assets and undertakings (as evaluated in consequent segments), the Australian gold industry is probably going to in any case have a few many years of flourishing, however concern regularly surfaces from inside the gold mining segment about the life span of assets and the generally quick digging cycle for gold stores.” The connection amongst vitality and gold mining is mind boggling and profoundly factor, and is additionally talked about in (Mudd, 2009, 2010). “To analyze the connections and conceivable patterns for gold mining, the information from (Mudd, 2007) was re-analyzed, including some extra-long stretches of information.” “The essential angle included was mine compose underground, open cut or joined (i.e. blended), with the connections between vitality force and mineral review.” Essentially to water, there is generous scramble for all mines, in spite of the fact that higher-grade mines normally have bring down vitality power. There are a scope of issues with the information announced by different organizations, including all out vitality utilization just and not by immediate and backhanded vitality, and the absence of vitality sources being portrayed completely (particularly by data sources, for example, diesel or power by fuel write). Besides, vitality forces would be firmly connected to mine designs, for example, handling arrangement, granulate estimate, venture age, mine profundity and scales, et cetera. The degree of site-specific factors which support vitality power require additionally inquire about, however given declining metal evaluations, and particularly the personal connections between vitality sources, ozone harming substance outflows and environmental change, vitality force will be a developing and significant issue for the gold business. The connection between ozone depleting substance discharges “(GGEs) and gold mining is unpredictable and exceptionally factor, and is additionally talked about in (Mudd, 2009b, 2010)”. “To inspect the connections and conceivable patterns for gold mining, the information from (Mudd, 2007) was re-analyzed, including some extra-long stretches of information.” “So also

to water and vitality, there is considerable dissipation for all mines, albeit higher review mines regularly have a lower GGEs power. There are various issues with the information revealed by different organizations. For example, most accessible information on GGEs are add up to figures as opposed to information separated either by source, (for example, diesel or power by fuel write), or by vitality compose (immediate and backhanded). Besides, as GGE powers are personally connected to vitality utilization, and any viewpoint influencing vitality blend at a specific site would likewise influence GGEs. As found in Figure 24 (underneath), as a rule, gold mines utilizing coal-based power (the red arrangement) have a normally higher GGEs force for a similar vitality power contrasted with hydroelectricity-based mines. In connection to vitality issues fluid powers utilized especially in open cut mining are a key thought.

The volume of waste shake being moved to permit a substantially littler volume of valuable mineral to be separated and prepared are probably going to end up more tricky as the cost of fluid fills increments. As evaluations diminish, the proportion of waste to profitable shake ends up bigger; influencing fuel to utilize even less beneficial than it may be in another application.” Moreover, the cost of the ozone harming substance discharges related with the copying of petroleum derivatives “for transport applications at mining activities will be one of the primary effects of putting a cost on carbon for the dominant part of mining tasks in Australia”. “Electric vehicles are one response to this inquiry, anyway without huge changes to power age, ozone depleting substance outflows will at present be a consideration.” Greater utilization of sustainable power source at mining tasks might be one approach to enhance execution around there. Water utilize is expanding yet water productive procedures to decrease this are not as of now very much created. “For the Western Australian mining industry, it was evaluated that the mining business

"creates 95% of its own water supplies" from groundwater and surface water sources (75% and 25% individually)." The report utilizes information from a literature review completed for this investigation to help a figure of \$700 million as the cost of water disclosure and advancement, and progressing expenses of around \$100 million for every annum (ECS 2004). "Abuse of water (drawing on groundwater sources quicker than they can be revived) is depicted in this report, is defended on the premise that different clients couldn't utilize it in existing structures (ECS 2004), anyway this view does not consider non-human clients, or the backhanded biological administrations given by these low-quality ground and surface water sources." A survey of gold mineral preparing by Longley, 2004 contended that consolidating procedure steps, for example, gravity as well as buoyancy taken after by cyanide filtering would prompt diminished vitality utilization, enhanced wellbeing "because of lower cyanide necessities and significantly less tailings defiled by cyanide." "For instance, Newmont's Nevada Group activities, which depend on 8 open cut and 6 underground mines and a complex of 14 processes, the extent of unmanageable gold prepared has expanded from 65% of every 2001 to 79% out of 2010 (Newmont, var.)." Stubborn minerals, regularly comprising of gold enriched sulfides, require more unpredictable and higher cost preparing techniques, in this way inserting higher unit gold creation costs. This pattern is firmly identified with the exhaustion of close surface oxide metals, which are less demanding to process, and the expanding extent of more profound yet more obstinate sulfide minerals. All things considered, Newmont has needed to adjust and arrange their metal preparing to suit these qualities prompting the perplexing framework presently set up. The worldwide gold industry has been at the cutting edge of supportability detailing, which has risen specifically since the 2002.

Earth Summit in Johannesburg. Maintainability revealing includes detailing against key zones of execution as for social, monetary and natural viewpoints, and reports are regularly distributed in parallel with customary corporate yearly announcing. The most mainstream convention presently utilized “is the Global Reporting Initiative (GRI), now in its third release (GRI, 2006), which is joined with a particular mining segment supplement (GRI, 2010).” “Notwithstanding, there are still extremely critical effects from mining as demonstrated by means of the No Dirty Gold battle (NDG, 2012).” “The GRI incorporates a scope of quantitative and subjective pointers that empower appraisals of yearly supportability execution.” For natural viewpoints, the markers incorporate immediate and backhanded vitality utilization, immediate and circuitous ozone harming substance outflows, water utilization, materials inputs, and impacts on water assets, ecological consumption, and spills. It is clear that though the Australian mining industry has encountered some hurdles throughout its history, the implementation of green mining practices has stoked any negative-effects of mining within that sector. This has been demonstrated in the exploration of gold in particular. There is the need for Ghana to adopt some of these rather efficient green mining practices in order to achieve its sustainable development goals; those pertaining to minerals exploration. Ghana must also learn from the Canadian model of green mining.

3.3.3 Prospects in the Field of Green Mining

According to our respondent, from his expertise and knowledge in Finland: Finland is part of the European Union (EU) and hence does follow tight rules on EU policies on the environment, mining waste, and strong environmental policies from their local government. According to the Alliance for Global Sanitation:

green mining simply refers to putting good technologies to work.¹⁶ It is a concept that's been introduced in the mining industry to ensure that mining is done

sustainably, and value added to the work. Green mining thus, involves a lot of factors such as policy factors, infrastructure and financial factors.

The Alliance for Global Sanitation is of the core inclination that, the Mineral Commission (MC) and Environmental Protection Agency (EPA) should enforce regulations effectively. Also, the three divisions of the mining world; the Government of Ghana, Mining Community and Mining Companies should grow to encapsulate NGOs and the Media. Non-Governmental Organizations can help champion the cause of Green mining if they are all involved in the advocacy process. Finland is part of the European Union (EU) and hence does follow tight rules on EU policies on the environment, mining waste, and strong environmental policies from their local government. The Alliance for Global Sanitation believes that Ghana has good and sound policies on mining and the environment, such as the 'Lis' among others, but there are some gaps with the implementation procedure, which has to be improved.¹⁷ The NGO does ensure that foreign mining companies from the EU region do adapt to EU standards when they get to Ghana to invest in the Mining sector. The NGO is also of the core belief that social impact assessment and environmental Impact assessment should be thorough and done well. Thus, companies should be penalized where these rules of procedure are breached.

3.4 Measure to reduce negative environmental impact of mining by Golden Star Resources

The study revealed that, at Golden Star Resources, the purpose of these new mining concept is to allow the utilization of all usable minerals and by-products to minimize the amount of waste. At the onset of its mining operations in the late 1980s' in Dumase, a town with a small population, Golden Star noticed the area was located on sulphuric acid so decided to relocate the community, after environmental assessment. The company started construction but abandoned it due to

financial constraints. Golden Star Resources require that green mining demands a far reaching assessment of different ventures, thinking about the natural condition. Abuse of environmental frameworks to look on and assess the financial exercises of undertakings, and to accomplish manageable improvement of the biological framework. The Company likewise asks for its specialists to assess the social and natural advantages. Before the inception of the Green Mining Concept, Golden Star Resources had in place measures to reduce the negative impact of mining. Some of which are as follows; regular submission of the operational reports of mining companies, and regular field inspection to monitor mining operations. The organization also partners with the EPA ensures all mining operations leaves less negative effect on the environment.¹⁸ These measures does include ensuring that the noise from blasting are minimized, pollution of water bodies are reduced and that, reclamation of most of the land used has been done. The towns Bogoso, Odumase, and Brakwa are towns directly affected by the activities of Golden Star Resources. After talking to a number of people between the age brackets 16-35 from various backgrounds, respondents did have some concerns with to their livelihood in the society. Many did complain of the lack of jobs even after Golden Star Resources started mining in the community. Some were also dissatisfied with the mining practices of Golden Star Resources because of its adverse effect on the environment.¹⁹ Towns like Brakwa and Tudwa have been seriously affected by the mining techniques of Golden Star. At Bogoso, most of the lands given to the mining company has been reclaimed because of poor mining practices, which did lead to the cracking of houses around the area. A respondent explains that:

The security at the mining premises is very poor and have led to the death of intruders who trespassed the premises in the hope of making money overnight. At the town, Brakwa, the chemicals used in mining has destroyed substantial water bodies. Even rain water can no longer be used as a source of water reliance. The mining practices has polluted water bodies beyond consumption.

At Odumase, one of the major communities very close to Golden Star Resources, some reclaimed that:

The activities have destroyed access to farm lands, because the path to farmlands are in the way of their reclaimed land. The chemicals used by the mining company has destroyed rain water and made it unbearable to use. Rain water actually looks unhealthy to use.

At Odumase, it was discovered that people have in the past died as a result of an open pit that hasn't been covered, a fish pond that was created was destroyed by the chemicals from the tailings of Golden Star Resources.²⁰ Also, employment opportunities are not given to indigenes, but rather given to town men from another place. Golden Star resources as a mine doesn't have much effect on them. Though Golden Star Resources promised to resettle all people who have been affected because of blasting in the communities, the affected people have not been resettled till date. Though the Environmental Protection Agency (EPA) has been at these towns several times to look at the water bodies and land destroyed, no change has been affected. Dust from the trucks and vehicles greatly affect them in the community, air pollution is on the high, bore hole water that were dug are polluted, and cannot be used without treatment. At Odumase, the tailing dam sometimes has the channel or tube connecting waste water to the site spilling over unto our mine sites, and destroying farmlands in the process.²¹ The chemicals used by Golden Star have sometimes destroy water bodies and even the fishes in them. This has prevented the successful harvest of fishes. The mining practices at Bogoso by the Golden Star Resources is an apt demonstration that green mining practices have not been well enforced by both the Minerals Commission, Ministry of Mines and Energy and other stakeholders in the mining industry in Ghana. The laxity with which regulation of mining activities are carried out within these communities have been exemplified through the inadequacies of Golden Star Resources in their

exploration bid. It is therefore both necessary and imperative for these stakeholders to steer up their mandate in order to better regulate mining practices within these communities and beyond.

Green mining simply implies using the best practices to ensure that the environment is protected after mining. At Golden Star Resources, progressive rehabilitation is an approach that is used to keep up with green mining policies. The respondents from the company were all of the view that:

The company has put in place an environmental management plan to determine when the mining process begins in order to accelerate the implementation of permit conditions. The mining process at Golden Star Resources begins with soil evaluation so as to conform to green mining standards.

According to the organization's Environmental Resource Unit, the top soil is tested, and stock piled for future rehabilitation. When this is done the oxide waste is also stock piled and used to build a band around the waste dam that will be created. Subsequently, the mining takes place, and that is followed by transition, and fresh minerals in the waste is put inside the oxide waste band to avert any acidic reaction the oxide band has created. This process reacts and neutralizes the acidity of anything going into the environment. When that is done the waste bands, and the quality of ground water with boreholes are thoroughly checked to regulate the aquifers. When there is blasting, noise and evaluation monitoring are done. The Environmental Resource team at Golden Star relays the report to regulators monthly. When mining is done the mine backfills the pit that has been indicated, and crops are cultivated to prevent erosion. For the agricultural year, trees are planted around the mining sites at Bogoso township to add nitrogen to the soil. Samples are sent to Ghana Standards Authority for analysis to measure quality, and check if it's within the world health organization standard. Palm trees, foreign trees and other plants are cultivated, depending on what the organization discusses with the community. In Prestea, Huni Valley municipality palm

trees grow and even majority of the people are into that. As part of our Golden Star's Community Social Responsibility (CSR), people donate land for the planting of palm trees. Though the people of Bogoso did complain of lack of jobs even after the arrival of Golden Star Resources, the company have used these tree planting exercises as a defense for the provision of Community Social Responsibility. According to Golden Star Resources, the adoptability of Green mining methods has been a major challenge because of financial constraints. Though the organization does subscribe to global compacts and send reports yearly as part of measures to meet up to world gold standards, the International Finance Company (IFC) loans that the company solicits have so many conditions attached to them. For instance, if you are going by performance standards in rehabilitation, they do examine mining conditions, and how permit conditions are strictly adhered to. At Golder Star Resources, environmental policies are implemented at each department, and each department takes environmental matters in the short and long term and incorporates them into planning. Government has already done that. The Government of Ghana has implemented this through the L1 2182 which was promulgated in 2012 on mineral and mining regulations, health safety and technical, corporate-social responsibility, and environmental issues pertaining to mining. According to the Environmental Resource Unit of Golden Star Resources, the LI 1652 of the EPA of 1999 also serves a guide for mining firms. Though Bogoso township have benefited from the mining operations of Golden Star Resources through its corporate social responsibility, the community is yet to benefit much holistically in areas such as education and infrastructure where the people within the Bogoso township are lacking. The assessment of the activities of Golden Star at Bogoso have proven that "Green mining policies are not easy to conform to where mining resources lack the needed financial and logistical means to implement policies."

3.5 Policy to Promote Green Mining Mechanism and Sustainability

3.5.1 Sustainability in the Green Mining Process

Corporate sustainability in mining does not always relate to the corporate affairs of the organization. In the mining industry, corporate sustainability also refers to the measures that mining firms do adopt to sustain environmentally friendly methods of mining like green mining. A discussion with the Corporate Sustainability Manager (CSM) of Golden Star resources helped in identifying modern methods of sustainability in the green mining practise in Ghana. The environmental policies adopted by Golden Star Resources are approved by the CEO of the company and supported by the Board of Directors. At Bogoso, Wassa and Prestea townships, Golden Star Resources organizes training for all our employees to be equipped with what is expected of them as employees with respect to green mining to meet up with legal requirements. Green mining is a good business decision because it saves mining firms like Golden Star a great deal of financial resources when policies are well implanted. When fuel is saved for mining, water is recycled. Prior to the operations of Golden Star, the local indigenes at Bogoso, Prestea and Wassa townships did dump refuse and that caused several sicknesses. As a result of timely green mining procedures by Golden Star, the health of the people was saved. It also saved the company fuel (energy) and financial resources that the organization would have invested into heavy machinery. At Golden Star Resources, sustainability is green mining and green mining is sustainability. According to the guidelines of the Corporate Sustainability Unit at the Bogoso and Wassa facilities, the green mining arrangement at Golden Star is in two significant stages. One is to get good advice for the corporate division of the company on how to best practice the corporate social responsibility pertaining to best mining practices. The other role is to help support the environment safe prior to mining. Thus, at Golden Star, resource persons are charged to share with

indigenes of the various mining communities, smarter ways to go about keeping the environment and mine operations as well.

The operations at Bogoso, Prestea and Wassa townships are also sensitive to the local culture of the people. This is taken into consideration greatly, while assisting the community with environmental impact assessment. At Wassa and Prestea township, it was discovered that most of the mining companies help sustain the environment as compared to some of the other industries in Ghana. The mining companies there do a lot of environmental impact assessment. Most of all the assessments done in these communities are as a result of mining activities. The resultant of these assessments are the reasons why there are good environmental geological maps of Bogoso and Wassa townships. Mining companies before mining do a lot of impact assessment before disturbing the environment. At Golden Star, it was discovered that because of stringent impact assessments prior to the mining process, the company has never had their environmental impact assessment declined by the Environmental Protection Agency in Ghana because, the company has adopted internationally acclaimed standards and principles with respect to green mining. Some of those measures do include noise impact assessment, three-dimensional assessments for mining sites, and other measures geared at protecting the environment and mining communities from direct mining hazards.

Radiologically it was assessed after visiting some of the mining sites of Golden Star that, the company is able ascertain the age of water being drilled, and hence where it was coming. The benefit of this being that, it saves power and save fuel. Green mining is a concept where mining companies are able to achieve their objective of extracting minerals of interest from the earth with

minimal damage to the environment. At the end of it, the goal is to return the land or attempt to return it to its original state or to a near state that the land was in before mining. After a discussion with the General Manager of Golden Star Resources, it was assessed that land reclamation is the best method used to return mining lands to their original state. The company has adopted similar approaches at Mampong, where mining was carried out on forest reserves and land returned for normal use afterwards. More so, the respondent highlighted:

Employees at Mampong facility were taken through a training program on what is expected of them and taken through the stringent procedures needed to successfully mine in a forest reserve. All pits at the Mampong facility have been back filled except for one. Thus, cover crops and timber are planted on the land to restore it afterwards. The company has about 160 hector Tailings, and deposited several million tons of tailings. The company has made conscious efforts in closing tailings dam by converting them to oil palm plantations.

He continued to say:

This was significant because it's a large stretch of land, and normally the life of Tailings dam never ends. Converting to an agricultural facility immediately helps famers get to benefit from the land. Oil palms absorb a lot of water, and it is expected that will help the managing of the water bodies around the tailings dam.

Though these practices by Golden Star Resources has minimized the downstream environmental impacts of some tailings storage facilities, it presents a good test case for post-mining land use in Ghana. The company has a strong record in oil palm plantation as a measure of sustainability after mining; green mining, so it seeks to transfer that wealth of knowledge base into rehabilitation. Golden Star Resources hope to invest its resources to develop the plantation and employ farmers on the lands for the next 25 years, while will continuing to guide them on how to go about it to benefit from the proceeds. The resultant waste after extracting gold is known as tailings. Sustainability in the green mining process is thus, the ability to mine using environmentally

friendly measures to bring about greater levels of transformation for both the mining community and workers of the mining company.

3.6 Conclusion

This research looked at analyzing the extent to which stakeholders in the mining industry have adopted mining awareness strategies. It also sought to analyze the prospects and challenges for the adoption of Green Mining. The research focused on Golden Star Resources as our main case study and how the adoption of Green Mining by Golden Star Resources has reduced the negative environmental impacts of mining. Finally measures, policy directives that could be implemented to promote the use of Green Mining to ensure sustainability was discussed.

The study revealed that Golden Star Resources Practices Green Mining. By so doing Golden Star Resources practices progressive rehabilitation and monitors the quality of ground water and air quality. These monitoring is done based on noise and evaluation of blast, reporting to regulators monthly and so on and so forth. Golden Star has never had their EIS, environmental impact assessment declined by the EPA before.

Endnotes

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CHAPTER FOUR

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

4.0 Introduction

This chapter discusses the results, conclusions and recommendations for the study. The result of major findings and conclusion does constitute the summary of major findings. The practical implications of the results are discussed with recommendations suggested by researcher.

4.1 Summary of Major Findings

The findings of this study have varying implications, but it is worthwhile first discussing those findings. The study established that the relative significance of mining commitment to the “world Gross Domestic Product (GDP)” amid the most recent century demonstrates an expansion by a factor of 27 in metals and minerals creation, “and by a factor of 8 in absolute materials extraction, while GDP raised 23 fold.” It additionally settled that green mining exercises are extremely various and have diverse natural impressions. “The two issues in which are of major overall significance are mine tailings and corrosive mine seepage.” “Tailings” when all is said in done are voluminous and contain lethal components that might be discharged and presented in the bio geosphere. The study also discovered that India positions among top five worldwide players as far as creation of a few imperative minerals. India is rich with different mineral resources, which incorporate petroleum products, ferrous and non-ferrous metals and modern minerals. An aggregate impact of green mining has the mining exercises like, penetrating, impacting, smashing “and material transportation, produces immense clamor and vibrations in the mining areas do sometimes result in hearing loss, health related problems and loss of performance”. All inclusive, India positions

among the best five players as far as creation of a few critical minerals. “Since 1947, India's mining industry has indicated fast development. In the preplan period preceding 1950, India created 24 kinds of minerals with an aggregate estimation of US\$23 million.” “Today, it produces 90 minerals, with an anticipated aggregate an incentive to contact over \$30 accounting for about 2.5% of the GDP in the next four years.” The study established that Australia and Canada have been very successful in Green mining on the global arena. “A high ecological cost which has been related with long periods of unregulated mining and mineral-handling action made it mindful that it needs to strike a harmony between mineral advancements from one perspective and the greening of nature on the other.” Long periods of unregulated mining and mineral preparing exercises like penetrating, impacting, squashing and other related exercises have not come without high natural expenses.

On the challenges and prospects of green mining adaptation globally, and in Ghana, it was established that, in examination with different areas, the potential social and ecological issues related with mining and mineral handling tasks are both noteworthy and complex to oversee. Be that as it may, disclosure, extraction and preparing of mineral assets in green mining is generally viewed as a standout amongst the most naturally and socially troublesome exercises attempted by business in the twenty-first century. In any case, the examination built up that the negative effect of mining on wellbeing, arrive, water, air, plants and creatures, and different parts of society can be decreased via watchful arranging and usage of mining exercises. Wise utilization of mineral assets advances the financial improvement of a country and its individuals. There are also significant effects of mining on ecology, and thus as a result, critical ranges of the ground are debased and existing environments are supplanted by undesirable squanders. The mineral

extraction prepare definitely modifies the physical and organic nature of a mined region. Strip-mining, commonly practiced to recoup coal saves, crushes vegetation, causes broad soil harm and pulverization and changes microbial communities .Small-Scale mine proprietors of industrializing nations like Ghana need the specialized or budgetary capabilities for legitimate investigation, mining advancement, mineral extraction, or handling. Such companies like Golden Star Resources in Ghana moreover regularly need adequate mechanical hardware and satisfactory support offices which decreases yield per unit input and increments in squander generation. Thus, this study established that, small scale mines are not only subjected to regulation as much of small scale mining activities are carried out illegally, and thus difficult to monitor and control. Unlike Ghana's Green mining sector, others like India was shut to outside financial specialists till 1994, finding a way to change the part to pull in higher volumes of Foreign Direct Investment (FDI). The study did find out that, lack of management in most of the mining companies in the developed and developing nations are less worried over ecological issues and hesitant to distribute sufficient monetary, mechanical and HR to actualize the green administration rehearses. There is additionally an inescapable measure of aversion by top administration towards execution of green administration rehearses as it includes enormous measure of documentation work and a genuine resistance revealed amid ecological evaluating process. Lack of inadequate awareness regarding the effect of mining on the environment among citizen, furthermore, administration is aggravated by the low levels of education and the poor broad communications concern. Controllers are frequently seriously constrained by absence of satisfactory and usable data as likewise clearness and definition on a few perspectives relating to mining tasks. This study also established that, the prospects of Green mining in Ghana has been of significant debate due to the emergence of rampant Chinese mining companies in the country who have exploited a significant proportion of

the industry. Though there has been stringent measures put in place by the government, some corrupt institutions of government have often bolstered illegal mining operations; flouting green mining practices by both local and foreign nationals in the process. The study also established that the judicious utilization of mineral resources promotes the economic development of a nation and its people. For example, India is rich with various mineral resources, which include fossil fuels, ferrous and non-ferrous ores and industrial minerals. In Ghana, the absence of suitable innovation, crude extraction methods, a hesitance to plan and negligence towards ecological issues of mining businesses have prompted inefficient mining, poor mineral recuperation, the age of mass mine waste, occasional shortage of ground water, and a number of environmental threats including dust created from shooting task in surface mines.. The study did also established that Africa contains around 30% of the world's mineral assets including the biggest known stores of an extensive variety of deliberately essential minerals. Yet only 5% of global mineral exploration have occurred in Ghana. According to the Mineral Commission, the institutional set up also has to be strengthened in order to mitigate any unfettered practices that could grossly affect river bodies and the environment. The study did prove that, any upsurge in green mineral exploration in Ghana must be connected to major infrastructural ventures, including streets and railroads to move items from mine to smelters. The study proved that the mining industry is among the human exercises with most extensive ecological and social effects. In Ghana, the green mining sector is usually returned to feature mining methods, their belongings, and current difficulties.

At Odumase, one of the major communities very close to Golden Star Resources, some reclaimed lands had destroyed access to farm lands, because the path to farmlands are in the way of their reclaimed land. The chemicals used by the mining company has destroyed rain water and made it

unbearable to use. The study established Commission formulates recommendations on national policy for exploration of minerals to avert the abuse of mineral assets with exceptional reference to setting up national needs with due respect to the economy, and instruct the Ministry concerning Lands and Natural Resources on issues relating Ghana's precious mineral resources.

The study established that, the adaptation of green mining at Golden Star Resources at Wassa and Prestea Township has helped sustain the environment as compared to some of the other industries in Ghana. The assessments done in those communities are as a result of mining activities. The resultant of these assessments are the reasons why there are good environmental geological maps of Bogoso and Wassa townships. The study did also established that Golden Star Resources have employed some measures and policy directives aimed at sustaining green mining. For instance, employees at Mampong facility were taken through a training program on what is expected of them, and taken through the stringent procedures needed to successfully mine in a forest reserve. All pits at the Mampong facility have been back filled with the exception of one. Thus, cover crops and timber are planted on the land to restore it afterwards. The company has about 160 hector Tailings, and deposited several million tons of tailings. The company has made conscious efforts in closing tailings dam by converting them to oil palm plantations. The study also discovered that though Golden Star Resources had put in some measures to promote green mining and abide by national and international regulations, there was enough grounds to establish that the company was still in breach of certain laid down green mining policies. This was evident after talking to various focus groups by the researcher, who described how the various communities at Bogoso township have suffered as a result of polluted river bodies and farmlands after Golden Star operations.

4.2 Conclusions

The result of the study did confirm the hypothesis that, green mining have had a significant impact on the environment in Ghana. Thus, the hypothesis was justified, because the study indicates that green mining policies have led mining companies to implement environmentally friendly methods of mining. At Golden Star Resources, although the implementation of green mining policies have been financially constraining, stringent measures have been put in place to ensure that environmentally friendly mining procedures are conformed to by the company. The company has put in place an environmental management plan to determine when the mining process begins in order to accelerate the implementation of permit conditions. The mining process at Golden Star Resources begins with soil evaluation so as to conform to green mining standards. According to the organization's Environmental Resource Unit, the top soil is tested, and stock piled for future rehabilitation. When this is done the oxide waste is also stock piled and used to build a band around the waste dam that will be created. Subsequently, the mining takes place, and that is followed by transition, and fresh minerals in the waste is put inside the oxide waste band to avert any acidic reaction the oxide band has created. This process reacts and neutralizes the acidity of anything going into the environment. When that is done the waste bands, and the quality of ground water with boreholes are thoroughly checked to regulate the aquifers. When there is blasting, noise and evaluation monitoring are done. The Environmental Resource team at Golden Star relays the report to regulators monthly. When mining is done the mine backfills the pit that has been indicated, and crops are cultivated to prevent erosion. The study thus, reveal that Green Mining concept promotes material and energy efficiency, ensures availability of mineral resources for future needs, minimizes adverse environmental and social impacts, improves work and organizational practices and ensures sustainable land use.

The study also explained the process of green mining evaluation and how it can reduce negative environmental impact of mining. For instance, Golden Star Resources require that green mining demands a complete assessment of different endeavors, thinking about the biological condition. Abuse of natural frameworks to look on and assess the monetary exercises of ventures, and to accomplish economic improvement of the biological framework. The Company additionally asks for its laborers to assess the social and natural advantages. Before the inception of the Green Mining Concept, Golden Star Resources had in place measures to reduce the negative impact of mining. Some of which are as follows; regular submission of the operational reports of mining companies, and regular field inspection to monitor mining operations. The organization also partners with the EPA ensures all mining operations leaves less negative effect on the environment. These measures include ensuring that the noise from blastings are minimized, pollution of water bodies are reduced and that, reclamation of most of the land used has been done. The study also revealed that most of the stakeholders of mining in Ghana do confuse mineral exploration with mineral exploitation. Whereas the former does imply the process of mining in general, the latter does refer to the abuse of those procedures to rid mining communities of its mineral wealth. The study discovered that the preponderance of the stakeholders of mining in Ghana like the Minerals Commission, Ghana Chamber of Mines and even the Ministry of Lands and Mineral Resources have speciously confused mineral exploration and exploitation. It is thus, an imperative to bring this to the light as doing so would actually help in sustaining better green mining procedures. There is the need to put in stringent measures to combat mineral exploitation so us to benefit the communities where mineral exploration is done. Thus, the study proves that, by identifying the glaring gap between mineral exploration and exploitation, green mining measures can be

implemented with the ease at which it should be done. The study also revealed that the Environmental Protection Agency in Ghana is a major stakeholder in enforcing green mining policies in Ghana. The EPA before the inception of what it refers to as the ‘Akoben’, used the “Carrot and Stick” method in promoting environmentally safe mining. This method was not efficient and sufficient enough to place mining companies in keeping up to standard. The ‘Akoben principle’ in 2010 stood for alertness and readiness in fighting for the environment. It is an environmental performance rating and disclosure initiative of the Environmental Protection Agency (EPA), and the Government of Ghana. The Akoben programme compared the environmental quality parameters of mines against set of standards. It is an environmental performance rating and disclosure initiative of the Environmental Protection Agency (EPA), and the Government of Ghana. Also, water quality parameters under this method, was compared to best international standards to measure its effectiveness. Under the ‘Akoben initiative’, the environmental performance of mining and manufacturing operations are assessed using a five-color rating scheme; Red, Gold, Green, Blue and Orange. The study discovered that the fact that Ghana is a third world country doesn’t imply that mining policies and policies governing mining are inferior or not to the standard of the foreign ones. It was also revealed in the study that public disclosure also allows for the EPA to publish the results for investors to know what the red flags for the mines are and this deters investors from agreeing to invest in the mines. This serves as a deterrent to the mines and causes them to keep in shape. Thus, the study clearly did identify green mining awareness strategies used by mining companies in Ghana. The study also explained the need for green mining to be well enforced in Ghana. Since its inception, the study clearly demonstrates that the implementation of green mining practices in Ghana has contributed positively to the Ghanaian economy by cutting down government expenditure on the mining

sector, promoting environmentally friendly mining procedures, and fostering community health and development through corporate social responsibilities of these mining companies.

The concept of Human security thus encapsulates the relevance of the protection from sudden and hurtful disruptions in the patterns of daily life. The protection of the environment from the negative and harmful practices of mining is crucial for the protection and enforcement of the safety of individuals in a given place or community. Therefore, any form of activity that poses a threat to the quality of life and dignity of human beings or members of a society can result in civil unrest. The inhabitants of Dumase, Brakwaline and Bogoso could have been vitally affected by the nature of mining by Golden Star Resources given the adverse effects of mining on any environment. However, Green mining policies have safeguarded the environment as they have led Golden Star Resources to environmentally friendly mining practices that have been useful to the Ghanaian community by preserving the community and its environs. Although financially constraining, Green mining techniques as enforced by the Golden Star Resources from the early mining stages through to the processing of minerals and to rehabilitation of the environment have proven to secure the environment and thus the livelihoods of individuals in the neighboring communities who otherwise would have had their livelihoods disrupted. Measures such as the 'Akoben initiative' by the EPA to safeguard the environment and policy initiatives by the Minerals Commission have both curbed the what would otherwise have been damaging and harmful to the communities in close proximity to Golden Star Resources (Bogoso, Brakwaline and Dumase). These institutions have acted as Liaisons for the mining communities and have guided mining companies by enforcing them to toe a certain line less disruptive to the environment. Human Security focusing on the protection and maintenance of the livelihood of individuals in mining

communities is crucial to the realization of individual dignity of human beings as members of the society.

4.3 Recommendations

The researcher recommends that the Government of Ghana should liaise with major stakeholders in the mining sector to create awareness on minerals exploitation in the country by both foreign and local investors. It is also imperative that the major stakeholders in the mining industry in Ghana do learn from the pacesetters of green mining; Canada and Australia by providing platforms for successful mining companies in these countries to share ideas and resources on sustainability in green mining. There is the need for the Ministry of Lands and Mineral Resources to embark on familiarization seminars to educate all stakeholders in the mining industry of the glaring difference between mineral exploration and mineral exploitation. It is both imperative and overbearing to come to the realization that the gap between the two is not just a matter of semantic difference, but a green mining opportunity. Thus, the Government of Ghana must liaise with other important stakeholders like NGO's and the Ghana Chamber of Mines to sensitize mining companies and communities on the lapses in minerals exploration; mineral exploitation. The researcher also recommends that the Minerals Commission and other regulatory stakeholders do step up in the enforcement of green mining policies by withdrawing the license of both foreign and local investors who flout green mining policies as a deterrent for practicing environmentally unfriendly mining practices. Finally, the researcher would recommend that the Government of Ghana provides logistical incentives like land for mining companies that conform to green mining practices after their first 3 years of operations in order to encourage them to adopt safer practices.

4.4 Implications for Future Research

The study is very significant because it provides a platform for addressing the exploitation of communities where mineral exploration are carried out, and identifies good green mining practices needed to avert any form of mineral exploitation by both local and foreign mining companies. The study has indicated that green mining could have a very positive impact on mining communities if green mining policies are well enforced in Ghana. Thus, if the relevant stakeholders in of mining in Ghana do enforce green mining policies timely and well, there would be a greater convergence in green mining policies in the near future. The findings and recommendations made by the researcher will serve as a platform for further research in the mining sector, as well as provide the basis for solving future related problems in the mining industry.

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APPENDIX

INTERVIEW GUIDE

LEGON CENTER FOR INTERNATIONAL AFFAIRS DEVELOPMENT

This interview guide is designed to investigateGreen mining awareness strategies among stakeholders in the mining industry in order to ascertain the prospect and challenges for the adoption of Green mining in Ghana..... This survey is to solicit data for writing a master's degree long essay and your kind support is crucial for the successful completion of the thesis. Your responses will be treated confidential. Please attempt to answer all the questions. Thank you very much for your time and assistance.

Section A: Mining awareness prospect and challenges of Green Mining

- a. What do you think is Green Mining?
- b. From my research Green Mining is a foreign concept. Yes/No?
- c. What are some of its prospects in Ghana?
- d. What are some of its challenges in Ghana?
- e. Is illegal mining a challenge to Green mining?

Section B: Measures employed to reduce negative environmental impacts of mining.

- a. How has Golden Star Practiced Green Mining?
- b. We are told the land here is predominantly sulphuric in content. What has been done to prevent the drain of sulphuric into the environment?
- c. How has Golden Star dealt with the water crisis in the environment?

Section C: Policy to promote Green mining mechanisms and ensure sustainability.

- a. What do you think went wrong for a policy such as Green Mining to be introduced? This question is because mining has been in existence for several years so what called for this concept to be birthed on the global domain again?
- b. What policy directives would you advice the government to initiate in order to promote Green Mining here in Ghana?
- c. Are there foreign policy directives adopted by governments, international organizations that have been used to promote Green mining in other countries?