

**FACTORS INFLUENCING SUSTAINABILITY OF GOLD
MINING PROJECTS IN RONGO SUB COUNTY,
MIGORI COUNTY.**

BY:

ODHIAMBO ELIZABETH ANYANGO

**A RESEARCH PROJECT REPORT SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF
MASTERS OF ARTS IN PROJECT PLANNING AND
MANAGEMENT, UNIVERSITY OF NAIROBI**

2015

DECLARATION

This research proposal is my own work and has not been presented for a degree or any award in any other university.

Signature: _____

Date: _____

Elizabeth Anyango Odhiambo

L50/82384/2012

This research proposal has been submitted for examination with my approval as the university supervisor:

Signature: _____

Date: _____

Mr. Onuonga G. Odhiambo

Lecture, University of Nairobi.

DEDICATION

This research proposal is dedicated to my husband Kennedy Ochieng Riba, My father Benjamin Odhiambo Osiany, my mother Joyce Gayi Odhiambo and my children Phares Odiwuor and Joy Graca Awuor for their support, sacrifices and motivation.

ACKNOWLEDGEMENT

I wish to express my most heartfelt gratitude to my ever supportive supervisor Mr. Onuonga George Odhiambo for taking his valuable time to add value to this research project and for his guidance throughout the research process.

I am grateful for the support and goodwill of the lecturers at the University of Nairobi for the knowledge imparted on me during the entire period of my study that enabled me to face this research study with confidence. This team of lecturers includes, Mr Awino Joseph, Dr. Samuel Mwanda, Mr. Abila Alfred and Mr. Yona Sakaja.

I salute my colleagues in the 2013 class of masters for being my source of encouragement, information and ensuring that I completed this work on record time. In this category of classmates, I recognize Mr. Odongo George, Bernard Wangunda, Maurice Otunga and Dorothy Awuor.

I wish to thank my colleagues at work who supported me during this course especially Samson Sule, Kenneth Tolo, Gabriel Nyangweso, Beatrice Odiwa and Micah Oranga of Agriculture Department SONY SUGAR Company who were always ready to support, encourage and cover for me whenever I was away.

My gratitude goes to the research assistants Tom Oginga and John Odero for their time and dedication during data collection by ensuring that they gained the confidence of the respondents.

I honestly appreciate the assistance of the local Area chief Mr. Philip Dande for allowing us to undertake this research in his location and for assuring the locals that the research was basically for academic purposes.

Finally, I am grateful to the respondents for their willingness to freely give out information to the best of their knowledge and the cooperation they accorded us during data collection process.

TABLE OF CONTENT

TITLE	PAGE
DECLARATION	ii
DEDICATION	iii
ACKNOWLEDGEMENT	iv
TABLE OF CONTENT	v
LIST OF FIGURE.....	vii
LIST OF TABLES	viii
LIST OF ABBREVIATIONS AND ACRONYMS	viii
ABSTRACT.....	ix

CHAPTER ONE

INTRODUCTION

1.1. Background of the study.....	1
1.2. Statement of the problem.....	5
1.3. Purpose of the study.....	5
1.4. Objectives of the study.....	6
1.5. Research questions.....	6
1.6. Significance of the study.....	6
1.7. Limitations of the study.....	7
1.8. Delimitation of the study.....	7
1.9. Basic assumptions of the study.....	8
1.10. Definition of significant terms used in the study.....	8
1.11. Organization of the study.....	8

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction.....	10
2.2. The concept of sustainability of gold mining projects.....	10
2.3. Influence of Technology on sustainability of gold mining project.....	13
2.4. Influence of Economic Issues on sustainability of gold mining projects...	16
2.5. Influence of Environmental factors on sustainability of Gold mining projects...	19
2.6. Influence of Social-cultural factors on sustainability of gold mining projects...	22
2.7. Theoretical framework of the study.....	25
2.8. Conceptual Framework of the study.....	26

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Introduction.....	28
3.2. Research Design.....	28
3.3. Target Population.....	29
3.4. Sample size and sample selection.....	29
3.5. Data collection instruments.....	30
3.6. Data Collection Procedures.....	31
3.7. Methods of Data Analysis.....	32
3.8. Ethical Considerations.....	34

CHAPTER FOUR

DATA ANALYSIS, INTERPRETATION, PRESENTATION AND DISCUSSION

4.1. Introduction.....	36
4.2. Questionnaire Return Rate.....	36
4.3. Demographic Characteristics of the Respondents.....	37
4.4. Influence of technology on sustainability of gold mining projects.....	43
4.5. Influence of economic factors on sustainability of gold mining projects.....	48
4.6. Influence of environmental issues on sustainability of gold mining projects.....	53
4.7. Influence of socio cultural factors on sustainability of gold mining projects.....	57

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction.....	62
5.2 Summary of the study findings.....	62
5.3. Conclusions.....	68
5.4. Recommendations.....	69

REFERENCES.....	71
------------------------	-----------

APPENDIX I: LETTER OF TRANSMITTAL.....	75
---	-----------

APPENDIX II: RESEARCH QUESTIONNAIRE.....	76
---	-----------

LIST OF FIGURES

Figure 2.1 Conceptual framework of the study.....	27
---	----

LIST OF TABLES

Table 3.1: Operationalization Table.....	33
Table 4.1: Questionnaire Response Rate.....	37
Table 4.2: Age of the respondents.....	38
Table 4.3: Gender of the Respondents.....	39
Table 4.4: Respondents' marital orientations.....	40
Table 4.5: Respondents level of education.....	41
Table 4.6: Length of time in the gold mining projects.....	42
Table 4.7: Influence of availability of equipment on sustainability of gold mining projects.....	44
Table 4.8: Influence of ease of use on sustainability of gold mining projects.....	45
Table 4.9: Influence of technological training on sustainability of gold mining projects.....	46
Table 4.10: Influence of changes in technology on sustainability of gold mining projects.....	47
Table 4.11: Availability of resources on sustainability of gold mining projects.....	48
Table 4.12: Variety of resources sustainability of gold mining projects.....	50
Table 4.13: Sourcing strategies on sustainability of gold mining projects.....	51
Table 4.14: Frequency of sourcing on sustainability of gold mining projects.....	52
Table 4.15: Influence of environmental impacts on sustainability of gold mining projects.....	54
Table 4.16: Influence of economic activities on sustainability of gold mining projects.....	55
Table 4.17: Influence of environmental safety on sustainability of gold mining projects.....	56
Table 4.18: Influence of cultural practices on sustainability of gold mining projects.....	58
Table 4.19: Influence of relevance of the culture on sustainability of gold mining projects.....	59
Table 4.20: Influence of cultural change on sustainability of gold mining projects.....	60

ABSTRACT

The purpose of this study was to identify factors influencing sustainability of gold mining projects in Rongo sub county, Migori County. The study intended to establish the influence of technology, economic issues, environmental and social-cultural factors on sustainability of gold mining projects with the aim of assisting local community, through knowledge of these factors to economically exploit the natural resources for sustainability. The basic assumption of the study was that the data collection instrument was valid and reliable in taking the desired measures, the samples drawn were assumed to be representative of the target population in its major characteristics and that the respondents were willing to give information honestly and objectively. The study was based on Sustainable Development theory by Hoolly Johns (1976). This theory holds that sustainable development of any initiative is based on ownership, participation, skills transfer and a cultural change attitude. To secure project access and ensure that invested assets eventually see a return, there is need for community consultation and the delivery of tangible benefits to impacted communities. This study being descriptive, investigative in nature and spread over a wide geographical area, a descriptive survey research design was considered most appropriate. It also employed a probability sampling design to ensure that high objectivity in sample selection is achieved by giving each item in the target population equal chances of being selected and included in the final sample drawn owing to the fact that this study was quantitative in nature. Stratified random sampling technique was therefore used. Quantitative data, which was collected using closed ended questions in the questionnaire, were chronologically arranged with respect to the questionnaire outline to ensure that the correct code was entered for the correct variable. Data cleaning was done and tabulated and analyzed with the aid of Statistical Package for Social Sciences (SPSS 21.0) which generated descriptive statistics such as percentages and frequencies. Qualitative data was organized into a checklist which was clustered along the variables of the research study to ease consolidation of information and interpretation and then analyzed through content analysis. In this study one hundred and thirty eight (138) copies of questionnaire were administered to the respondents by the research assistants with close supervision of the researcher and 132 returned duly completed giving a response rate of 94.20%. Revealed in the study was that majority of those who were engaged in gold mining projects in Rongo Sub County were married people predominantly men, with responsibility of providing for their families. It was noted that most of the gold mining respondents indicated that their projects did not have access to adequate resources where human labour formed the greatest resource for key project activities. From the findings of the study, it is significant to formulate regulatory measures to ensure that gold mining is practiced within the required environmental safety, such that pits left are reclaimed to render them productive again. The government of Kenya through the department of Mining should develop policies and proper legal framework to make gold mining projects sustainable, in which appropriate technology is adopted, both for exploration and extraction of gold products. The study also recommends areas for further research.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

In recent years there has been a growing demand for the world's non-renewable natural resources and multinational companies have invested heavily in states that have oil, gas or minerals in their territories. The states concerned, often in the developing world, have had a welcome increase in revenue as well as new jobs as a result, (Aryee 2011). However, exploitation of these resources with less attention on their availability for the future generation is currently attracting interest of stakeholders, and gold mining being the precious domain as it has been, issues of sustainability must be addressed, Nobbe (2010).

Sustainability of gold mining projects is hard to achieve among the countries where the resource is mined, as more often extractors compete to gain from this activity with less concern on its availability in future, Doc (2011). Focusing on sustainability of gold mines in the rural areas in Australia, Zacky (2010) indicated that long term realization of the benefits of gold mining is a function of use of appropriate technology, availability of resources, socio cultural issues and environmental factors.

According to Rrenno (2012), gold mining projects are popular in Venezuela, but currently facing serious challenges of sustainability, as continuous exploitation continues, yet none has raised the question of how to make this commodity available for future generation. He attributes

sustainability of these projects to use of modern technology, cultural factors as well as the physical environment.

In the view of, Isobel (2009), mining is a localized activity, on which many communities and regions depend. Mining itself depends fundamentally on the presence of the gift of nature-a mineral deposit. It can persist, sometimes for decades, in a community or region through continued development of new mineral reserves during mining. Furthermore, Antony (2007) states that, it can persist even after the physical quality of deposits declines, for example, size, grade, metallurgical quality, because of advantages given to a community in the form of existing infrastructure and agglomeration economies. Nevertheless, a mineral deposit eventually is depleted.

World Banks Mining Report (2011) indicates that large-scale gold mining has a significant economic, social and environmental footprint and there is undoubtedly a complex interplay between gold mines and the communities/countries in which they operate. The report also added to the understanding of this interplay, showing that gold mining can bring benefits to people's lives. Much of the focus on the "resource curse" centers on the thesis that many developing countries suffer, rather than benefit from their natural resource riches.

Neary (2007) also points out that mining and mineral processing have the potential to be important sources of income and driving forces behind broader economic development. But this potential is not always realized. He highlights that; the mineral-dependent nations include some of the poorest and worst performing economies in the world due to lack of proper strategies of sustainable mining. However, Kumar (2006) observes that, natural resources when managed well

and with transparency, can lead to accelerated, sustainable economic and social development for producer countries and their local communities.

Reporting from a survey undertaken in South Africa based on factors influencing sustainability of the mining industry, Zona (2011) stated that this industry was facing numerous challenges, as even people with little or no knowledge of resource management were fully involved in the mining activities, focusing on immediate gains and rarely on long term benefits to posterity. He outlines that sustainability of mining industry anchors on environmental attributes, use of appropriate technology and socioeconomic factors.

According to Monako (2011), working with the communities of gold miners in Congo, sustainability of a project is based on availability of sufficient resources, presence of technical competencies in use of machines and the collective consciousness of people involved. He further observes that the presence of natural resources may not automatically indicate prosperity to a nation, but due to competition for the resources, conflicts are abounded and this explains the reason behind the prevalence of conflicts in most mineral- rich communities in Africa.

In the views of Bamako (2010), conducting a survey on sustainability status of the copper mining in Tanzania, insufficient resources to invest in the mining industry compels the mining community to adopt use of ineffective techniques that lead to depletion of the resources, thereby failing sustainability test. Moreover, environmental factors play pivotal role, as well as the cultural fabrics of the mining community on the extent to which these resources are made available for now and future.

In Sudan, mining of oil has been associated with endless conflicts that over time have driven a wedge among the various communities creating divisions even on religious grounds as a result of competition to control exploitation of the resource, Kiir (2012). He notes that this wanton exploitation of oil deposits in the African communities with no focus on sustainability will give rise to serious competition, which in turn will spell a recipe for continuous conflicts.

In Kenya, just like elsewhere in the world, the mining industry stretching from quarry, fluorspar, soda ash, gold and even sand harvesting has not been sustainable, since the immediate need for obtaining survival has often been the driving force among the mining communities, Agot (2012). According to Shakala (2011), mining of Titanium in Kwale may not be sustainable as it demands a lot of financial resources to be invested in the industry, sophisticated technological equipment for mineral exploration and extraction and a great concern for environmental components supporting the initiative.

In Migori County, gold mining is a major economic activity in places such as Makalda, Karungu and Rongo, yet these resources are being extracted without any serious consideration on measures of sustainability, so that the future generation may also enjoy the benefits, Okal (2010). A central question raised in past studies is how gold mining projects can be improved and made sustainable, so that these resources will benefit all stakeholders – state, citizens, resource company, workers and local communities – in a way which is perceived as ‘fair’ by the present and future generation and which also contributes to poverty reduction aimed at achieving economic development, Adalo (2013). In the light of the concerns raised, this study sought to investigate factors influencing sustainability of gold mining projects in Rongo Sub County, in Migori County.

1.2 Statement of the problem

Gold mining being one of the land use activities in Rongo Sub County has been going on for many years, leading to deforestation ,a substantial loss of farmland, and widespread spill-over effects as farmland are transformed into mining sites. This is with the main aim of generating income to supplement the earnings from sugarcane farming which is the main economic activity in the region, Koriko (2013).

However, sustainability of gold mining projects in the region remains a major concern among scholars and development agencies since there is no appropriate regional linkages and in turn the sustainability of regional economies as a mine inevitably declines, inappropriate compensation for non-market costs borne by mining regions, primarily environmental and social costs, insufficient sharing of the benefits with mining regions, absence of regional representation and involvement in decision making, Yoto (2012). In other words, mining regions within Rongo Sub County often bear a disproportionate share of the costs of mine development for which they are not compensated adequately, receive an inappropriately small share of the net benefits, and do not participate adequately in decision making.

According to Rongo Sub County Department of Natural Resources Report (2013), Communities from and within these regions have not fully appreciated the impact of gold mining projects on their social and economic status and instead associate it with poverty, and that these projects have failed to be sustainable. This study therefore sought to investigate factors influencing sustainability of gold mining projects in Rongo Sub County.

1.3 Purpose of the study

The purpose of this study was sought to investigate factors influencing sustainability of gold mining projects in Rongo Sub County Migori County.

1.4 Objectives of the study

This study was guided by the following objectives;

- 1) To establish the influence of technology on sustainability of gold mining projects in Rongo Sub County.
- 2) To evaluate how economic issues influence sustainability of gold mining projects in Rongo Sub County.
- 3) To assess the influence of environmental factors on sustainability of gold mining projects in Rongo Sub County.
- 4) To determine the extent to which socio-cultural factors influence sustainability of gold mining projects in Rongo Sub County.

1.5 Research Question

The study was geared towards answering the following research questions;

- 1) To what extent does technology influence sustainability of gold mining projects in Rongo Sub County?
- 2) How do economic issues influence sustainability of gold mining Projects in Rongo Sub County?

- 3) How do environmental factors influence sustainability of gold mining projects in Rongo Sub County?
- 4) What influence do socio cultural factors have on sustainability of gold mining projects in Rongo Sub County?

1.6 Significance of the study

The study would be significant to the local community since they would be able to understand and appreciate the factors influencing sustainability of gold mining projects and seek ways to economically exploit the endowed natural resources for sustainability. It would also be of great importance to the government of Kenya through the Ministry of Mining as relevant information would be availed on right policies and proper legal framework to put in place to make gold mining projects sustainable. Background information from the study would be available to research organizations and scholars interested in carrying out further research in this area.

1.7 Limitations of the study

The study was limited by a number of factors, ranging from unwillingness of some respondents in providing full information for unknown suspicions and fear of the project being undertaken by a private developer. However the researcher explained to the respondents the aim of the study that was purely academic and that any information obtained would be treated with utmost confidentiality.

Being conducted in Rongo Sub County during long rains, weather phenomenon greatly posed difficulties in accessing the respondents at the mines since less mining activities occur during

such weather. However proper timing was done to ensure that the research was carried out when mining was at the peak.

1.8 Delimitations of the study

The study was restricted to factors influencing sustainability of gold mining projects in Rongo Sub County, Migori County. It focused on all the gold mining community comprising of the miners and general workers, Rongo Sub County department of natural resources personnel, traders in gold and other key stakeholders in the gold mining sites in the Sub County.

1.9 Basic assumptions of the study

The study was grounded on the basic assumptions that the data collection instruments would be valid and reliable in taking the desired measures, the study sample drawn would be representative of the target population in its major characteristics and that the respondents would be willing to give information honestly and objectively.

1.10 Definition of significant terms used in the study

Sustainability: the ability of current generations to meet their needs without compromising the ability of future generations meeting their needs.

Gold mining projects: development interventions that involve exploration, extraction and sale of gold as the final products.

Technological factors: use of modern technological equipment in the exploration, extraction and processing of gold products.

Economic factors: related to resources that are invested in the gold mining projects, such as acquisition of mining implements and other mining logistics.

Environmental factors: gold mining projects are implemented within the confines of the physical environment.

Socio cultural factors: aspects of the social organisation of the people on the basis of their belief systems.

1.11 Organization of the study

The study is organized into five chapters. Chapter one features, background of the study, statement of the problem, purpose of the study and objectives of the study. Also included in this chapter are research questions, significance of the study and limitations of the study. Moreover, chapter one also outlines basic assumptions of the study, delimitations of the study, definition of significant terms used in the study and organization of the study.

Chapter two highlights literature review done against the study variables, theoretical framework, conceptual framework and summary of the literature review. Chapter three captures research methodology used, the research design, target population, sample size and sample selection. Besides, it also presents data collection instruments, piloting, validity of the instruments and instruments' reliability. In addition, it also outlines methods of data collection, procedures for data collection, methods of data analysis, operationalization of the variables and ethical considerations in research. Chapter four puts to focus data analysis, presentation, interpretation and discussions, with chapter five featuring summary of findings, conclusions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

In this chapter, literature, which is related to and consistent with the objectives of the study, is reviewed. Important theoretical and practical problems are brought out; relevant literature on the aspects pertaining to sustainability of gold mining projects globally, internationally, nationally, regionally and locally are discussed. It also puts to perspective the theoretical framework and the conceptual framework of the study.

2.2. The concept of sustainability of gold mining projects.

Sustainability of gold mining projects is hard to achieve among the countries where the resource is mined, as more often extractors compete to gain from this activity with less concern on its availability in future, Doc (2011). Focusing on sustainability of gold mines in the rural areas in Australia, Zacky (2010) indicated that long term realization of the benefits of gold mining is a function of use of appropriate technology, availability of resources, socio cultural issues and environmental factors.

According to Rrenno (2012), gold mining projects are popular in Venezuela, but currently facing serious challenges of sustainability, as continuous exploitation continues, yet none has raised the question of how to make this commodity available for future generation. He attributes sustainability of these projects to use of modern technology, cultural factors as well as the physical environment.

In the view of, Isobel (2009), mining is a localized activity, on which many communities and regions depend. Mining itself depends fundamentally on the presence of the gift of nature-a mineral deposit. It can persist, sometimes for decades, in a community or region through continued development of new mineral reserves during mining. Furthermore, Antony (2007) states that, it can persist even after the physical quality of deposits declines, for example, size, grade, metallurgical quality, because of advantages given to a community in the form of existing infrastructure and agglomeration economies. Nevertheless, a mineral deposit eventually is depleted.

World Banks Mining Report (2011) indicates that large-scale gold mining has a significant economic, social and environmental footprint and there is undoubtedly a complex interplay between gold mines and the communities/countries in which they operate. The report also added to the understanding of this interplay, showing that gold mining can bring benefits to people's lives. Much of the focus on the "resource curse" centers on the thesis that many developing countries suffer, rather than benefit from their natural resource riches.

Neary (2007) also points out that mining and mineral processing have the potential to be important sources of income and driving forces behind broader economic development. But this potential is not always realized. He highlights that; the mineral-dependent nations include some of the poorest and worst performing economies in the world due to lack of proper strategies of sustainable mining. However, Kumar (2006) observes that, natural resources when managed well and with transparency, can lead to accelerated, sustainable economic and social development for producer countries and their local communities.

Reporting from a survey undertaken in South Africa based on factors influencing sustainability of the mining industry, Zona (2011) stated that this industry was facing numerous challenges, as even people with little or no knowledge of resource management were fully involved in the mining activities, focusing on immediate gains and rarely on long term benefits to posterity. He outlines that sustainability of mining industry anchors on environmental attributes, use of appropriate technology and socioeconomic factors.

According to Monako (2011), working with the communities of gold miners in Congo, sustainability of a project is based on availability of sufficient resources, presence of technical competencies in use of machines and the collective consciousness of people involved. He further observes that the presence of natural resources may not automatically indicate prosperity to a nation, but due to competition for the resources, conflicts are abounded and this explains the reason behind the prevalence of conflicts in most mineral- rich communities in Africa.

In the views of Bamako (2010), conducting a survey on sustainability status of the copper mining in Tanzania, insufficient resources to invest in the mining industry compels the mining community to adopt use of ineffective techniques that lead to depletion of the resources, thereby failing sustainability test. Moreover, environmental factors play pivotal role, as well as the cultural fabrics of the mining community on the extent to which these resources are made available for now and future.

In Sudan, mining of oil has been associated with endless conflicts that over time have driven a wedge among the various communities creating divisions even on religious grounds as a result of competition to control exploitation of the resource, Kiir (2012). He notes that this wanton

exploitation of oil deposits in the African communities with no focus on sustainability will give rise to serious competition, which in turn will spell a recipe for continuous conflicts.

In Kenya, just like elsewhere in the world, the mining industry stretching from quarry, fluorspar, soda ash, gold and even sand harvesting has not been sustainable, since the immediate need for obtaining survival has often been the driving force among the mining communities, Agot (2012). According to Shakala (2011), mining of Titanium in Kwale may not be sustainable as it demands a lot of financial resources to be invested in the industry, sophisticated technological equipment for mineral exploration and extraction and a great concern for environmental components supporting the initiative.

In Migori County, gold mining is a major economic activity in places such as Makalda, Karungu and Rongo, yet these resources are being extracted without any serious consideration on measures of sustainability, so that the future generation may also enjoy the benefits, Okal (2010). A central question raised in past studies is how gold mining projects can be improved and made sustainable, so that these resources will benefit all stakeholders – state, citizens, resource company, workers and local communities – in a way which is perceived as ‘fair’ by the present and future generation and which also contributes to poverty reduction aimed at achieving economic development, Adalo (2013).

2.3. Influence of Technology on sustainability of gold mining projects

In nature minerals of interest exist physically and chemically combined with the host rock. Removal of the unwanted gangue to increase the concentration of mineral in an economically viable manner is the basic of mineral processing operations. Each unit process and its operation

are therefore treated separately, Arees (2010). The greatest challenge to a mineral processor is to produce high grade concentrates consistent at maximum recovery from the ore body. To quantify recovery a reasonable idea of the initial concentration of gold in a lode is required. Proper sampling representing the ore body is therefore essential.

According to Donn (2009) there is need for the proper techniques of sampling of ore followed by the design and operation of unit processes that help to release the mineral from the associated rocks. Separation and concentration processes using techniques involving screening, classification, solid – liquid separations, gravity separation and flotation then follow. These techniques are inadequate hence a hindrance to sustainability of gold mining projects.

According Buchanan (2010), the difficulty of successfully implementing new technologies into mines has been experienced by most mining companies worldwide. It is not just an African problem, but one which has been tackled brother countries and operators, who have be enable to develop methodologies for technology transfer and implementation which can be used in developing countries. It is widely recognized that technology has a vital role to play in the development and application of new mining methods, which will improve safety, health, and operational effectiveness in the mines leading to their sustainability.

The riffles are designed to create dead zones in the current to allow gold to drop out of suspension. The box is placed in the stream to channel water flow. Gold-bearing material is placed at the top of the box. The material is carried by the current through the volt where gold and other dense material settles out behind the riffles. Less dense material flows out of the box as tailings, Meri (2009).

Kotter (2006), notes that many attempts have been made in recent years to introduce new technologies into mining operations in developing countries. Amongst these are noteworthy successes, as well as some disappointing failures. Often, the reason for failure does not lie with the technology itself, but with the work system into which the technology is introduced. Such failures may come with a significant opportunity cost, and have a detrimental effect on future development, simply because the system has not been adequately engineered, and the risks have not been adequately assessed and managed. Technology initiatives have often failed because the technology was not appropriate for the work system into which it was introduced: perhaps it was too technically advanced for the level of skill available, or it may have required too radical a change in the way work is done.

Stope drill rigs have been introduced into the mining environment with limited success, despite clearly quantifiable advantages and benefits, Tarr et al (2006). This has been due to factors such as: resistance to change and unnecessarily complex technology application of new mining methods. Out of the low level of training, the unskilled job content, and large numbers required underground—if not for survival at the lower end of the cost curve, then at least to reduce the exposure of men to underground conditions. Richard (2000) points out that trials have often been singularly successful, but implementation has been limited, often dwindling to a return to tried and trusted means. Electronic delay detonation technology has taken time to become accepted. The initially high capital cost and operating cost of the units were seen by management as excessive compared to conventional systems.

Ownership and involvement of operators of mechanized and automated mining equipment from the early stages of design is considered by Pukkila (2011) as key towards achieving

sustainability. At Boulby Mine, for example, operators and maintenance staff were involved from the beginning in the development of auger boring technology. They had a clear understanding of the purpose of the development, and the impact of the technology on the success of the mine, and contributed positively by participating in the ergonomic design of the machinery, with management and the supplier of the equipment. The prototype machine was welcomed onto site because of the ownership created by this approach.

For sustainable gold mining projects, Dasys (2012) shows that technology being introduced must be appropriate to the level of development of the work system adequately engineered with a work force involved in every step of the way in its design and implementation. In addition, Malherbe (2011) also indicates that a new technology must develop a clear objective which is identifiable in terms of documented and quantifiable bottom line benefits and mechanisms for sharing experience.

2.4. Influence of Economic Issues on sustainability of gold mining projects.

In the perception of Pukkila (2011), for sustainability of gold mining projects, mining should be efficient, equitable and predictable. efficient in the sense that the process results in appropriate public participation at lowest cost in terms of time and expense; equitable in that the process gives each interested party to mineral development, owners as well as other community members, an appropriate opportunity to be heard; and predictable in that the process itself is understood by all parties.

On predictability, it is not that the outcome of the process should be predictable, in the sense that a mining company would know beforehand whether its proposed mining project would be approved; rather that the process through which approval is requested is understood and

predictable. According to Jamer (2010), mining is an economic venture like any other business operation or industrial activity and heavily requires financial investment to execute the various activities in the mining sites. This means that low income miners, unlikely to access funds from financial institutions often face economic challenges in their daily mining operations.

The excavation, transport, and management of waste rock present a significant cost. The ratio of waste rock to ore, especially for open cut mines, can often be a critical element of economic mine planning. Further to this, waste rock dumps cover a significant area and therefore require major costs in rehabilitation. If future environmental requirements specify the backfill of mined out open cuts, it is critical to know the mass or volume of waste rock for good engineering design of rehabilitation measures, Tarr et al (2006).

Mine infrastructure often requires the use of waste rock overburden during mine construction or operation, especially as tailings dams. Failure to adequately predict the extent of waste rock and its necessary characteristics (strength, density and the like), may prove costly in the re-design of tailings dams, or even lead to a delay in mine development, Pukkila (2011).

The benefits from gold mining, such as monetary profits, are not always distributed fairly between a mining company, governments and local affected communities. As such, there can be a common perception that the risks and benefits are skewed, with the communities who will commonly have to bear the long term risks not sharing sufficiently in the benefits during and after mining.

In the views of Komm (2009), usually, small-scale miners find it difficult to access loans from private finance institutions because of lack of trust and accountability in the sector. This especially applies for female miners and of course for the informal sector. It is almost impossible to get loans for working capital. Unfortunately, doubts about the ability and willingness of small-

scale miners to pay back their loans are in many cases not baseless. Small-scale miners are by nature extremely mobile and therefore are prone to appear and disappear from one mining locality to another very rapidly.

According to Maureen (2011), assessing a mine's impact on local and regional economic development is powerfully aided by a careful examination of the mine's full social benefits and costs, since even where the long-term effects of mining on economic development are positive, this long-term gain comes at the cost of short-term disruption and adjustment associated with booms and busts in the mining sector.

Economists have shown that heavy reliance on mining is not a good long-term national economic strategy (Foley and DeFries 2005). For the most part, mineral-rich developing countries have some of the slowest growth rates in the world, and the highest poverty rates—a phenomenon economists call "the resource curse." Harvard economists Jeffrey Sachs and Andrew Warner studied 95 developing countries that were minerals exporters for the period 1970 to 1990. They found that the higher the dependence on natural resource exports, the slower the per capita growth.

The fast, easy revenues brought in to countries through gold mining frequently crowd out investment for other, more diverse and labour-intensive sectors such as agriculture and manufacturing. With many countries simply exporting the raw metals, they lose out on opportunity to add value by creating finished products, which would provide more jobs and revenue (Adjei, E. 2007). yet another shortcoming is the industry's employment record. Mining

is no longer a strong generator of jobs. The formal sector employs just 2.75 million people-just 0.09 percent of the global workforce-and that number is in rapid decline.

2.5.Influence of Environmental factors on sustainability of Gold mining projects

Minerals are a non-renewable resource, which means they can only be taken out of the ground at one time. Once mineral deposits have been depleted, the aftermath of a large-scale mining operation is typically a landscape of devastation: Thousands of hectares of poisoned, rubble-strewn land drained by acidic streams that will likely remain polluted for thousands of years to come, Carol (2008).

In many developing countries, the companies that have enriched themselves through this destruction are not held accountable for mitigating it. Some wealthier countries such as the United States attempt to avoid this end game by requiring (at least on paper) that the mining company set aside a certain amount of money upfront to cover these inevitable expenses for water treatment, reinforcing liners for tailings holding ponds, and other measures, Velma (2007). However, such financial insurance policies have fallen woefully short of what it costs to begin to reclaim these mine sites, some of which are among the world's most contaminated places. Mining companies in the United States have underestimated the costs of closing their operations by as much as \$12 billion, according to a 2003 estimate by the Mineral Policy Cente. When that happens, taxpayers have to step in to pick up the tab, Betty (2009).

Mining and processing of mineral resource may have a considerable impact on the land water and biological resources, Nyambok (2005), thereby having a great influence on its sustainability. Mining gold from the earth can have grave environmental implications since large swaths of land

must be destroyed for a relatively small portion of gold. Elis and Ramankutty (2008) consider gold mining as a destructive activity to the natural environment around mines, it creates waste rock disposal problems, and uses harsh chemicals which can be significant sources of waste and harm to workers and nature.

Moving much earth doesn't just require a lot of energy. It can also lead to toxic mine drainage, probably the biggest environmental concern associated with gold-mining. When rock that has been buried for a long time is dug, air and moisture can set off chemical reactions that produce acids and leach toxic metals. Sulfuric acid, arsenic and copper, for example, run off into lakes, rivers and streams, they pose serious risks for populations of fish and other aquatic organisms. Mine drainage is a problem for many kinds of operations, but it's especially significant for gold extraction. For one thing, gold is often found in rock that contains a lot of acid-generating sulfides; for another, mining gold produces much more unwanted rock than does mining other minerals.

In the view of Down (2008), chemicals used in gold mining pose great threat to the environment and people using them. For example; Small concentrations in rock containing gold is dissolved using cyanide. The large quantities of cyanide necessary to extract gold often end up in the environment. Cyanide is highly toxic to humans and wildlife, with amounts smaller than a grain of rice being enough to kill a human. Mercury is also often used to amalgamate with the metal. The gold is produced by boiling away the mercury from the amalgam, a hazardous process due to toxicity of mercury vapour.

According to International Labour Organization Report (2006), mercury can be absorbed through the skin or inhalation of its vapour. Prolonged exposure to mercury can lead to serious physical

disorders and neurological problems since informal gold miners often do not wear protective clothing (e.g. hardhats) or know correct methods for digging tunnels and using explosives (Seeping into the soil or water supply, it can contaminate food and drinking water leading to both human and animals' deaths. Finally, mines that have long been abandoned can continue poisoning the environment around them as water washes out toxic chemicals and minerals, Nyambok (2005)

According to Melin (2010), Gold mining produces substantial air pollution. Many gold mines are open-air pits. Dust is produced during excavation, which can be harmful to people living in the vicinity. Fumes from the toxic chemicals used in the extraction process; mix with vehicle exhaust from the cars and heavy machinery producing dense, polluted air. Off-site, most gold is sent to a processing plant to undergo smelting, a process by which the gold is melted down to eliminate impurities. These smelting facilities produce massive amounts of air pollution. Acid mine drainage which occurs when water, either from rain or underground springs, washes through a mine, drains into the ecosystem, bringing along toxic chemicals dormant in the mine.

Gold is typically contained in sulfur rich rock, which when brought to the surface may contribute to acid rain. These acids leach through rock piles and liberate other hard metals, such as cadmium, lead, arsenic and mercury. Leach out finds its way into the water table, creating ecosystem problems.

In the context of mining, the definitions of sustainable gold mining vary widely, however, generally along the lines of whether a civic, environmental, government or industry perspective is advocated. This is taken to include the availability of resources and a productive environment at former mining or milling sites. It is clear that gold mining operations need to consider

sustainable development, especially since the legacy of gold mining can resonate for some hundreds of years, Burret (2009).

Monna (2011) states that “although gold mining has historically been an environmentally damaging enterprise, recent advancements in technology and industry standards are helping to mitigate the damage. Smelting plants, as is the case with many factories in the United States, are becoming cleaner and holding to higher emissions standards. Measures are being taken by mining companies to prevent acid mine drainage, such as checking the levels of dangerous minerals in the ground before drilling. However, cyanide is still the industry standard for extraction because an effective replacement hasn't been found.

It is argued that the process of gold mining is inextricably linked to economic and social issues such as land use, giving rise to more exploration as prices rise due to perceptions of potential supply shortages as demand grows. Commonly, the view that mineral resources are finite is rejected by the mining industry due to this continuing cycle of the discovery of new deposits, new technology and the desire to continue meeting rising demand, Tilton (2003).

The industry is now changing to promote sustainability and environmental best practices, and consumer groups now exist to inform the public about the decision to buy "clean" gold. However this is not yet been implemented in Kenya hence a hindrance to the sustainability of gold mining projects.

2.6. Influence of Social-cultural factors on sustainability of gold mining projects.

Kenya, famous for its natural beauty and wildlife, is a country which remains subject to limited commercial exploitation of its wealth in minerals (Brown LLP, 2013). The mining industry in Kenya lags significantly behind its bordering neighbours with whom it shares a number of

known mineral belts; particularly Tanzania to the south. 70-80% of mining is done by small-scale to artisan miners. The current mineral exploitation is dominated by non-metallic minerals such as fluorite, soda ash, gypsum, vermiculite, limestone, a variety of gemstones, ornamental and constructional stones including sand harvesting.

Historically Kenya had focused on developing farming, tourism, manufacturing and service industries. Until recent years, mining exports only amounted to around 1 per cent of the GDP. The main mining operations under small-scale include gemstone mining at the Coast region, gypsum mining at Kajiado and alluvial gold mining in western and northern Kenya, Osumo (2011).

Socio cultural factors embody those aspects of collective consciousness of the entire community on the basis of shared cultural heritage that dictate the type of activities any given community embrace, Dolly (2010). In the light of this reality, economic activities engaged in by members of a community, more often, are those approved on the common front. According to World Resource Organization (2007), it was established that in recent years, resource extraction companies have seen development projects evaporate as communities have found the capacity and the will to oppose and shut down operations. Mining and energy companies have lost billions of invested dollars, had their reputations dragged through the mud, and watched in horror as share prices tumbled.

According to Monally (2010), sustainability of gold mining projects is a participatory process that creates and pursues a vision of community that respects and makes prudent use of all its resources - natural, human, human-created, social, cultural, and scientific. Sustainability seeks to ensure, to the degree possible, that present generations attain a high degree of economic security

and can realize democracy and popular participation in control of their communities, while maintaining the integrity of the ecological systems upon which all life and all production depends, and while assuming responsibility to future generations to provide them with the visions, hoping that they have the wisdom and intelligence to use what is provided in an appropriate manner.

To secure project access and ensure that invested assets eventually see a return, leading companies recognize the need for community consultation and the delivery of tangible benefits to impacted communities. At the cutting edge, companies are acknowledging the need for securing the free, prior, and informed consent (FPIC) of affected communities. Supported by recent developments in law and in industry guidelines, FPIC is emerging as the standard for Indigenous communities—and a guideline companies should progress toward for all communities impacted by minerals and energy, Monna (2011).

Gold mining companies have become increasingly familiar with the benefits of engaging communities prior to and during project construction. Informal consultations between individual project managers and the heads of local communities have been replaced by procedures for systematically consulting communities. The stereotypical hard-driving mine manager operating without guidance or standards has been replaced by board-endorsed corporate policies, codified stakeholder consultation procedures, effective training, and the hiring of experienced consultation specialists, Melin (2010).

Furthermore, recognizing the legacy of the past, leading companies have been able to put together impact and benefit agreements (IBAs) in performance with communities. Though in many cases these IBAs are less than two decades old, the results to date look promising. IBAs

generally provide for employment, economic development, business opportunities, environmental protection, and in some cases, equity positions for impacted communities.

The field of stakeholder consultation even has its own standard: the AA1000 Stakeholder Engagement Standard is a principles-based framework for designing, implementing, assessing, communicating, and assuring the quality of the stakeholder engagement process. These practices represent a positive evolution in both mining and oil and gas development. But, in many cases, they aren't enough.

2.7.Theoretical framework of the study

According to Tromp and Kombo (2002), theoretical framework refers to a collection of interrelated ideas based on theories attempting to clarify why things are the way they are based on theories, introducing new view of the research problem, allowing understanding realm of the problem, helping conceptualize the topic in its entirety and to acknowledge the problem from a wider perspective for objectivity. According to Mugenda & Mugenda (2003), in many fields, theories and propositions about concepts and relationships have been formulated. In such fields, the researcher may be interested in ascertaining or testing a particular theory.

This study was grounded on Sustainable development theory by Hoolly Johns (1976). This theory holds that sustainable development of any initiative is based on ownership, participation, skills transfer and a cultural change attitude. To secure project access and ensure that invested assets eventually see a return, leading companies recognize the need for community consultation and the delivery of tangible benefits to impacted communities. At the cutting edge, companies

are acknowledging the need for securing the free, prior, and informed consent of affected communities.

Gold mining companies have become increasingly familiar with the benefits of engaging communities prior to and during project construction. Informal consultations between individual project managers and the heads of local communities have been replaced by procedures for systematically consulting communities. The stereotypical hard-driving mine manager operating without guidance or standards has been replaced by board-endorsed corporate policies, codified stakeholder consultation procedures, effective training, and the hiring of experienced consultation specialists.

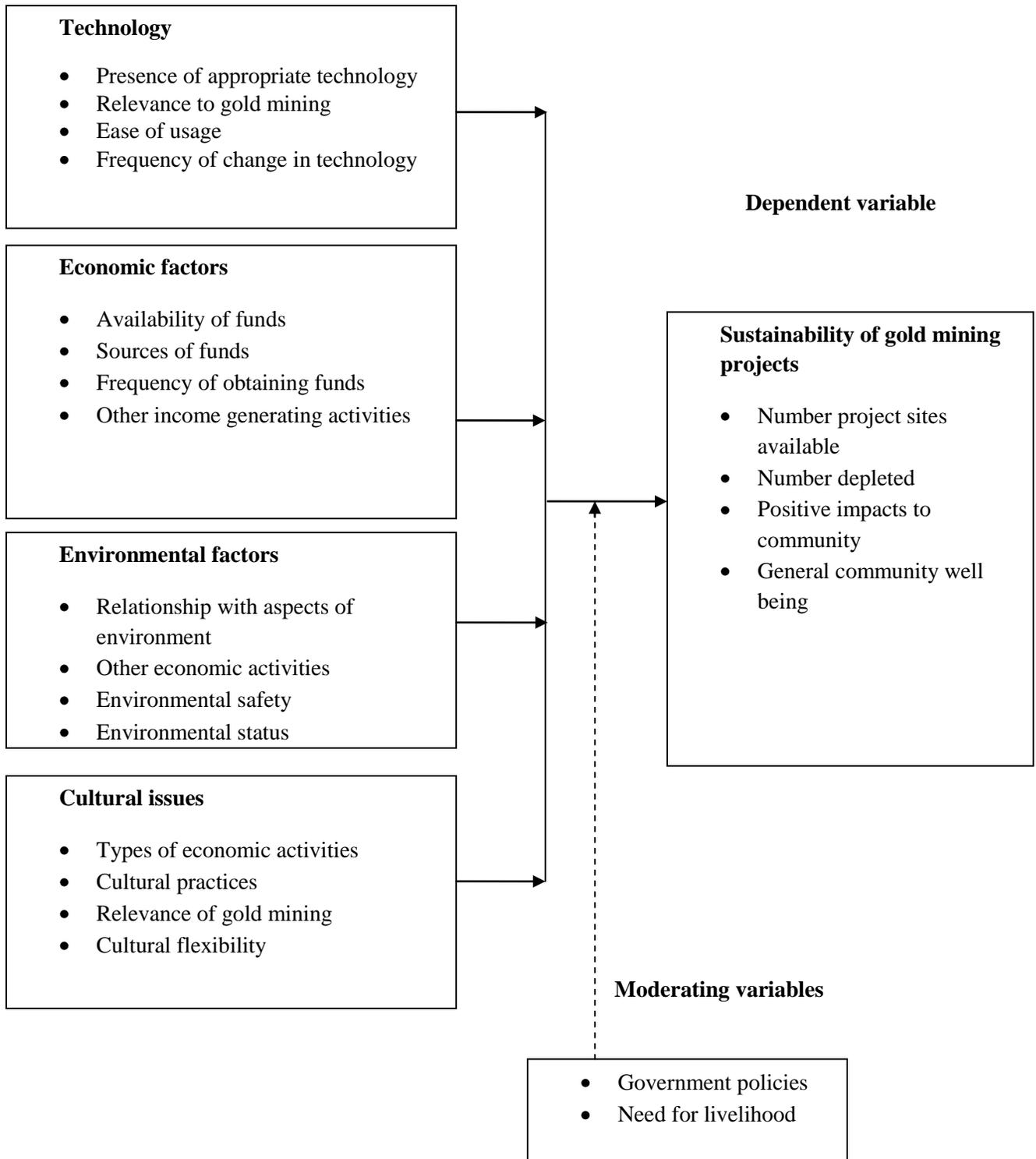
This theory was considered suitable since the study was based on factors influencing sustainability of gold mining projects in Rongo Sub County, in which the key elements of this theory support. In order to realize sustainability of a project, transfer of skills is critical and so are the peoples feeling of ownership and community participation.

2.8. Conceptual Framework of the study

A conceptual framework can be defined as a set of broad ideas and principles taken from relevant fields of inquiry and used to structure a subsequent presentation, Kothari (2005). In this study, sustainability of gold mining projects, which is the dependent variable, was perceived to depend mainly on technology applied, economic factors, environmental issues; and socio-cultural beliefs of the local community. This relationship is illustrated in table 2.1.

Figure 2.1 Conceptual framework of the study

Independent variables



CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes aspects of the research methodology used in study. These features include, research design, target population, sample size and sampling selection. In addition, data collection instruments, instrument's pretesting, instrument's validity and instrument's reliability are also featured. Besides, data collection procedures, methods of data analysis, operationalization of the variables and ethical considerations are also presented.

3.2 Research Design

Research design is the blueprint that enables the investigator to come up with solutions to problems and guidelines in the various stages of the research Nachmias and Nachamias (2004). According to Kothari (2005), a research design is the arrangement of conditions for collection and analysis of data in a manner that aims to combine relevance to research purpose with economy in procedure. It is the conceptual framework within which research is conducted.

The study adopted a descriptive survey research design. A survey is an attempt to collect data from members of the population in order to determine the correct status of that population with respect to one or more variables. Besides, a survey research design is probably the best method available to social scientists and other educators who are interested in collecting original data for purposes of describing a population Mugenda and Mugenda (2003).

Given that this study was descriptive in nature, geographically spread over a wide geographical area and sought to investigate factors influencing sustainability of gold mining projects, a descriptive survey research design was considered most appropriate.

3.3 Target Population

A population is defined as a complete set of individuals, cases or objects with some common observable characteristics Mugenda and Mugenda (2003). Target population refers to the entire group of individuals or objects from which the study seeks to generalize its findings, Cooper and Schindler (2008).

In this study the target population, based on registration of Gold Mining Sites Record (2013) available at the department of Natural Resources Office Migori County indicates that there are 10 mining sites with 1384 miners in Rongo Sub County.

3.4. Sample size and sample selection

3.4.1. Sample Size

A sample is defined as a subset of a target population, Mugenda and Mugenda(2003). Sampling on the other hand is that part of statistical practice concerned with the selection of an unbiased or random subset of individual observations within a population of individuals intended to yield some knowledge about the population of interest, especially for the purposes of making fair generalization of results back to the population from which they were chosen, Kothari (2005).

Gay in Mugenda and Mugenda (2003) suggests that for correlation studies 30 cases or more is required; for descriptive studies, ten percent of the target population is enough and for experimental studies, at least 30 cases are required per group. This study, being descriptive, a

sample size of ten percent of target population was used, giving a sample size of 138 respondents.

3.4.2. Sample Selection

Owing to the fact that this study was quantitative in nature, it employed a probability sampling design to ensure high objectivity in sample selection is achieved by giving each item in the target population equal chances of being selected and included in the final sample drawn. Stratified random sampling technique was therefore used in by dividing the target population into groups on the basis of each mining site in the sub county.

3.5 Data collection instruments

The study being descriptive in its major characteristics, coupled with the fact that the sample size was relatively large, self-completion questionnaire, involving both open-ended and closed-ended questions was used for gathering data. Open-ended questions focused on giving in-depth answers providing more details on the study aspects, while closed-ended questions were meant to keep the respondents on tract and to the point. According to Cooper and Emory (2008), a self-completion questionnaire is convenient as respondents could fill them during free time or when workloads are manageable besides it is cheaper and quicker to administer.

3.5.1. Instruments pretesting

Piloting is a preliminary study conducted on a small scale to establish the effectiveness of the data collection instruments and it should be 1%- 10% of the study sample size, Mugenda and Mugenda (2003). In this study, a pretest sample of 10% of the sample size was used, giving 14 respondents. It was conducted in order to ascertain and detect any ambiguities, questions that

were not easily understood or poorly constructed and even those that were irrelevant. The results were therefore used to improve the questionnaire.

3.5.2 Instruments Validity

The validity of an instrument is the degree to which an instrument measures what it is intended to measure (Polit & Hungler 2001). Content validity refers to the extent to which an instrument represents the factors under study. To achieve content validity, questionnaires will mainly consist of questions on the variables. Content validity will further be ensured by consistency in administering the questionnaires. A measure of reliability and validity will also be guaranteed by discussion of the instrument with experts and research supervisor and by ensuring high precision and minimal errors in the data entry through training of the research assistants.

3.5.3. Instruments Reliability

Polit and Hungler (2001) refer to reliability as the degree of consistency with which an instrument measures the attribute it is designed to measure. Data collector bias was minimized by restricting the number of people administering the questionnaires, and standardizing conditions such as exhibiting similar characteristics to all respondents. In this study, a test retest reliability method was used, in which the instrument was administered twice to the same sample and the results compared using Pearsons product moment correlation of coefficient(r) and by obtaining an alpha value of 0.87, the data collection instrument was found to be highly reliable.

3.6. Data Collection Procedures

The research process commenced with the preparation of the research proposal, presented before the panel of assessors of the University of Nairobi, corrections effected and research permit

obtained from the National Council of Science and Technology. With the research permit, the researcher dispatched two research assistants for data collection, presenting the permit to all relevant authorities and the respondents as proof of authority to conduct research.

3.7 Methods of Data Analysis

Quantitative data, which was collected using closed ended questions in the questionnaire, were be chronologically arranged with respect to the questionnaire outline to ensure that the correct code was entered for the correct variable. Data cleaning was done and tabulated and analyzed with the aid of Statistical Package for Social Sciences (SPSS 21.0) which generated descriptive statistics such percentages and frequencies. Qualitative data was organized into a checklist which was clustered along the variables of the research study to ease consolidation of information and interpretation and then analyzed through content analysis. Content analysis is the process of analyzing verbal or written communications in a systematic way to measure variables qualitatively (Denzin & Lincoln, 2000). Analyzed information was subsequently presented using frequency distribution.

Table: 3.1: Operationalization Table.

Objectives	Variables	Indicators	Measurement scale	Data collection method	Data analysis
To evaluate the influence of technology on sustainability of gold mining projects Rongo Sub County.	Independent Technology Dependent Sustainability of gold mining projects	Project types Variety of projects Rate of increment.	Nominal	Questionnaire	Quantitative
To investigate the influence of economic issues on sustainability of gold mining projects in Rongo Sub County.	Independent Economic factors Dependent Sustainability of gold mining projects	-Availability of resources Types of resources Sources of the resources	Ratio	Questionnaire	Quantitative
To assess the extent to which	Independent Environmental	Degradation Depletion	Ordinal	Questionnaire	Quantitative

environmental factors influences sustainability of gold mining projects in Rongo Sub County.	issues Dependent Sustainability of gold mining projects	Pollution Effects on other environmentally related economic activities			
To examine the influence of sociocultural factors on sustainability of gold mining projects in Rongo Sub County	Independent Socio cultural factors Dependent Sustainability of gold mining projects	Type of practices Flexibility to change	Ordinal	Questionnaire	Quantitative

3.8. Ethical Considerations

According to David Resnik (2011), there are several reasons for adhering to ethical norms in research. Norms promote the aims of research, such as knowledge, falsifying or misrepresenting research data promote the truth and avoid error. William M.K (2006) lists some of the ethical

issues, as informed consent, confidentiality and anonymity. Given the importance of the ethical issues in several ways, the researcher did commit to acknowledging other scholars works through quotation and citation. In this study copyright and aspects of patenting were respected and a plagiarism of any form was strictly avoided.

In the entire research period, respondents' identity and confidentiality were observed such that, any data obtained was not disclosed to any other person. The researcher ensured that human subjects were fully protected, no harm, cruelty and coercion was used in the research process and the results, as promised, would be shared with those who did participate. In this study, there was no data forgery allowed, no coercion of respondents to offer data, as well as no form of undue influence used to obtain information as all respondents took part on voluntary basis.

CHAPTER FOUR

DATA ANALYSIS, INTERPRETATION, PRESENTATION AND DISCUSSION

4.1: Introduction

This chapter presents data analysis, interpretation, presentation and discussion. Data analysis was done against the background of the key study variables and their level of influence on sustainability of gold mining projects in Rongo Sub County.

4.2: Questionnaire Return Rate

According to Mugenda and Mugenda (2003), response rate refers to percentage subjects that respond to the research instrument. A response rate of 50% is deemed adequate for analysis and reporting, a response rate of 60% is good and a response rate of 70% and over is considered very good. One hundred and thirty eight (138) copies of questionnaire were administered to the respondents by the research assistants with close supervision of the researcher and 132 returned duly completed giving a response rate of 94.20% as illustrated in table 4.1

Table 4.1 Questionnaire Response Rate

Site	Number given	Returned	Response Rate
Nyaburu	20	20	100.00
Kopuodho	22	22	100.00
Ahero	19	19	100.00
Kisumu	26	20	76.92
Kambuya	25	25	100.00
Sakwa	26	26	100.00
Total	138	132	94.20

From table 4.1, it is revealed that, out of the 138 copies of the questionnaire administered to the respondents, 6 were not returned, while 132 were received back having been duly filled by the respondents, giving a response rate of 94.96%. In view of this, the study is considered to have returned an excellent questionnaire response rate.

4.3: Demographic Characteristics of the Respondents

This section discusses the respondent's demographic features that the researcher considered significant to the study. Such demographic characteristics include sex, age, level of education and marital status.

4.3.1 Characteristics of the Respondents by Age

As is usual with social sciences studies, the researcher assumed that differences in age of the respondents would have substantial significance to bear in the study, since age of an individual

influences engagement in different economic ventures. In view of this, the respondents were asked to complete the questionnaire stating their ages and their responses recorded as illustrated in table 4.2

Table 4.2 Age of the respondents

Age	Frequency	Percentage
20 and below	07	03.02
20-30	11	09.08
30-40	47	33.85
40-50	51	40.39
Above 50	16	13.66
Total	132	100.00

Table 4.2 indicates that of the 132 respondents who were engaged gold mining projects in Rongo Sub County, 07(03.02%) were 20 and below years, 11(09.08%) were 20-30 years, 47(33.85%) were 30-40 years, 51(40.39%)were 40-50 years and 16(13.66%) were above 50 years. Revealed by these figures is that majority of those who were engaged in gold mining projects in Rongo Sub County were in their middle and taken these activities as their main occupation for livelihood. However, in a more advanced age of 50 years and above, as well as in the tender ages below 20 years, these residents were remarkably few because of the dangers involved in gold mining, which occasionally lead to death when mine sites submerge.

4.3.2: Characteristics of Respondents by Gender

Gender issues are crucial in the determination of the individual's decision to enter into any economic activity, despite concerns about gender rules in public appointments, however, in gold mining projects; one would expect more men than women. In view of this phenomenon, the respondents were asked to complete the questionnaire indicating their gender and their responses noted as in table 4.3

Table 4.3 Gender of the Respondents

Sex	Frequency	Percentage
Male	108	84.24
Female	26	15.76
Total	132	100.00

Table 4.3 reveals that, of the 132 respondents who completed the questionnaire, 108(84.24%) of were male, while a paltry 26(15.76%) were female. This is indicative of the fact that gold mining, being a risky and more rewarding economic venture, is often a preserve of the male world.

4.3.3: Respondents' marital orientations

Marital orientation of an individual, to a great deal, is a determinant of engagement in certain occupations, and more often, adult responsibilities can always compel people to take up any engagement provided gains are promised. On the account of this, the respondents were asked to

complete the questionnaire showing their marital orientations and Table 4.4 illustrates their responses.

Table 4.4 Respondents’ marital orientations

Marital orientation	Frequency	Percentage
Single	05	03.04
Married	87	66.58
Widowed	15	10.62
Divorced	13	10.01
Other	12	10.61
Total	132	100.00

Table 4.4, shows that of the 132 gold mining residents in Rongo Sub County who participated in the study, 05(03.04%) were single, 87(66.58%) were married, 15(10.62%) were widowed, 13(10.01%) were divorced and 12(10.61%) of indicated other marital orientations. This indicates that gold mining draws married people with responsibilities of providing for their families and hence considered a full time occupation, yet these resources get depleted raising questions about their sustainability.

4.3.4: Respondents level of education

Education is an endeavor that equips individuals with knowledge, skills and desirable attitudes necessary for obtaining means of survival in the society. Level of education therefore determines the nature of activities, with simple ventures demanding less education than sophisticated ones.

In consideration of this reality, the respondents were asked to complete the questionnaire indicating their level of education and their responses taken as depicted in table 4.5.

Table 4.5: Respondents level of education

Level of education	Frequency	Percentage
Primary	42	32.63
Secondary	64	48.45
Tertiary	12	11.32
University	00	00.00
Other	14	10.60
Total	132	100.00

It is revealed in table 4.5 that majority of the respondents engaged in gold mining projects in Rongo Sub County 64(48.45%) had secondary school education, 42(32.63%) had primary school level education, 12(11.32%) had tertiary level education, with none having identified with university level education and 14(10.60%) stated the other category. Implied is that the gold mining projects, being technological in nature, requires skilled personnel to manipulate the mining machinery, yet such educated lot were missing in these ventures. It is therefore tempting to hold the view that these projects, implemented by people with low levels of education, are bound to fail sustainability test.

4.3.5: Length of time in the gold mining projects

Through regular interaction with the rudiments of an activity and people from diverse backgrounds, one tends to acquire certain experiences that enrich execution of tasks. In this context, even in the gold mining projects, accumulated experience obtained over time can often enrich the mining activities. In the light of this consideration, the respondents were asked to fill the questionnaire stating the length of time they had been in the projects in Rongo Sub County and their response captured as indicated in table 4.6.

Table 4.6: Length of time in the gold mining projects

Length of time	Frequency	Percentage
Below 1 year	58	43.94
1-5years	54	40.90
5-10 years	10	07.56
Above 10years	02	01.52
Total	132	100.00

In table 4.6, out of the 132 respondents who were engaged in gold mining in Rongo Sub County 58(43.94%) had been engaged in the projects for a period of less than 1 year, 54(40.90%) had been engaged in the projects for a period between 1-5 years, 10(07.56%) had been engaged for 5-10 years and 02(01.52%) had been in these projects for over 10 years. The implication is that these projects, being engaged in for a short duration, were actually unsustainable. It is vital to observe that engagement in these projects is optimal at just about one year and subsequently, the gold miners seek for economic engagement elsewhere.

4.4: Influence of technology on sustainability of gold mining projects

Gold mining projects, unlike other ordinary projects, are technology driven and delivery of the final products highly depends on the level of appropriate technology adopted. In order to ensure that maximum benefits are obtained for now and posterity, appropriate technology must be considered. In this study, appropriate technology was measured on the basis of availability of equipment, ease of usage and technical training of personnel.

4.4.1: Influence of availability of equipment on sustainability of gold mining projects

Availability of appropriate technological equipment makes extraction of gold ores and the resultant final product an easy task to perform. In this case, the respondents were asked to fill the questionnaire indicating the type of equipment commonly used in the gold mining projects and their responses captured as illustrated in table 4.7.

Table 4.7: Influence of availability of equipment on sustainability of gold mining projects

Equipment	Frequency	Percentage
Exploration Machines	00	00.00
Extraction Machines	00	00.00
Manual Tools	122	90.24
Sieving Tools	06	06.76
Other	04	04.00
Total	132	100.00

Table 4.7 reveals that the 132 gold mining respondents in Rongo Sub County who completed the questionnaire indicating their commonly used technological equipment in their projects, 122(90.24%) used manual tools, 06(06.76%) were using sieving tools and, 04(4.00%) were using other tools, yet none were using either extraction, or exploration machines.

Implied is that the use of appropriate technology in the gold mining sites in the Sub County was none prioritized and this is explained by the popularity of the use of ordinary manual working tools that could hardly enrich gold mining prospects to offer sustainable development.

4.4.2: Influence of ease of use on sustainability of gold mining projects

Even in circumstances when certain technological equipments are adopted, the ease of usage could significantly influence effective task performance for desirable project results. Ease of usage is also related to development of competencies in specific areas so that some form of specialization in task performance is achieved. On account of this reality, the respondents were asked to fill the questionnaire indicating the extent to which they agreed or disagreed that the common equipments are easy to use and their responses noted as depicted in table 4.8.

Table 4.8: Influence of ease of use on sustainability of gold mining projects

Ease of usage	Frequency	Percentage
Strongly agree	00	00.00
Agree	00	00.00
Neutral	12	09.09
Disagree	32	29.92
Strongly disagree	78	59.09
Total	132	100.00

Table 4.8 reveals that of the 132 gold mining respondents in Rongo Sub County who filled the questionnaire indicating ease of use of mining equipment, 12(09,09%) were neutral, 32(29.92%) disagreed, 78(59.09%) were in strong disagreement, with none indicating any form of agreement.

Implied from these statistics is that due to lack of exposure to the mining equipment and training in the use of technology, most of the miners in Rongo found manipulation of these machines difficult and this behavior could definitely lead to unsustainable development.

4.4.3: Influence of technological training on sustainability of gold mining projects

Use of appropriate technology often does not depend on the availability of the equipments, but is generally a function of the development of technical competencies through specialized forms of training. In view of this, the respondents were asked to complete the questionnaire stating their areas of technical training and their responses captured as illustrated in table 4.9.

Table 4.9: Influence of technological training on sustainability of gold mining projects

Form of training	Frequency	Percentage
Operations	00	00.00
Human capital	00	00.00
Business	34	25.76
Mining	00	00.00
Other	128	74.24
Total	132	100.00

Table 4.9 indicates that, out of the 132 gold mining respondents in Rongo Sub County who filled the questionnaire stating areas of technical training, 34(25.76%) stated training in business and , 128(72.24%) indicated other forms technical training, yet none identified with mining, operations and human capital management.

These statistics imply that most of the gold miners were operating as individuals managing their own activities, with little team involvement in the performance of project tasks. This state of affairs indicates that signs that these projects may be unsustainable are high.

4.4.4: Influence of changes in technology on sustainability of gold mining projects

The researcher operated on the assumption that the most turbulent force influencing business operations in the world is technology and often acquisition of technological skills once may achieve very little in terms keeping with the pace of change. The respondents were asked to

complete the questionnaire stating agreement or disagreement that they often adapt to emerging changes in technology and their responses were captured as shown in table 4.10

Table 4.10: Influence of changes in technology on sustainability of gold mining projects

Rating	Frequency	Percentage
Strongly Agree	09	06.08
Agree	11	07.46
Neutral	10	09.08
Disagree	66	49.26
Strongly Disagree	36	28.03
Total	132	100.00

Table 4.10 indicates that of the 132 gold miners in Rongo Sub County who completed the questionnaire stating agreement or disagreement that they often adapt to emerging technological changes, 09(06.08%) strongly agreed, 11(07.46%) agreed, 10(09.08%) were neutral, 66(49.24%) disagreed, with 36 (28.03%) having strongly disagreed.

The implication is that most of the gold miners in Rongo Sub County were unable to keep pace with the emerging changes in technology, particularly those aspects applied in the gold mining activities. In view of this observation, sustainability of the gold mining projects would remain a tall order to realize, as there seems to be more exploitation towards depletion with less regard to the future generation.

4.5: Influence of economic factors on sustainability of gold mining projects

Gold mining projects, like any other project, requires finances and other resources to effectively execute the project activities in order to deliver the desired results. On this account, economic factors dictate the extent to which adequate funds can be availed for use in these projects, which in turn determines the level of project sustainability. This variable was measured on the basis of availability resources, variety of resources, sourcing strategies, and frequency of sourcing.

4.5.1: Availability of resources on sustainability of gold mining projects.

Engagement in gold mining projects cannot be effective without proper mobilization of resources, since these projects demand massive investment in technological equipment as well as performing other crucial activities. In the light of this consideration, the respondents were asked to fill the questionnaire stating the extent of agreement or disagreement that they mobilized adequate resources in the gold mining projects in Rongo Sub County and their response captured as indicated in table 4.11.

Table 4.11: Availability of resources on sustainability of gold mining projects.

Rating	Frequency	Percentage
Strongly Agree	09	06.08
Agree	11	07.46
Neutral	10	09.08
Disagree	66	49.26
Strongly Disagree	36	28.03
Total	132	100.00

Table 4.11 indicates that of the 132 gold miners in Rongo Sub County who completed the questionnaire, 09(06.08%) strongly agreed, 11(07.46%) agreed, 10(09.08%) were neutral, 66(49.24%) disagreed, with 36(28.03%) having strongly disagreed.

By implication, most of the gold mining respondents indicated that their projects did not have access to adequate resources for key project activities, as they stated that resource mobilization was less effective. In view of these responses, it is objective therefore to believe that the gold mining projects in Rongo Sub County are unsustainable.

4.5.2. Variety of resource mobilized on sustainability of gold mining projects.

In order to effectively undertake key project activities in the gold mining sites for purposes of realizing the objective of deriving value for now and posterity, variety of resources must be sought. The respondents were therefore asked to complete the questionnaire indicating variety of resources used in their projects and table 4.12 illustrates their responses.

Table 4.12: Variety of resources sustainability of gold mining projects.

Resource	Frequency	Percentage
Finance	10	08.50
Materials	06	05.00
Human labour	110	91.50
Other	06	05.00
Total	132	100.00

Table 4.12 reveals that of the 132 gold mining respondents in Rongo Sub County who completed the questionnaire indicating the variety of resources mobilized for use in their projects, 10(8.50%) stated financial resources, 6(5.00%) mentioned material resources and the majority at 110(3.33%) indicated human labor.

From the table, it is realized that the greatest resource used in gold mining projects was human labor, a situation that paints the picture of poor resource mobilization; hence chances of these projects being sustained have reduced considerably. Besides, even the human capital alluded to does not represent skilled personnel, but manual laborers with little value added to the projects.

4.5.3: Sourcing strategies sustainability of gold mining projects.

Resources to be used in a project intervention may be available if the stakeholders adopt superior strategy of resource mobilization strategies. In this study, as an indicator of resource adequacy, the researcher was interested in establishing if superior fund raising techniques were being used for mobilizing project resources so as to achieve project sustainability. The respondents were therefore asked to complete the questionnaire indicating common means of raising resources and their responses captured as in table 4.13.

Table 4.13: Sourcing strategies on sustainability of gold mining projects.

Strategy	Frequency	Percentage
Personal contribution	76	63.33
Loans from family and friends	26	36.67
Bank loans	00	00.00
Donation	00	00.00
Total	132	100.00

Table 4.13 reveals that, of the 132 gold mining respondents in Rongo Sub County who completed the questionnaire indicating resource mobilization, 76(63.3%), stated obtaining resources from personal contributions, 26(36.67%) mentioned obtaining resources from relatives and none stated getting resources from banks through loans and donation from well wishers.

The above statistics imply that resources mobilization strategies remained inferior since most respondents relied on meager personal contributions to invest in their projects, yet these were very insufficient in addressing the requirements of the project functions.

4.5.4: Frequency of sourcing on sustainability of gold mining projects.

Gold mining projects, being technical in nature, put a lot of resource burden on the project stakeholders, so much that regular sourcing of the funds and other resources become primary requisite for the realization of sustainable development. In this respect, funds have to be regularly sourced to ensure that no activity is denied the requisite resources. The respondents

were therefore asked to fill the questionnaire stating the frequency of sourcing and their responses noted as displayed in table 4.14.

Table 4.14: Frequency of sourcing on sustainability of gold mining projects.

Rate	Frequency	Percentage
Very Regular	00	00.00
Regularly	00	00.00
Indifferent	16	12.12
Less regularly	112	84.85
Other	04	03.03
Total	132	100.00

Table 4.14 indicates that of the 132 gold mining respondents in Rongo Sub County who completed the questionnaire stating the frequency of mobilizing project resources, 16(12.12%) stated being indifferent, 112(84.85%) indicated less regularly and 04(03.03%) stated the other category, with none indicating obtaining resources for project activities, either very regularly, or regularly,.

Implied by these statistics is that resource mobilization remained in its low levels spelling high chances that project activities, done at the resource advantage, no miracle would be performed by the project stakeholders to ensure their sustainability.

4.6: Influence of environmental issues on sustainability of gold mining projects.

Gold mining projects are implemented on the physical environment, just like all other development interventions and normally project activities performed have certain impacts on the component of the environment. Gold mining therefore contributes immensely to different forms of environmental degradation, such that these adverse effects on the environment often pose challenges to realizing environmental sustainability.

This variable was therefore measured on the basis of the projects effects on the components of the environment, relationship with other environmental related economic activities and general environmental safety.

4.6.1. Influence of environmental impacts on sustainability of gold mining projects

Sustainability of gold mining projects can also be measured on the basis of how the key project activities affect the various components of the surrounding environment. Often in most gold and other minerals mining sites, deep and life threatening pits are left which also frequently burry miners alive.

On account of this, the respondents were asked to complete the questionnaire indicating their extent of agreement, or disagreement that gold mining project activities adverse affect the components of the environment and hence unsustainable and their responses illustrated in table 4.15.

Table 4.15: Influence of environmental impacts on sustainability of gold mining projects

Adverse impacts	Frequency	Percentage
Strongly agree	76	57.57
Agree	46	34.85
Neutral	08	06.06
Disagree	00	00.00
Strongly disagree	00	00.00
Total	132	100.00

Table 4.15 reveals that of the 132 gold mining respondents in Rongo Sub County who filled the questionnaire indicating the extent of agreement, or disagreement that gold mining project activities adversely affect the components of the environment and hence unsustainable, 76(57.57%) were in strong agreement, 46(34.86%) agreed, 08(06.06%) were neutral.

By implication, gold mining projects even in the views of the miners, are considered among the greatest environmental pollutants and wanton exploitation of this resource without due regard to posterity, is equally unsustainable.

4.6.2. Influence of other economic activities on sustainability of gold mining projects

No project intervention is implemented in an isolated environment in which other economic activities do not compete for space and in establishing how effective an initiative is, mutual relationship must be developed. In the light of this concern, the respondents were asked to

complete the questionnaire indicating how gold mining projects interrelates with other economic activities for sustainable development and their responses illustrated in table 4.16.

Table 4.16: Influence of other economic activities on sustainability of gold mining projects

Impact	Frequency	Percentage
Very adverse	64	48.46
Adverse	56	42.42
Neutral	12	09.09
Less adverse	00	00.00
Other	00	00.00
Total	132	100.00

Table 4.16 reveals that of the 132 gold mining respondents in Rongo Sub County who filled the questionnaire indicating the interrelationship between gold mining activities and other economic activities undertaken, 64(48.46%) stated that these gold mining activities have very adverse effects on other economic ventures, 56(42.42%) mentioned adverse and 12(09.09%) were neutral.

Implied is that gold mines pose a lot of threats to other activities undertaken on the environment, as miners tend to follow the imminence of gold products even in established agricultural firms, in total disregard to the value attached to those other activities and should such trends continue, gold mining projects will often fail to meet thresholds of sustainability.

4.6.3. Influence of general environmental safety on sustainability of gold mining projects.

General environmental safety is critical in determining the level of sustainability of a development intervention and gold mining activities, being executed in the physical environment, must thrive in the safest of environments. In the context of this desire, the respondents were asked to complete the questionnaire indicating the extent of agreement, or disagreement that gold mining project activities occur in safe environment and their responses illustrated in table 4.17.

Table 4.17: Influence of environmental safety on sustainability of gold mining projects.

Safety	Frequency	Percentage
Strongly agree	00	00.00
Agree	00	00.00
Neutral	12	09.09
Disagree	62	46.96
Strongly disagree	58	43.93
Total	132	100.00

Table 4.17 reveals that of the 132 gold mining respondents in Rongo Sub County who filled the questionnaire indicating the extent of agreement, or disagreement that gold mining project activities occur in safe environment, 62(46.96%) stated disagreement, 58(43.93%) strongly disagreed and 12(09.09%) were neutral.

Implied is that gold mining projects activities, over and above being unsafe to the miners, also make the physical unsafe and hence unsustainable.

4.7. Influence of socio cultural factors on sustainability of gold mining projects.

Socio cultural issues embody all aspects of a community's cultural heritage practiced over generations and generally transmitted through social interactions and define the belief systems, food eaten, clothes and the general community patterns of life. In this study, socio cultural issues were considered critical to sustainability of the gold mining projects, since patterns of behavior of the stakeholders involved in these projects offer a platform for execution of project activities. This variable was measured on the basis of the cultural practices of the gold mining community, relationship of the practices to sustainability and the rate of cultural change to embrace new ways of life.

4.7.1. Influence of cultural practices on sustainability of gold mining projects.

The cultural practices of a community define the extent to which people engage in various activities and the goals that are to be achieved in order to create a common pattern of human interaction for survival. Generally, social norms restrict individuals to certain standards of behavior and for purposes of conformity; individuals tend to operate within the domain of socially approved values.

In light of this eventuality, the respondents were asked to complete the questionnaire indicating the commonly practiced aspects of culture and their responses illustrated in table 4.18.

Table 4.18: Influence of cultural practices on sustainability of gold mining projects.

Practice	Frequency	Percentage
Initiation	00	00.00
Traditional rites	00	00.00
Education	47	35.60
Religion	45	34.09
Other	40	30.31
Total	132	100.00

Table 4.18 indicates that, out of the 132 gold mining respondents in Rongo Sub County who filled the questionnaire stating common cultural practices, 47(35.60%) stated educational practices, 45(34.09%) indicated practicing religion, 40(30.31) mentioned other aspects of culture, yet none identified with initiation and traditional rites.

By implication, the gold mining community was considered to be practicing modern conventional aspects of life and hence was expected to embrace more progressive project management strategies for addressing challenges of sustainability of these initiatives.

4.7.2. Influence of relevance of the culture on sustainability of gold mining projects.

Not all practices that are cultural in nature enrich project activities for realization of the desired outcomes, but often these practices influence the attitude of the people in their interaction with one another in the performance of project tasks. In this respect, relevance of these practices must be assessed to ascertain if they can positive influence project results and the respondents were

asked to complete the questionnaire indicating the extent of agreement, or disagreement that the commonly practiced aspects of culture are relevant to project sustainability and their responses illustrated in table 4.19.

Table 4.19: Influence of relevance of the culture on sustainability of gold mining projects.

Practice	Frequency	Percentage
Strongly agree	40	30.30
Agree	51	38.63
Neutral	10	07.57
Disagree	11	08.33
Strongly disagree	10	07.57
Total	132	100.00

Table 4.19 indicates that, out of the 132 gold mining respondents in Rongo Sub County who filled the questionnaire stating the extent of agreement, or disagreement that the commonly practiced aspects of culture are relevant to project sustainability, 40(30.30%) strongly agreed, 51(38.63) agreed, 10(07.57%) were neutral and the same response was obtained by those who were in strong disagreement, and 11(08.33%) disagreed.

By implication, majority of the respondents felt that aspects of the culture practiced in the community were relevant to meeting the thresholds of the gold mining projects in Rongo Sub County. However, a visit to the gold mining sites reveals that these sites often remain death traps as pits left were rarely reclaimed for supporting other agricultural activities.

4.7.3. Influence of cultural change on sustainability of gold mining projects.

Sustainability of project interventions has been the greatest preoccupation of countries all over the world in such magnitudes that conferences have been held to enable all countries execute common strategies to address this. This noble goal is easily achieved with a cultural change, in which people begin to assess the implications of their actions in relation to other people's survival.

In light of this eventuality, the respondents were asked to complete the questionnaire indicating the influence of cultural change on sustainability and their responses illustrated in table 4.20.

Table 4.20: Influence of cultural change on sustainability of gold mining projects.

Change	Frequency	Percentage
Greatest	62	46.96
Great	50	37.88
Indifferent	20	15.16
Negligible	00	00.00
Other	00	00.00
Total	132	100.00

Table 4.20 Indicates that, out of the 132 gold mining respondents in Rongo Sub County who filled the questionnaire stating influence of cultural change on project sustainability, 62(46.96%) stated greatest, 50(37.88%) indicated great, with 20(15.16) being indifferent.

These figures imply that cultural change had significant influence on sustainability of the gold mining projects, and there was need to ensure that people adopt progressive practices to achieve this goal.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This section presents summary of the study findings on the basis of the study variables and their influence on sustainability of gold mining projects in Rongo Sub County. Besides, this chapter presents conclusions drawn from the study and recommendations, both for policy formulation and further research.

5.2 Summary of the study findings.

In this study one hundred and thirty eight (138) copies of questionnaire were administered to the respondents by the research assistants with close supervision of the researcher and 132 returned duly completed giving a response rate of 94.20%

5.2.1 Demographic Characteristics of the Respondents

On demographics, the researcher considered sex, age, level of education, length of operations and marital status. Revealed in the study was that majority of those who were engaged in gold mining projects in Rongo Sub County were in their middle and taken these activities as their main occupation for livelihood. However, in a more advanced age of 50 years and above, as well as in the tender ages below 20 years, these residents were remarkably few because of the dangers involved in gold mining, which occasionally lead to death when mine sites submerge.

Moreover, it was noted that gold mining, being a risky and more rewarding economic venture, was often a preserve of the male world. Marital orientation of an individual, to a great deal, is a

determinant of engagement in certain occupations, and more often, adult responsibilities can always compel people to take up any engagement provided gains are promised. The study established that gold mining drew married people with responsibilities of providing for their families and hence considered a full time occupation, yet these resources were getting depleted raising questions about their sustainability.

Education is an endeavor that equips individuals with knowledge, skills and desirable attitudes necessary for obtaining means of survival in the society. Level of education therefore determines the nature of activities, with simple ventures demanding less education than sophisticated ones. It was realized that the gold mining projects, being technological in nature, requires skilled personnel to manipulate the mining machinery, yet such educated lot were missing in these ventures

Through regular interaction with the rudiments of an activity and people from diverse backgrounds, one tends to acquire certain experiences that enrich execution of tasks. In this context, even in the gold mining projects, accumulated experience obtained over time can often enrich the mining activities. The study revealed that these projects, being engaged in for a short duration, were actually unsustainable. It is vital to observe that engagement in these projects is optimal at just about one year and subsequently, the gold miners seek for economic engagement elsewhere.

5.2.2: Influence of study variables on sustainability of gold mining projects

Gold mining projects, like any other project, requires finances and other resources to effectively execute the project activities in order to deliver the desired results. On this account, economic

factors dictate the extent to which adequate funds can be availed for use in these projects, which in turn determines the level of project sustainability.

It was noted that most of the gold mining respondents indicated that their projects did not have access to adequate resources for key project activities, as they stated that resource mobilization was less effective. In view of these responses, it is objective therefore to believe that the gold mining projects in Rongo Sub County are unsustainable. In order to effectively undertake key project activities in the gold mining sites for purposes of realizing the objective of deriving value for now and posterity, variety of resources must be sought.

The study established that the greatest resource used in gold mining projects was human labor, a situation that paints the picture of poor resource mobilization; hence chances of these projects being sustained have reduced considerably. Besides, even the human capital alluded to, does not represent skilled personnel, but manual laborers with little value added to the projects.

Resources to be used in a project intervention may be available if the stakeholders adopt superior strategy of resource mobilization strategies. It was observed that resources mobilization strategies remained inferior since most respondents relied on meager personal contributions to invest in their projects, yet these were very insufficient in addressing the requirements of the project functions.

Gold mining projects, being technical in nature, put a lot of resource burden on the project stakeholders, so much that regular sourcing of the funds and other resources become primary requisite for the realization of sustainable development, the study noted that resource mobilization remained in its low levels spelling high chances that project activities, done at the

resource advantage, no miracle would be performed by the project stakeholders to ensure their sustainability.

Gold mining projects, unlike other ordinary projects, are technology driven and delivery of the final products highly depends on the level of appropriate technology adopted. In order to ensure that maximum benefits are obtained for now and posterity, appropriate technology must be considered. Availability of appropriate technological equipment makes extraction of gold ores and the resultant final product an easy task to perform. It was realized that use of appropriate technology in the gold mining sites in the Sub County was none prioritized and this is explained by the popularity of the use of ordinary manual working tools that could hardly enrich gold mining prospects to offer sustainable development.

Moreover, ease of usage of technology is also related to development of competencies in specific areas so that some form of specialization in task performance is achieved. The study established that due to lack of exposure to the mining equipment and training in the use of technology, most of the miners in Rongo found manipulation of these machines difficult and this behavior could definitely lead to unsustainable development.

Use of appropriate technology often does not depend on the availability of the equipments, but is generally a function of the development of technical competencies through specialized forms of training, yet most of the gold miners were operating as individuals managing their own activities, with little team involvement in the performance of project tasks. This state of affairs indicates that signs that these projects may be unsustainable are high.

The researcher operated on the assumption that the most turbulent force influencing business operations in the world is technology and often acquisition of technological skills once may

achieve very little in terms keeping with the pace of change. However, most of the gold miners in Rongo Sub County were unable to keep pace with the emerging changes in technology, particularly those aspects applied in the gold mining activities. In view of this observation, sustainability of the gold mining projects would remain a tall order to realize, as there seems to be more exploitation towards depletion with less regard to the future generation.

Gold mining projects are implemented on the physical environment, just like all other development interventions and normally project activities performed have certain impacts on the component of the environment. Gold mining therefore contributes immensely to different forms of environmental degradation, such that these adverse effects on the environment often pose challenges to realizing environmental sustainability. Often in most gold and other minerals mining sites, deep and life threatening pits are left which also frequently burry miners alive. It was noted that gold mining projects even in the views of the miners, are considered among the greatest environmental pollutants and wanton exploitation of this resource without due regard to posterity, is equally unsustainable.

No project intervention is implemented in an isolated environment in which other economic activities do not compete for space and in establishing how effective an initiative is, mutual relationship must be developed. The study realized that gold mines pose a lot of threats to other activities undertaken on the environment, as miners tend to follow the imminence of gold products even in established agricultural firms, in total disregard to the value attached to those other activities and should such trends continue, gold mining projects will often fail to meet thresholds of sustainability. General environmental safety is critical in determining the level of sustainability of a development intervention and gold mining activities, being executed in the

physical environment, must thrive in the safest of environments, gold mining projects activities, over and above being unsafe to the miners, also make the physical unsafe and hence unsustainable.

Socio cultural issues embody all aspects of a community's cultural heritage practiced over generations and generally transmitted through social interactions and define the belief systems, food eaten, clothes and the general community patterns of life. Generally, social norms restrict individuals to certain standards of behavior and for purposes of conformity; individuals tend to operate within the domain of socially approved values.

The study established that the gold mining community was considered to be practicing modern conventional aspects of life and hence was expected to embrace more progressive project management strategies for addressing challenges of sustainability of these initiatives. Not all practices that are cultural in nature enrich project activities for realization of the desired outcomes, but often these practices influence the attitude of the people in their interaction with one another in the performance of project tasks

Moreover, majority of the respondents felt that aspects of the culture practiced in the community were relevant to meeting the thresholds of the gold mining projects in Rongo Sub County. However, a visit to the gold mining sites reveals that these sites often remain death traps as pits left were rarely reclaimed for supporting other agricultural activities. Sustainability of project interventions has been the greatest preoccupation of countries all over the world in such magnitudes that conferences have been held to enable all countries execute common strategies to address this. This noble goal is easily achieved with a cultural change, in which people begin to assess the implications of their actions in relation to other people's survival. It was revealed that

cultural change had significant influence on sustainability of the gold mining projects, and there was need to ensure that people adopt progressive practices to achieve this goal.

5.3. Conclusions

Land use has already altered more than half of the planet's terrestrial ecosystems, mainly for increasing the provision of a few services, such as food production. Since not all services can be maximized simultaneously, every land use decision involves trade-offs, often resulting in competing interests and substantial conflicts about the desired use of land among stakeholders

Gold mining being one of the land use activities in Rongo constituency has been going on for many years, leading to deforestation ,a substantial loss of farmland, and widespread spill-over effects as farmland are transformed into mining sites. This is with the main aim of generating income to supplement the earnings from sugarcane farming which is the main economic activity in the region.

However the sustainability of gold mining projects in the region remains a major concern due to lack of appropriate regional linkages and in turn the sustainability of regional economies as a mine inevitably declines, lack of appropriate compensation for non-market costs borne by mining regions (primarily environmental and social costs), insufficient sharing of the benefits with mining regions, lack of regional representation and involvement in decision making.

In other words, mining regions within Rongo Constituency often bear a disproportionate share of the costs of mine development for which they are not compensated adequately, receive an inappropriately small share of the net benefits, and do not participate adequately in decision making that leads to a mine. These concerns have led to a number of efforts aimed at enhancing the contribution of mining to local communities and regions. Lack of proper technology,

awareness and capacity building on how to economically exploit gold, being a non-renewable resource, for sustainability have contributed immensely to underutilization and misuse of the natural resource. Communities from and within these regions have not fully appreciated the impact of gold mining on their social and economic status and instead associate it with poverty.

5.4. Recommendations

5.4.1. Recommendations for policy formulation

From the findings of the study, it is significant to formulate regulatory measures to ensure that gold mining is practiced within the thresholds of addressing environmental safety, such that pits left are reclaimed to render them productive again. Moreover, policies based on strategies of environmental and resource sustainability for now and posterity should also be constituted so that issues of sustainability of these initiatives are addressed effectively.

The government of Kenya through the department of Mining should develop policies and proper legal framework to put in place to make gold mining projects sustainable, in which appropriate technology is adopted, both for exploration and extraction of gold products.

5.4.2: Recommendations for further research

This research study, like any other, offers study gaps that future scholars should strive to address so as to contribute to the building of knowledge in this area of concern and the following are worth considerations;

1. What is the influence of training on sustainability of gold mining projects in Rongo Sub County?

2. How do political factors influence sustainability of gold mining projects in Rongo Sub County?
3. What are the most effective strategies to be used in order to address cases of sustainable development community projects in Kenya?
4. What is the influence stakeholder participation on sustainability of gold mining projects in Rongo Sub County?

REFERENCES

- Adjei, E. 2007. Impact of mining on livelihoods of rural households. A case study of farmers in the Wassa Mining Region, Ghana.
- Aidara I. Bergbauindustrie in Westafrika. Food First International. 2008; 1:4–5.
- Ali, Saleem H. (2006), "Gold Mining and the Golden Rule: A Challenge for Developed and Developing Countries", *Journal of Cleaner Production* 14 (3–4): 455–462,
- Antony Halley (2013).Unlocking value in gold.
- Aryee BNA. Ghana's mining sector: Its contribution to the national economy and Resources Policy. 2001; 27(2):61–75.
- Azcue, J M (Ed.) 1999, *Environmental Impacts of Mining Activities: Emphasis on Mitigation and Remedial Measures*. Environmental Science, Springer-Verlag, Berlin, Germany, 320 p.
- Barrett, G J, 2000, *Revegetation of Salt-Affected Land after Mining: Germination and Establishment of Halophytes*. PhD Thesis, School of Environmental Biology, Curtin University of Technology, Perth, WA, 161 p.
- Buchanan, D.J. Mining Health and Safety Research—Quo Vadis; *IMM* November 2010, vol. 3, no. 35, London.
- Collin Fitzsimmons (2006), eHow Contributor
- Dasys, A. and Aalto, M. Mining automation technology transfer—hurdles to implementation; *Proc. CMMI*, Montreal 2012.
- Down C.G: stocks,J (1977) Environmental Impact of Mining.
- DUPARC, Sacha J. (2011), *Thematic Investments: Gold Miners' Free Cash Flows Expansion: Gold Prices Far Outpacing Capital & Operational Costs*
- Ellis EC, Ramankutty N. Putting people in the map: Anthropogenic biomes of the world. *Frontiers in Ecology and the Environment*. 2008.

ESDWG, 2011, *Final Report – Mining*. Ecologically Sustainable Development Working Group (ESDWG),

Euro mines Annual Report 2011. Raw materials are the future.

Foley JA, DeFries R, et al. Global consequences of land use. *Science*. 2005; 309(5734):570–574.

Frohlich N. (1995). *Socio-economic status and the health of the population*. New York USA, Oxford University Press.

Hatcher, L (1994). A step by step approach to using the SAS(R) system for factor analysis and structural equation modeling.

Hore-Lacy, 2006, *Mining and the Environment*. Australian Mining Industry Council, 5th Edition, Dickson, ACT,

IIED & WBCSD, 2002, *Breaking New Ground: Mining, Minerals and Sustainable Development*. Published by Earth scan for International Institute for Environment & Development (IIED) and World Business Council for Sustainable Development (WBCSD), London, UK.

International Labour Organization (2006), International Programme on the Elimination of Child Labour (IPEC) Geneva.

International Labour Organization magazine (2012) No.74, Giving youth a better start

Isobel C and William H (2009). *Practical Geostatistics*.

Isobel C and William H (2009). *Practical Geostatistics*.

Jane Perlez and Lowell Bergman. "Tangled Strands in Fight over Peru Gold Mine," *The New York Times*. October 25, 2005.

Jonathan Cavanagh (2011). Las minas Del Peru-Top mining Companies in Peru
Kariuki. D Kenya NGO Earth Summit

Kumah A. Sustainability and gold mining in the developing world. *Journal of Cleaner Production*. 2006; 14(3–4):315–323.

Lottermoser, B, 2003, *Mine Wastes - Characterization, Treatment and Environmental Impacts*. Springer-Verlag, Berlin, Germany, 291 p.

Malherbe, G. The Wheel of Change, *Virtual Consulting*, 2011

Maureen Upton (2011). Gold Mining and the Transformation of Developing Economies.

May Brown “mining in Kenya, the start of a new era”

Meadows, D H, Meadows, D L, Randers, J & Behrens, W W, 1972, *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*. Potomac-Earth Island, London, UK.

Mineral Commodities Summaries (2008)

Monna, F.E. Camizuli, et al. Environmental Science and Technology

Mugenda, O.M & Mugenda, A.G. (2003). Research Methods; Quantitative Approaches. Nairobi, Kenya, Act Press.

National Coalition on Mining (2006). Ghana: Campaign to stop the violence in mining.

Now and Beyond: Minera Yanacocha. Newmont Mining Company website. 2004. pg. 8.

Oxfam Press Release: Oxfam Calls on Newmont Mining Company to Publicly Renounce Human Rights Abuses at Peruvian Gold Mine. July 31, 2007.

Peter Hecht. "Peasants in Peru near showdown on mercury spill," Miami Herald. March 5, 2005.

Pukkila, J. and Sarrka, P. Intelligent Mine Technology Program and its implementation; *Proc. Massmin 2011*, Brisbane 2011.

Richard, P.L. Effective Production Monitoring in Open Pit Mines: Beyond the

Rodriguez, J.P., T.D. Beard, et al. 2006. Trade-offs across space, time and ecosystem services. *Ecology and Society* 11 (1): 28.

Roos N. (1997). *Gender Socio-Economic Status & Family Status as determinant of food behaviour*. London, UK. Cambridge University Press.

Tarr, R.G., Fouche, J., Rogers, T.C., and Pocock, J.W. How to leverage your bottom line with good drilling and blasting practice; *Journal SAIMM*, vol. 100, no. 2, March/April 2006 Johannesburg.

Technology; *Proc. CMMI*, Montreal 2000

The National Institute for Environmental Health Science

Tilton, J E, 2003, *On Borrowed Time? Assessing the Threat of Mineral Depletion*. Resources for the Future, Washington DC, USA.

Turner, B.L., E.F. Lambin, et al. 2007. The emergence of land change science for global environmental change and sustainability. *Proceedings of the National Academy of Sciences of the United States of America* 104 (52): 20666–20671.

United States Geological Survey 2002 Mineral Industry Report

United States Geological Survey, 2005 Minerals Yearbook; South Africa.

World Resources Institute, *Development without Conflict: The Business Case for Community Consent*, May 2007

APPENDIX I: LETTER OF TRANSMITTAL

Dear Respondent

RE: FACTORS INFLUENCING SUSTAINABILITY OF GOLD MINING PROJECTS

I am a student at the University of Nairobi pursuing Master of Arts degree programme. Currently, I'm carrying out a research on the factors influencing gold mining projects in Rongo Sub County (Migori County). I kindly request you to fill in this questionnaire. The information collected will be used strictly for the purpose of this study and will be treated confidentially.

Thank you for agreeing to participate in the study.

Yours Faithfully

Elizabeth Anyango Odhiambo

APPENDIX II: RESEARCH QUESTIONNAIRE

1. Indicate your age in years
 - a) 20 and below
 - b) 20-30
 - c) 30-40
 - d) 40-50
 - e) Above 50
2. Indicate your sex
 - a) Male
 - b) Female
3. State your marital orientation
 - a) Single
 - b) Married
 - c) Widowed
 - d) Divorced
 - e) Other
4. show your level of education
 - a) primary
 - b) secondary
 - c) tertiary
 - d) university
 - e) other

5. Specify the length of time taken in the gold mining projects
 - a) Below 1 year
 - b) 1-5 years
 - c) 5-10 years
 - d) Above 10 years
6. Indicate the extent to which you agree that there is availability of resources on sustainability of gold mining projects
 - a) Strongly Agree
 - b) Agree
 - c) Neutral
 - d) Disagree
 - e) Strongly disagree
7. Indicate the variety of resources available for the sustainability of gold mining projects
 - a) Finance
 - b) Materials
 - c) Human labour
 - d) Other
8. What are the sourcing strategies on sustainability of gold mining projects
 - a) Personal contribution
 - b) Loans from family and friends
 - c) Bank loans
 - d) Donation
9. specify the frequency of sourcing on sustainability of gold mining projects

- a) Very regular
- b) Regularly
- c) Indifferent
- d) Less regularly
- e) Other

10. What are the equipment available that influence sustainability of gold mining projects

- a) Exploration machines
- b) Extraction machines
- c) Manual tools
- d) Sieving tools
- e) Other

11. To what extent do you agree that the ease of use of technological equipment influence sustainability of gold mining projects

- a) Strongly agree
- b) Agree
- c) Neutral
- d) Disagree
- e) Strongly disagree

12. What form of technological training influence sustainability of gold mining projects?

- a) Operations
- b) Human capital
- c) Business
- d) Mining

e) Other

13. To what extent do you agree that changes in technology influence sustainability of gold mining project?

a) Strongly Agree

b) Agree

c) Neutral

d) Disagree

e) Strongly Disagree

14. To what extent do you agree that environmental impacts influence sustainability of gold mining projects

a) Strongly agree

b) Agree

c) Neutral

d) Disagree

e) Strongly disagree

15. How adverse do other economic activities influence sustainability of gold mining projects

a) Very adverse

b) Adverse

c) Neutral

d) Less adverse

e) Other

16. To what extent do you agree that environmental safety influence sustainability of gold mining projects

- a) Strongly agree
- b) Agree
- c) Neutral
- d) Disagree
- e) Strongly disagree

17. Indicate cultural practices that influence sustainability of gold mining projects

- a) Initiation
- b) Traditional rites
- c) Education
- d) Religion
- e) Other

18. To what extent do you agree that relevance of the culture influence sustainability of gold mining projects

- a) Strongly agree
- b) Agree
- c) Neutral
- d) Disagree
- e) Strongly disagree

19. How great does cultural change influence sustainability of gold mining projects

- a) Greatest
- b) Great
- c) Indifferent
- d) Negligible
- e) Other