

**SIMON DIEDONG DOMBO UNIVERSITY OF BUSINESS AND INTEGRATED
DEVELOPMENT STUDIES**

**THE IMPLICATIONS OF ENVIRONMENTAL THREATS OF ARTISANAL AND
SMALL-SCALE GOLD MINING (GALAMSEY) ON RURAL LIVELIHOOD
DIVERSIFICATIONS IN THE UPPER WEST REGION OF GHANA**

MOOMIN SEIDU

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BY

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**THESIS SUBMITTED TO THE DEPARTMENT OF ENVIRONMENT AND RESOURCE
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REQUIREMENTS FOR THE AWARD OF DOCTOR OF
PHILOSOPHY IN ENVIRONMENT AND
RESOURCE MANAGEMENT**

JUNE, 2024

DECLARATION

Student

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere. The works of other authors used in this work have been duly acknowledged by complete references.

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Supervisors

I hereby declare that the preparation and presentation of this dissertation were supervised in accordance with the guidelines on supervision of thesis laid down by the Simon Diedong Dombo University of Business and Integrated Development Studies.

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ABSTRACT

Artisanal and small-scale gold mining (ASGM), a low-tech, low output, low capital investment and low formalization have become prevalent in developing countries including Ghana. The study investigated the implications of environmental threats of artisanal and small-scale gold mining (Galamsey) on rural livelihood diversifications in the Upper West Region of Ghana. The study seeks to: examine the mode of operations of and the driving factors of ASGM, assess the socio-economic implications of ASGM, explore the effects of ASGM on rural livelihoods diversification, analyze the environmental effects of Land Use Land Cover trends driven by ASGM and evaluate laws and government policies governing the mining sector in the Upper West Region. The study relied on pragmatism as a philosophical underpinning. The research is a case study which relies on explanatory concurrent triangulation mixed method involving simple random, snowball and purposive sampling methods. The study selected 320 community members using a simple random sampling as well as 40 artisanal and small-scale gold miners using snowball sampling method across the 10 mining. The study also used the purposive sampling in selecting key informants for the study. The Statistical Package for Social Sciences (SPSS version 24.0) was used to analyze the quantitative data while thematic analysis was used for the qualitative data collected from the field. The results show that 78% of the miners are engaged in surface mining methods. The findings indicate that majority (73.1%) of non-miners and miners (52.5%) regard ASGM as a cause of some diseases. The study also revealed that ASGM has negatively influenced rural livelihoods that are natural-based especially agriculture. Again, the study results show majority of respondents (80.3%) pointing to land degradation as a major environmental threat of ASGM. Finally, the study reveals 100% of ASGM operators were not licensed due to several reasons. The study recommended that Minerals Commission and the EPA should promote underground mining. It also recommended that EPA, in collaboration with the Ghana Health Service, should conduct periodic sensitization programs on the health effects of ASGM. Furthermore, the Ministry of Employment, Jobs, and Labor Relations, along with the Ghana Enterprises Agency (GEA), should integrate alternative livelihood programs and job opportunities into mining community development plans. Again, the EPA and the District Assemblies should implement strict land reclamation policies and enforce sustainable mining practices to mitigate land degradation. Finally, the minerals commission should decentralize and simplify Small Scale Mining Licensing procedures for easy regularization of illegal mining activities.

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DEDICATION

This work is dedicated to my late elder sister, Salimata Moomin, of blessed memory, who passed away during the final stages of my PhD thesis. Sister, may you rest peacefully in the bosom of the Almighty. Amen.

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CHAPTER ONE

GENERAL INTRODUCTION

1.0 Overview

Artisanal and small-scale gold mining has attracted much attention in recent times. Drawing on the DFID's sustainable livelihood framework, the study explores the nexus of ecological threats of artisanal mining on rural livelihood diversifications among selected mining communities in the Upper West Region of Ghana. The thesis's rationale is to explore how ASGM is impacting the natural environment as well as shaping the livelihood portfolios of the people of Upper West Region in Ghana general. Against this backdrop, I interviewed artisanal miners, household heads, stakeholders and community members to gather information to answer the study's overarching objectives.

The study topic has been further elucidated in the statement, which provides a clear delineation of the specific issue that warrants the undertaking of this research. The chapter thereafter outlines the objectives and research issues that were pursued and addressed, accordingly. The research also includes a discussion on the significance and scope of the study. Ultimately, this chapter elucidates the organizational structure of the remaining portions inside this study.

1.1 Background of the study

Globally, in mining localities, ASGM has emerged as an employment source of equal or greater significance in the past few decades. It is about manual approach of extraction simple technology and processing of minerals like gold. Many studies have focused on the aforementioned issue, such as the papers by (Arthur-Holmes & Busia, 2022; Ofosu & Sarpong, 2022). ASGM provides a significant source of income for approximately 2 to 3% of the global population (World Bank, 2020; Girard et al., 2022). While environmental impacts of ASGM cannot be disregarded (Arthur-Holmes & Ofosu, 2024), it remains a paramount source of employment, especially for miners and educated unemployed youth (Maconachie & Conteh, 2025).

Artisanal and small-scale gold mining (ASGM) has become a significant contributor to global gold production, particularly in developing countries. It provides livelihoods for millions of people but is often associated with severe environmental challenges, including deforestation, soil

erosion, mercury pollution, and water contamination (Donkor et al., 2024). ASGM operations frequently lack regulatory oversight, leading to land degradation and biodiversity loss. The economic benefits, though substantial, are often offset by the environmental costs and negative health impacts on miners and surrounding communities.

The major motivation for participating in ASGM is the desire to create assets that support livelihoods (Aizawa, 2016). The studies mentioned earlier (Mansola et al., 2019; Baffour-Kyei et al., 2021) showcase asset ownership importance in livelihood discussions, as these assets play a key role in tackling unemployment, hunger, resilience over impoverishment and increasing self-capacity within rural economies (Mansola et al., 2019; Brockington, 2019).

In Africa, ASGM plays a crucial role in economic development, particularly in countries such as Ghana, Mali, Burkina Faso, and the Democratic Republic of the Congo. ASGM provides direct employment for over 10 million people and indirectly supports millions more (Cuya et al., 2021). However, the environmental consequences of ASGM are increasingly problematic. Many ASGM operations occur in ecologically sensitive areas, disrupting ecosystems and reducing biodiversity. Additionally, ASGM contributes to socio-economic issues such as child labor, gender inequality, and land-use conflicts between miners and local farmers (Huntington & Marple-Cantrell, 2022; Adranyi, 2024). The informal nature of ASGM makes it difficult for governments to regulate and enforce environmental standards, exacerbating its negative impact on sustainable rural livelihoods (Stringer & Altink, 2023).

West Africa is a hub for ASGM, with major mining activities occurring in Ghana, Burkina Faso, Mali, Tanzania and Côte d'Ivoire. The region's geology is rich in gold deposits, attracting thousands of small-scale miners. However, the rapid expansion of ASGM has led to severe environmental degradation and conflicts over land and water resources (Ondayo et al., 2024). The economic contributions of ASGM to national economies are undeniable, but the environmental and social costs—such as child labor, gender disparities, and displacement of communities—pose serious challenges (Arnott, 2023).

One of the major socio-economic consequences of ASGM in West Africa is the displacement of rural farmers. Many smallholder farmers have abandoned agricultural activities due to land degradation and reduced soil fertility caused by ASGM operations (Osumanu, 2020). The loss of farmland has led to food insecurity and increased reliance on mining as an alternative livelihood (Mabe et al., 2021). Furthermore, ASGM in West Africa has been linked to organized crime, land conflicts, and violent confrontations between local communities and illegal miners (Baddianaah et al., 2021). Moving from traditional agriculture towards ASGM activities in remote areas rich in mineral nations in sub-Saharan region of Africa has triggered scholarly debate, examined by various researchers including Kelly et al. (2014; Baffour-Kyei et al., 2021).

A livelihood encompasses the means by which individuals and households sustain their basic needs, including food, shelter, and income. In rural communities, livelihoods are often based on natural resource-dependent activities such as agriculture, fishing, and small-scale mining (Hilson & Hu, 2022). Due to economic hardships, limited employment opportunities, and declining agricultural productivity, many rural households turn to Artisanal and Small-Scale Gold Mining (ASGM) as an alternative livelihood strategy (Adranyi et al., 2023). However, while ASGM may offer a short-term livelihood solution, it also presents long-term challenges such as land degradation, pollution, and health hazards that threaten the sustainability of other livelihood activities.

Sustainability refers to the ability to meet present economic, social, and environmental needs without compromising the ability of future generations to meet theirs. In the context of ASGM, sustainability involves balancing the economic benefits of mining with environmental conservation and social well-being (Clifford, 2022). One of the major sustainability concerns of ASGM is its impact on land use and land cover changes (LULCC). As miners extract gold, they clear forests, dig up large tracts of land, and leave behind polluted and barren landscapes that can no longer support agriculture or biodiversity (Nunoo et al., 2023).

Livelihood diversification refers to the process of expanding income-generating activities to reduce economic risks and improve household resilience (Mabe et al., 2021). In many ASGM communities, diversification occurs as a response to declining agricultural productivity, land degradation, or economic uncertainty. When ASGM leads to the destruction of farmlands and

water bodies, households are often forced to explore alternative economic activities such as petty trading, migration, charcoal production, or artisanal crafts (Nunoo et al., 2023).

Mining points to Ghana in all scales of mining get a huge value adding to the GDP of the country. As of 2016, the sector accounted for 11.9% of Ghana's GDP (ISSER, 2017; Mabe et al., 2021). Both Minerals Commission (2013) and Mabe et al. (2021) noted that the small-scale mining sector alone provides employment for about 1 million persons, whereas the large-scale mining industry employs 29,000 workers. It strikes those activities of ASGM represents widespread occurrence in countries like Ghana, Brazil and Indonesia (Macdonald, 2016; Mabe et al., 2021).

ASGM has grown more widely in developing nations, such as Ghana, characterized by its low technological sophistication, limited productivity, minimal capital investment, and inadequate formalization. Nevertheless, the contributions connected with ASM industry as far as sub-Saharan Africa (SSA) are diverse but fail to provide a clear picture of the real benefits that ASM has brought to the sub-region (Osumanu, 2020; Mabe et al., 2021; Baddianaah et al., 2022).

The socio-economic impact of ASGM extends beyond environmental degradation. The sector is characterized by unsafe working conditions, low wages, and the exploitation of child laborers, particularly in mining communities (Mensah et al., 2024). Additionally, ASGM has contributed to rising social vices such as prostitution, drug abuse, and violent conflicts in mining areas (Donkor et al., 2024).

Ghana is one of the leading ASGM economies in Africa, with the sector contributing about 35% of the country's total gold production. While ASGM provides an alternative source of income, its negative effects include loss of agricultural lands, water pollution, and deforestation (Gilbert & Albert, 2016; Dossou Etui et al., 2024). Rural livelihood diversification in Ghana has increasingly relied on ASGM, particularly as climate variability affects agricultural productivity. However, land-use conflicts between farmers and miners have become common, as mining depletes soil fertility and disrupts local ecosystems (Adranyi., 2024). McQuilken and Hilson (2016, as cited in Baddianaah et al., 2021) estimated that more than one million people are involved directly in ASGM, while another 4.5 million people are indirectly linked to ASM through income-related activities.

Despite the environmental issues related to ASGM, it provides a source of temporary employment, especially for people with limited skills and resources. ASGM, being a labor-intensive sector, has been widely studied by researchers (Banchirigah & Hilson, 2010); Baffour-Kyei et al. (2021). Perks (2019) argues that ASGM can help communities deal with economic difficulties and shocks, offering itself as a way of improving rural livelihoods, as supported by Perks (2019) and Wilson (2019). People may choose mining activities to reduce poverty and increase economic benefits from their work (Hilson & Garforth, 2013; Kelly, 2014). In Ghana, it has been noticed that many people in mineral-rich areas use ASM to diversify their income sources (Hilson and Garforth, 2013, as cited in Baffour-Kyei et al., 2021).

Ghana has implemented various policies to regulate the ASM industry and support its contribution to sustainable development (MinCom, 2014; Baffour-Kyei et al., 2021). The mining sector operates under several laws and guidelines, including the ASM Handbook for Ghana and the Mineral and Mining Act (2006) (Tychsen et al., 2017; Baffour-Kyei et al., 2021), specifying procedures for obtaining licenses, mining sites establishment, addressing environmental and socio-economic issues, and accessing financial and business planning support.

The legal frameworks overseeing ASM activities in Ghana to regulate the exploration of mineral resources in the country are the Mercury Law, the Precious Minerals Marketing Corporation Law and the Small-Scale Gold Mining Law (Akabzaa and Darimani, 2001; Hilson, 2001; Baddianaah et al., 2022). Ofosu-Mensah (2011), Baddianaah et al. (2022) and Akabzaa and Darimani (2001) opined that the meaning of ASM under Act 703 which is an updated Minerals and Mining Act of 2006 is "a native business which needs approval of the Minerals Commission for Ghanaian people who participate in mining activities." This definition replaces the Small-Scale Mining Law of 1989 (PNDCL 218). However, challenges include high licensing costs, complex administrative processes, and issues of corruption, collusion, and political interference hinder local miners from obtaining small-scale mining licenses, is reported in the works of researchers including Baddianaah et al. (2022; Adu-Baffour et al. (2021), Botchwey and Crawford (2018) and Gbedzi et al. (2022).

The Upper West Region of Ghana, traditionally an agrarian economy, has seen a rapid increase in ASGM activities in recent years. The influx of miners has led to significant environmental degradation, including deforestation, loss of biodiversity, and contamination of water sources such as the Black Volta River (Baddianaah et al., 2021). The destruction of farmlands has forced many farmers to abandon agriculture, leading to shifts in livelihood strategies (Nunoo et al., 2023).

ASGM in the Upper West Region has altered local land-use patterns, leading to conflicts between miners and farmers. Many households have had to diversify their livelihood strategies, engaging in activities such as petty trading, charcoal burning, and migration to urban centers (Donkor et al., 2024). However, these alternative livelihood strategies are often unsustainable, leaving many rural households vulnerable to economic shocks and environmental disasters (Bansah et al., 2023).

The role of regulatory institutions in managing ASGM in the Upper West Region has been largely ineffective due to weak enforcement of environmental laws and corruption within government agencies (Hilson & Hu, 2022). However, it is still uncertain how well these institutional structures perform in Ghana's situation to solve the ASGM issue has led to increased land degradation, making it difficult for rural communities to sustain their livelihoods. Persistent concerns about widespread corruption in institutions responsible for regulating the ASM sector continue to be a focal point (Baddianaah et al., 2021a; Owusu et al., 2019). It is evident that the negative impacts of ASGM, including the loss of livelihood options and environmental degradation, are being reversed, leading to a restoration of the previous state. This thesis aspires to investigate the implications of environmental threats of artisanal and small-scale gold mining (Galamsey) on rural livelihood diversifications in selected mining communities of the three mining districts in the Upper West Region, Ghana.

1.2 Problem Statement

Rural livelihoods are most sustainable when they are diverse, stable, and resilient to environmental and economic shocks. Ideally, rural economies should be driven by sustainable agricultural practices, ecotourism, handicrafts, and non-farm enterprises, ensuring long-term food security, environmental conservation, and economic stability (Abankwah, 2021). However, in many rural settings, particularly in Ghana's Upper West Region, the increasing expansion of Artisanal and Small-Scale Gold Mining (ASGM) has significantly disrupted this desirable livelihood structure. ASGM, though economically attractive, has introduced a range of environmental, socio-economic, and institutional challenges that threaten rural livelihood diversification, land sustainability, and household well-being (Baddianaah et al., 2021).

Empirical studies highlight ASGM as a major driver of land degradation, deforestation, and water pollution (Kazapoe et al., 2023). ASGM operations often involve indiscriminate excavation of land, deforestation, and pollution of key water bodies such as the Black Volta River, leading to loss of agricultural land, declining soil fertility, and contamination of water sources (Obodai et al., 2024). Research by Brunnschweiler et al. (2024) indicates that mercury and cyanide contamination in ASGM communities has resulted in significant declines in fish stocks and potable water sources, forcing rural households to depend on expensive alternative water supplies. The depletion of farmlands has made agriculture—a historically dominant livelihood in the region—unsustainable for many rural households, compelling them to abandon farming or adopt risky alternative livelihoods such as petty trading, charcoal burning, and migration to urban centers (Baddianaah et al., 2023). These environmental threats undermine the long-term sustainability of rural economies, raising concerns about how rural households adapt and diversify their income sources in response to ASGM-driven environmental shocks.

Despite its economic contributions, ASGM has exacerbated poverty and economic inequalities in mining-affected communities. While some individuals benefit from the direct income mining generates, a significant proportion of the population—particularly women, farmers, and landowners' experiences reduced livelihood options due to mining-induced land degradation (Kumi et al., 2023). Studies have shown that unregulated ASGM activities lead to exploitative labor conditions, health risks, and increased school dropout rates as children abandon education for mining-related activities (Baddianaah et al., 2021). This presents a critical research

gap on the long-term economic viability of ASGM-dominated rural economies and how affected households navigate income uncertainties.

Despite government interventions, weak institutional oversight and policy inefficiencies continue to allow the unregulated expansion of ASGM (Brunnschweiler et al., 2024). Regulatory bodies such as the Environmental Protection Agency (EPA) and the Minerals Commission have struggled to enforce land reclamation policies, water protection regulations, and mining safety standards, leading to a continued rise in illegal mining operations (Kazapoe et al., 2023). Government initiatives such as the Community Mining Scheme, designed to formalize small-scale mining, have failed to prevent environmental degradation and protect rural livelihoods (Baddianaah et al., 2023).

Moreover, lack of alternative livelihood programs means that affected communities are left without viable options beyond mining, perpetuating a cycle of environmental destruction and economic dependency on ASGM (Donkor et al., 2024). The failure of local governance structures to integrate sustainable land-use planning with mining regulations further worsens the situation, as rural households struggle to access reclaimed lands for farming or other productive activities (Obodai et al., 2024). This raises serious policy concerns regarding the effectiveness of regulatory institutions and the role of governance in balancing mining activities with sustainable rural livelihood development.

Notwithstanding these endeavors, empirical evidence and experiential observations indicate that the obstacles associated with the process of legalizing, environmental contamination, deterioration, and the need for diversification of livelihoods continue to endure (Hilson & Maconachie, 2020; Orleans-Boham et al., 2020; Zolnikov, 2020).

In addition, in Ghana, there is a rich literature on ASM including some regions of the globe. Some of the noteworthy works include those that evaluate the environmental effects of ASGM ((Joof et al., 2023; Mencho, 2022; Owusu et al., 2019; Boateng, 2018; Bansah et al., 2018). Additionally, there are studies that investigate the livelihood effects of ASGM (Oramah, 2013; Mbianyor, 2014; Osumanu, 2020; Baffour-Kyei et al., 2021; Baddianaah et al., 2021b; Huntington & Marple-Cantrell, 2022), policy implementation (Osei-Kojo et al., 2016; Tuokuu et al., 2019), coping strategies of displaced small-scale miners in Ghana (Mabe et al., 2021), implications of

illegal gold mining for Climate Smart Agriculture in the Nadowli-Kaleo District (Yiridomoh, 2021), and livelihood diversification (Hilson et al., 2013; Kwadwo et al., 2016).

Ghana's Upper West Region isn't a unique case, as seen by the sharp increase in illicit mining, especially in the country's north (Agyemang and Okoto, 2014; Laari et al., 2016; Baddianaah et al., 2021a, Baddianaah et al., 2022). With three percent of its total land area, the Upper West Region holds the potential for both surface and underground mining, as stated in the Ghana Chamber of Mines Report in 2008. A greater chunk of this land area is within the Nadowli-Kaleo, Wa East and the Wa West Districts where there is a rise in able-bodied workers from several parts of the region and other areas migrate to in search of mining opportunities. This migration is often driven by the perceived higher potential for income in Small Scale and Artisanal Gold Mining, with farmers leaving agriculture due to the unpredictability of climate change and decreasing soil fertility affecting productivity.

Engaging in the activities of ASGM holds the potential to introduce various environmental risks, influencing rural livelihood such as crop farming, animal husbandry, charcoal production, shea nut picking, shea nut oil processing, fishing just to mention but a few in Ghana's Upper West mining communities. If ASGM activities continue without adequate monitoring and enforcement of mining laws and policies, it could result in substantial economic decline, deteriorating health conditions, and diminished environmental quality in the Region leading to livelihood diversifications to sustain a living. Despite the Region's fertile soil for agriculture, there has been a noticeable shift among its economically active population towards artisanal gold panning. While this diversification aims to sustain livelihoods, it has rendered the area more vulnerable to adverse impacts on alternative income sources. The escalating growth of ASGM has become a significant cause for concern among both the local populace and the government (Hilson & Maconachie, 2020; Wireko-Gyebi et al., 2020; Baddianaah, 2022).

Furtherance to this, dangerous chemicals such as mercury and cyanide are used by miners in gold processing from its ore in the Black Volta tributary hence posing danger to both confined and unconfined aquifers culminating into the unsuitability of water sources both domestic and agricultural use in the Upper West Region. The mercury-contaminated water could not, for instance, be useful for farming, industrial and domestic purposes due to the dewatering effects on both surface and underground water sources.

Artisanal and small-scale gold mining is likely to boom at the expense of rural livelihoods that are anchored on the natural environment such as farming, animal rearing, charcoal production, shea nut picking among mining communities in the Upper West Region, which will employ majority of the people living in the area. The three districts namely; Nadowli-Kaleo, Wa West and the Wa East District would be on a cusp of a major livelihood deterioration if artisanal and small-scale gold mining is left to disrupt the physical environment.

However, the inquiry pertains to the influence of environmental threats arising from artisanal and small-scale gold mining on livelihoods diversifications. Previous research indicates that surface mining, particularly in relation to land degradation and pollution, has significant environmental impacts that can negatively affect rural livelihoods. These repercussions often result in the displacement of individuals, hence necessitating the development of alternate sources of livelihoods in the Wa East District of the Upper West Region (Agyemang & Okoto, 2014).

Furthermore, Osumanu (2020) argues that the evidence for ASGM activities at the national level is inadequate compared to that of large-scale mining. Therefore, a more thorough understanding of the activities of ASGM as well as their implications as far as the enhancement of rural livelihoods are of paramount importance. Besides, the extant literature available on the environmental threats by ASGM and livelihood diversifications are based on data at the national and very little research has been done at the local level especially the three mining districts of the Upper West Region in a single study causing a dearth or deficient in knowledge in this perspective. While existing studies have extensively examined the environmental and economic impacts of ASGM in Ghana, there remains limited empirical evidence on how ASGM-induced environmental threats shape rural livelihood diversification strategies in the Upper West Region (Baddianaah et al., 2021).

It is against this backdrop that this thesis aims to contribute to academic knowledge by investigating the implications of environmental threats of artisanal and small-scale gold mining (Galamsey) on rural livelihood diversifications in selected mining communities of the three mining districts in the Upper West Region, Ghana. The study therefore seeks to answer the following research questions:

1.3.1 Main Research Questions

The main research question is, how do the environmental consequences of artisanal and small-scale gold mining (ASGM) affect the diversification of rural livelihoods in the Upper West Region?

1.3.2 Specific Research Questions

The specific research questions of the study were:

- i. How does ASGM operate in the Upper West Region?
- i. How does ASGM impact the socio-economic conditions in the Upper West Region?
- ii. How does ASGM affect rural household livelihood diversification and activities in mining landscapes of the Upper West Region of Ghana?
- iii. How do land use and land cover changes driven by ASGM impact the environment in the Upper West Region?
- iv. How effective are regulatory institutions, laws, and government policies in governing the mining sector in the Upper West Region?

1.4 Research Objectives

1.4.1 Main Research Objective

The main aim of the study is to investigate the environmental consequences of Artisanal and Small-Scale Gold Mining and how they shape rural livelihood diversification in the Upper West Region.

1.4.2 Specific Research Objectives

The specific research objectives of the study were:

- i. To examine the mode of operations of and the driving factors of ASGM in the UWR
- ii. To assess the socio-economic implications of ASGM in the Upper West Region
- iii. To explore the implication of ASGM on rural household livelihoods diversifications, assets and activities in mining landscape of the upper West Region of Ghana.
- iv. Evaluate the environmental effects of Land Use Land Cover trends driven by ASGM in The Upper West Region
- v. To critically examine roles and effectiveness of regulatory institutions, laws and government policies governing the mining sector in the Upper West Region.

1.5 Significance of the Study

The importance of a study lies in its utility for research and its contribution to the existing knowledge or current condition of the topic under inquiry. According to Creswell (2009), it is emphasized that the value of a research study lies in the potential benefits it may offer to a certain group of individuals who may utilize and engage with the findings. The following aspects of this research can help one understand its significance:

First and foremost, the main objective of this research is to deepen our knowledge of the relationships that exist between ASGM operations, environmental risks, and the expansion of rural livelihoods. This study intends to provide significant insights into the promotion and use of sustainable practices in artisanal and small-scale mining in the gold-mining regions of the Upper West Region.

Once again, it's crucial to comprehend the ramifications of ASGM involvement as far as diversification of rural livelihoods is concerned. In sub-Saharan Africa this understanding serves as a fundamental foundation for developing customized policies that can effectively encourage sustainable environmental stewardship and alleviate poverty in countries rich in minerals with a specific focus on Ghana.

Additionally, this study aims to contribute to the existing body of academic literature by examining the coping methods utilized by individuals, households, and communities in response to the ecological risks caused by ASGM operations.

The study's findings are anticipated to enhance the comprehension of the causes and consequences of ASM in the Upper West Region as well as the entire Ghana. The mining activities in Ghana have been found to have significant environmental impacts, as well as repercussions for the livelihoods and occupational health of mine workers. Additionally, these operations have been associated with pollution and social disruptions in the areas surrounding the mining sites.

More so, due to the interdependence of the seventeen Sustainable Development Goals (SDGs), the mining industry has the capacity to have an impact on almost all of these goals, both positively and negatively. There is a significant chance that small-scale gold mining can help a country get closer to accomplishing its goals for the Sustainable Development Goals (SDGs). This covers contributions to the following goals: SDG 1: poverty reduction; SDGs 2 and 6: hunger alleviation and human health; SDGs 13–14: environmental sustainability; SDG 2: nutrition enhancement; SDG 5: social development; SDG 8: creation of decent work opportunities; SDG

12: cleaner production; and SDG 16: peace, justice, and governance. It also contributes to the development of partnerships that help achieve these objectives (SDG 17). Through the creation of infrastructure networks, greater tax revenues, and prospective job possibilities, mining performed a tremendous responsibility in advancing economic growth.

The advancement of technology, infrastructure, energy, and agriculture is greatly dependent on the ASGM extraction industry. Small-scale mining has been acknowledged as a primary cause of many of the problems that the Sustainable Development Goals (SDGs) aim to address. These problems include but are not limited to: population displacement; environmental; social inequality, degradation; conflicts; economic downturn; corruption; gender-based violence; tax evasion; human rights violations and increased health risks. The aim of the present study is to explore, pinpoint certain areas as far as the research findings, and possibly provide solutions.

Quiet apart from the above, the results of the study hold significant value for policymakers operating in the ASGM industry. In order to lessen the negatives effects of ASGM and highlight its beneficial contributions to the Sustainable Development Goals is to create an organized framework to deal with unlawful mining. Given the significant links that exist between ASGM and the Sustainable Development Goals (SDGs), it is imperative that the formalization of these mining operations be planned strategically in a way that is inclusive and all-encompassing. As a crucial component of post-COVID-19 recovery and larger efforts intended at accomplishing sustainable development, this strategy should prioritize all 17 Sustainable Development Goals (SDGs).

This study's main goal is to increase our understanding of the effects of ASGM, rural livelihood diversification, and the environment's relationship to mining operations. Furthermore, the goal of this study is to establish a foundation for further investigation into the relationship between ASGM and the expansion of rural livelihoods in communities involved in mineral extraction. As so, it will enhance the body of knowledge for both experts and researchers working in this subject.

1.6 Scope of the Study

The scope of the research delineates the parameters of the research, acknowledging the inherent limitations that prevent the researcher from investigating all subjects and locations, as noted by Kothari (2004). This practice assists the researcher in maintaining concentration on the

work at hand, enabling them to make informed judgments regarding necessary modifications during the research process. These modifications ultimately lead to the acquisition of information that is both legitimate and dependable (Miles and Huberman, 1994).

The definitions of ASGM, which is a multidimensional activity, vary among nations, policy research institutions, researchers, and international governmental bodies. This study focuses on the extraction and processing of gold, which are the primary material used in Ghanaian ASGM operations. Ignoring the nuances of ASGM communities frequently leads to the implementation of regulations and industry support programs that are insufficient, according to Hilson (2009; cited in Bakia, 2015). As far as Ghana is concerned the study investigates the relationship between the diversification of rural livelihoods in particular mining areas in Upper West Region and the environmental concerns related to artisanal and small-scale gold mining. It makes use of the DFID's framework for sustainable livelihoods. This research aims to improve understanding of the nature and scope of livelihoods associated with ASGM in the three mining zones in Ghana's Upper West Region.

Again, the study narrows its geographic on ten communities that are involved in artisanal and small-scale gold mining (ASGM) within three districts. These districts—, Wa West, Nadowli-Kaleo District and Wa East District were chosen based on their well-established mining histories as well as the predominant ASGM operational features in the Upper West. Five villages are included in the: Manwe, Kande, Goripie, Duu and Danyuokura located in the Wa East District. On the other hand, Eggu, Tapko, and Polee are the three unique communities that make up the Wa West District. Just a few villages, like Takpo and Charikpong, demonstrated significant galamsey activity and were thus added to the Nadowli-Kaleo District.

This study specifically targeted the following populations: leaders of small-scale and artisanal gold miners; assembly members; gold buyers; chiefs and elders; district assemblies; heads of households; youth groups; the Environmental Protection Agency; the Minerals Commission; District Assemblies, other workers at mining sites (e.g., food vendors, blacksmiths, cooks, and provision shop sellers); and non-mining community members. The purpose of include these subjects was to collect pertinent information that was directly related to the study's main objectives.

1.7 Organization of the Study

The research is structured in nine (9) chapters, and it begins by offering a comprehensive overview of the contextual framework for the current research. In this initial chapter, various aspects are covered, starting with an exploration of the study's background and an articulation of the problem statement. The research topic is further clarified through a detailed statement that clearly defines the specific issue driving the need for this research. Following this, the chapter proceeds to delineate the research questions and the research objectives guiding investigation. These objectives and questions are carefully considered and addressed throughout the study to ensure that the research remains focused and purposeful. Additionally, the chapter engages in a discussion regarding the significance and scope of the study, highlighting why the research is important and the extent of its coverage. Ultimately, this introductory chapter serves to provide a roadmap for the entire study by elucidating the organizational structure that will be followed in the subsequent chapters, setting the stage for a coherent and systematic exploration of the research topic.

Chapter Two of the research study examines relevant literature in detail. The chapter provides a comprehensive review of both theoretical and empirical studies to establish a conceptual framework. This framework serves as a guide for the research investigation, directly addressing the objectives outlined in Chapter One. Additionally, this chapter explores theories relevant to the study's objectives.

The third chapter of this study explains the research methodology that was used. It gives the reasons for choosing the study area, which was divided into two parts: the Upper West Region as the larger geographical area, and the Wa East, Wa West and Nadowli-Kaleo Districts as the smaller sub-geographical areas. This chapter also discusses the research philosophy and paradigm that guided the study. It describes the institutions that were visited during the data collection process and the steps that were taken to get access and permission from the authorities of these institutions. Moreover, this chapter justifies the key aspects research design, target population, calculation of the sample size, and the sampling techniques that were used. It examines the potential validity and reliability of the research findings and addresses the ethical issues that were

involved in the study. Finally, this chapter presents the specific methods that were used for data analysis and explains the theoretical framework that supports this mixed methods research.

Chapter four is dedicated to exploring the demographic characteristics of the study respondents and analyzing and discussing the results of objective one. This objective aims to examine the operational methods and underlying factors driving artisanal and small-scale gold mining (ASGM) in the Upper West Region (UWR).

Chapter five delves into the analysis and discussion of the results of objective two, which aims to assess the socio-economic implications of artisanal and small-scale gold mining (ASGM) in the Upper West Region. This chapter examines the impact of ASGM on employment, income levels, and the overall well-being of the communities involved. Additionally, it explores the social consequences, including changes in community dynamics such security issues, socio-cultural practices, health issues, providing a nuance understanding of the broader effects of ASGM activities in the study area.

Chapter six presents the analysis and discussion of the results of objective three, which aims to explore the implications of artisanal and small-scale gold mining (ASGM) on rural household livelihood diversification, assets, and activities in the mining landscapes of the Upper West Region of Ghana. This chapter focuses on identifying the types of livelihoods that are adversely affected by ASGM, as well as those that are created either directly or indirectly by mining activities. It delves into the livelihood strategies and mitigating mechanisms employed by the inhabitants of mining communities to cope with vulnerabilities arising from ASGM. Furthermore, it evaluates the availability and access to the five capitals or assets which includes: natural, human, social, physical, and financial as discussed in detail in chapter two of this study.

Chapter seven presents the analysis and discussion of the results of objective four, which aims to analyze the environmental effects of land use and land cover (LULC) trends driven by artisanal and small-scale gold mining (ASGM) in the Upper West Region. This chapter not only examines the environmental consequences of ASGM on the physical environment encompassing land, air, and water but also delves into the land use land cover analysis (LULC) changes induced largely by human activities, with mining being a significant factor. The chapter provides a detailed

analysis of changes in the five LULC classifications: bare lands, open vegetation, closed vegetation, water bodies, and built-up areas. This analysis is based on the interpretation of Landsat images covering a period of twenty years, from 2002 to 2022. Through these comprehensive analyses, the chapter sheds light on the broader environmental impacts of ASGM and the resulting changes in land use and land cover.

Chapter eight offers the analysis and discussion of the results of the last objective five focuses on the aims to critical examination of the roles and effectiveness of regulatory institutions, laws, and government policies governing the mining sector in the Upper West Region. This chapter reviews the Ghana Minerals and Mining Act 730 of 2006, the primary document regulating the mining sector, to identify its flaws and areas for improvement. The chapter also evaluates the performance and effectiveness of key regulatory institutions, including the Environmental Protection Agency (EPA), the Minerals Commission, District Assemblies, and traditional authorities. Additionally, the chapter discusses the coordination and collaboration among these institutions and how their efforts align with government policies. This overall review and analysis, the chapter provides insights into the strengths and weaknesses of the current regulatory framework and offers recommendations for enhancing the governance and regulation of the mining sector in the Upper West Region.

Chapter nine which is the final chapter encapsulates the summary of key findings, conclusions and recommendation of the research. It also captures the contribution of the study to knowledge, limitations of the study and suggestions on for future research areas.

CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 Introduction

According to Kumar (2006) and Neupane (2021), the literature review is a crucial part of the research process because it provides information and backing for different parts of the study. In addition to demonstrating that the researcher has the necessary expertise for the investigation, it aids in justifying the research objective and identifying gaps in current knowledge (Bui, 2014; Neupane, 2021). In this section, the study topic is assessed through the examination of pertinent and academic sources, including books, journals, reports, papers, and texts.

This chapter primarily aims to accomplish two things. Establishing a theoretical groundwork for the study subject is its primary objective. Secondly, it seeks to improve the study methodologies and place the results in context with the current literature (Kumar, 2006; Neupane, 2021). In order to establish a foundation for future work, this chapter surveys the relevant theoretical and empirical literature extensively on concepts as captured in the research objectives in Chapter one.

Highlighting the significance of the selected research subject and drawing attention to the gaps in the current literature, the following part analyses the empirical data from prior studies. In order to provide a theoretical foundation for addressing the research questions and issues, the third section builds on the literature review and follows the Sustainable Livelihood Framework proposed by the Department of International Development (DFID). This framework serves as the research's compass, enabling a comprehensive examination of the complexities and repercussions of small-scale and artisanal gold mining. In order to assess the impact of several factors on the lives of marginalized communities, researchers have developed the multi-faceted Sustainable Livelihood Framework.

2.2 Theoretical Framework

In order to understand and foretell events, research relies heavily on theories and concepts. (Liehr & Smith, 1999; cited in Neupane, 2021) A theory is a set of interrelated ideas that serves as a framework for a study by outlining the interconnections between various concepts, words, and variables. The term "concept" refers to a theoretical representation of an abstract idea (Liehr & Smith, 1999, p. 7, as cited in Neupane, 2021). Concepts, according to Liehr and Smith (1999, p.

7), are "the building blocks of a theory that communicate its abstract ideas. Thus, there is a tight relationship between theory and idea, with the former serving to ground and guide the latter, and vice versa, in order to answer research questions. A number of seminal theories provide the theoretical framework for the present investigation. These include the Classical Theory of the Informal Sector and the Paradox of Plenty theory.

2.2.1 The Classical Theory of the Informal Sector

In 1994, Gibson and Kelley saw that theoretical expositions of the informal sector were fragmented; thus, they developed the Classical Theory of the Informal Sector. The unifying concept of the literature on the informal sector, according to Chacha (2017), is that it is a product of the capital-limited character of the economy, where capital is scarce. Unemployed people are pushed into the informal sector, according to this theory, because the level of demand is determined outside. In addition, he noted that the informal sector creates a separate social class rather than capitalists or workers.

ASGM requires less initial investment than industrial mining. The emergence of artisanal mining activities can be attributed to the fact that large-scale mining businesses are unable to hire the majority of the workforce because of skill gaps. Labour productivity is typically low in the informal sector, and this includes the technology employed by artisanal miners (Gibson, & Flaherty, 2017). "ASGM activities in international development circles are identified as the most rudimentary branch of the mining sector," states Clausen et al. (2011; as cited in Boaduo, 2022). Mineral processing and excavation are typically described as an activity that requires a lot of manual effort and does not use advanced technology. Most artisanal mining occurs in the informal sector, outside of legal systems, according to Bazillier et al. (2023).

The Classical Theory of the Informal Sector provides a pertinent theoretical foundation for artisanal mining due to the sub-sector's low productivity, largely illegal nature, labor-intensive nature, and limited number of employees per firm. Artisanal and small-scale mining impacts the ability of mining communities to deal, mitigate, or manage risks and shocks, or it makes them more vulnerable, depending on how you look at it from the viewpoint of livelihoods.

Although it has had a significant impact, Classical Theory of the Informal Sector has its flaws. There are a few significant drawbacks, such as:

Firstly, all businesses and employees in the informal sector must share the same traits and goals, according to the theory. The complexity and diversity of the informal sector is overlooked

in this (Williams & Gurtoo, 2012). The informal sector encompasses wage workers, subcontractors, employers, and cooperatives, all of which have different skills, resources, and connections to the formal sector.

Again, skeptics argue that concepts like the "informal economy" have the potential to standardize diverse activities (Rosaldo, 2021). Adding insult to injury, academics frequently use the term to describe a subset of informal workers, such as city dwellers in the Global South who are self-employed and have poor incomes. To be precise, the informal economy is vast and diverse.

Studies by Simba & Tajeddin, (2023) indicate that 2 billion people, or 61% of the global population, are employed in informal jobs, as reported by the Workers in emerging economies make up 68% of the total, while workers in developed economies account for just 18%. They are employed in a wide variety of jobs, both in the city and the country, in formal and informal businesses, in both paid and unpaid work, and in both legal and illicit trade, according to certain definitions. Despite popular belief, not all people who work in the informal sector are poor. A wide range of economic and political transactions, including "informal work," bribery, housing, loans, and bribes, are all part of the informal economy.

The idea that informality artificially separates formal and informal economies has been advanced by critics for some time (Rosaldo, 2021). Many companies can be described as operating in a hybrid model that combines the two ideal sorts of activities. For example, according to Peattie (1980; cited in Svampa, 2019), contracts in Colombia ensure varying degrees of compensation and protections, indicating that the country's labour laws are gradational rather than binary. Street sellers in Lima, Peru were deemed "informal" according to Roever (2005) because they did not pay income taxes and did not adhere to labour and health standards. But rules were applied inconsistently and selectively, so they had to constantly negotiate for partial formalization measures.

This view holds that the informal economy is separate from and unrelated to the formal economy. The reality that regulation, subcontracting, competition, and complementarity can influence and link the informal and formal sectors cannot be ignored.

2.2.2 The Tragedy of the Commons

The artisanal miners extract the ore from a shared resource in order to meet their own economic needs, as demonstrated by Hardin's 1968 Tragedy of the Commons theory (Hardin, 1968; Agyeman et al., 2012). The majority of artisanal mining occurs in the informal sector, outside of legal systems, which is corroborated by earlier work of Clausen et al (2011).

Working within the bounds of large-scale mining concessions, artisanal miners respect the environment as a common-property resource that provides mineral ores. Also, because the land is considered common property, the locals in mining towns look up to the big mining enterprises for jobs (Baah-Ennumh, 2012). Thus, during employment times, the residents of these mining-host communities are given precedence by the large-scale mining. When big mining corporations can't find suitable jobs for locals because their skills aren't a good fit, those locals may resort to artisanal mining, which sometimes involves intruding on the concessions of the big companies, to make ends meet. The ASGM pollute the water bodies where they process their ores without thinking twice since they consider them common property. Despite the lack of action to reclaim the lands they mine on, they are able to expose the ecosystem to mercury with impunity (Baah-Ennumh, 2012).

But everyone in society has to deal with the fallout from the artisanal and small-scale gold miners' actions. When people in a community get sick from working in artisanal and small-scale gold mines, it's not only those people who suffer. The ASGM's activities are based on the tragedy of the commons since the land that contains minerals is seen as common property that people can use for their own benefit, even though society as a whole ends up paying the price.

The tragedy of the commons is a contentious topic, despite its significance. The tragedy of the commons, according to many scholars, is not unavoidable and may be controlled to avoid depletion, so Hardin's assertions are incorrect. The ideological roots of this idea and Hardin's politics are causing a lot of people concern.

Ostrom (2008) demonstrated that individuals can and do restrict use of commons to avoid overexploitation by researching resource management in civilizations worldwide. Lynne et al (2016) found that ordinary persons' mechanisms for regulating commons fared better than "fancy" government systems, which went against Hardin's pessimistic view of people as selfish agents.

Instead of a "commonly" held by a small group of people who restrict access, Hardin demonstrated the tragedy of the commons on pastureland by utilising open-access resources. It is

incorrect for Hardin to use the term "commons" when referring to resources that are "open-access" or "unregulated" (Houser, 2023).

According to Dahlman (1980; Anabo, 2016), the commons are governed by governmental or quasi-governmental regulations. Limited access to resources affects groups. According to Hopkins and Wilkins (2006), common pastureland in England has a long history. A designated set of people held these pasturelands, and they forbade everyone else from interfering with their property rights. Their exploitation was frequently overseen by the local court, government, or quasi-government. Common property rights have always controlled Turkey's fisheries. The fishing community has established quotas in an effort to stave off depletion. Authorities also exert control over the fishing industry (Berkes, 1992; Anabo, 2013).

As a supplement to coercive regulatory frameworks, Hardin's assumptions and solutions leave the community out of management, and the theory doesn't show how community management is relevant in practice or theory. Ostrom argues that communities can manage their natural resources under specific circumstances. Ostrom (2008), cited in Anabo (2013), argues that communities can establish and uphold shared standards for their shared resources without outside interference from the government. She advocates for decentralization of power in order to preserve finite natural resources under controlled circumstances.

Hardin is correct that the unbridled use of finite resources would be disastrous for both people and the economy, but he fails to address the issue of participatory natural resource management in his proposed solutions. When it comes to managing limited natural resources, the idea often disregards the importance of local empowerment. Furthermore, the theory did not consider any alternatives to coercive laws for managing natural resources; it only relied on them. Resource conservation is threatened, according to Hardin, by commons users. Social learning and stakeholder interaction are essential for the effective management of natural resources, particularly water.

2.3 Review of Concepts

2.3.1 Mining

According to Balasubramanian (2017) and Raze (2023), mining is the process of working the earth's surface for the purpose of extracting economically valuable minerals like diamonds and gold. In addition to meeting their economic and military needs, mineral mining is a major driver of economic growth and development in the majority of the world's countries (Mensah et al., 2015). Those who stand to gain from mining often claim that the industry can continue with little environmental impact (Balasubramanian, 2017; Fianko, 2021).

The impact of mining operations on water resources and quality in the communities that are directly or indirectly impacted by these projects' casts doubt on the idea of minimal environmental harm (IFC/WHO 2007).

Underground, open-surface (pit), placer, and in-situ mining are the four primary techniques of mining (Smith, 2019). Surface mining is believed to extract over two-thirds of the world's annual mineral production. Surface mining can be categorised into three main practices: open-pit, strip, and quarrying (Dubiński & Koteras, 2021). According to Qudrat-Ullah and Panthallor (2020) open-pit mining is a form of strip mining that requires the removal of overburden layers to access the mineral deposit, which is typically located at great depths in the earth. They went on to say that before the overburden is removed, it is common practice to clear, cut, and burn vegetation, as well as log trees.

2.3.2 The Livelihood Concept

Livelihoods are defined as an overarching notion. Nonetheless, according to Beall and Kanji (1999), the means and methods of producing a living are what constitute a livelihood. More and more, people are coming to terms with the fact that people and families meet their most fundamental socioeconomic requirements via a myriad of interrelated actions, skills, and resources. The idea suggests that earning a living is merely one aspect of livelihood. The following definition was provided by the DFID Sustainable Livelihoods Guidance Sheets (1999), drawing on Chambers and Conway (1992):

A person's capacity to provide for themselves, their assets (which might be material or social in nature), and the activities that bring in money are all part of their livelihood. To be

sustainable, a means of subsistence must be able to withstand and even thrive in the face of adversity, while also preserving or improving upon existing capacities and assets without compromising the integrity of the natural resource foundation.

The ground-breaking work of Robert Chambers in the 1980s laid the groundwork for the concept of livelihoods, which was later developed by Chamber, Conway, and other researchers in the early 1990s (DFID, 1999; Khatiwada & Subedi 2023). Several global platforms have acknowledged and supported the idea of sustainable livelihoods. In 1987, the Brundtland Commission placed an emphasis on rural residents' ability to own and access resources, meet their fundamental requirements, and ensure their livelihood stability. Agenda 21 of the United Nations Conference on Environment and Development (UNCED) in 1992 revised and expanded the idea to include "sustainable livelihoods for all. Subsequently, the Copenhagen Social Summit explicitly connected the concept to full employment and sustainable livelihoods, and the Beijing Platform emphasised the importance of women's livelihoods to effective development (UNDP, 1999; Khatiwada & Subedi, 2023).

After publishing its White Paper on International Development in 1997, DFID began to include sustainable livelihoods strategies into its development programmes with the goal of eradicating poverty (DFID, 1999; Khatiwada & Subedi, 2023). Wyss (2004) and Khatiwada and Subedi (2023) note that the World Bank, FAO, IFAD, and the European Commission are all pushing for this strategy. A framework for thinking about the goals, scope, and development priorities is the livelihood approach. For the purpose of better understanding livelihoods, especially for the poor, DFID has established the sustainable livelihood framework, which consists of six guiding principles. According to UNDP (1999) and DFID (1999), a person's livelihood encompasses all the activities that allow them to earn a living, meet their basic needs, and ensure their survival in all parts of their life. It includes the skills, assets (both monetary and social), and pursuits that are necessary for subsistence (Haobijam and Ghosh, 2023).

2.3.3 Concept of Rural Livelihood

In recent years, rural development and poverty reduction have increasingly incorporated the notion of livelihood and sustainable livelihood. The activities that ensure the survival and well-being of households in rural areas make up rural livelihoods (Opeyemi, Nwankwo, & Olagunju, 2021). Living conditions, skills, and resources, such as food, money, and assets, are what make up a person's livelihood, according to Chambers and Conway (1992); Kumar et al. (2023) and other researchers. There are two main types of livelihood strategies, according to Hassan (2021): those that rely on natural resources (such as collecting and gathering, farming, and livestock keeping) and those that do not (such as trade, services, and remittances).

Rural development efforts in the past aimed to ensure food security for low-income people by promoting modern agriculture (Hassan, 2021). According to Fabusoro et al. (2010) and Hassan (2021), the concept of livelihoods centres on the ways in which rural communities deal with the social, economic, and environmental challenges they face while trying to provide for their families. Investment, production system, and employment choices are all part of the decision-making process that people use as a coping technique. They supported the previous claim that rural Africans are turning to non-farm pursuits as a means of hedging their income against the ups and downs of farm revenue due to market failures in their home nations.

2.3.4 The Concept of Livelihood Diversification

Many scholars have looked into the idea of livelihood diversification in response to growing worries about the growth of non-farm economies in rural areas. In order to stay afloat and raise their level of living, many households engage in what is known as "livelihood diversification" (Dagunga, 2020). Diversifying one's means of subsistence is distinct from diversifying one's source of income, contrary to what some research suggests. As an example, Senadza (2014) examined how rural households in developing nations diversify their income sources and used the two terms interchangeably. In a study conducted by Zakaria et al. (2019), the welfare effect of livelihood diversification was examined among farm households in Northern Ghana. Farm households were asked to mark 1 if they engage in other income generating activities and 0 if they do not. The researchers used a dummy variable to represent livelihood diversification. Income diversification, rather than livelihood diversification in its whole, was the sole subject of this study. Livelihood diversification, as defined by Ellis (1998; Dagunga (2020), includes income

diversification as well as other types of diversification like cropland diversification and labour diversification, while income diversification is distinct from this (Asravor, 2018).

Engaging in alternate activities outside of farming is known as non-farm diversification. The expansion of commercial endeavours unrelated to farming, as defined by Dagunga (2020), is what this term refers to. Contrarily, growing different kinds of crops or raising different kinds of animals is what's known as "on-farm diversification" or "cropland diversification" (Asravor, 2018). "On-farm" implies a wide range of agricultural activities. The wage-employed and the self-employed make up the non-farming category of Ghana's economy (Asravor, 2018). Households that provide their labour in exchange for regular (daily, monthly, etc.) wages or salaries are considered to be part of the wage employed sector. On the flip side, those who work for themselves often run their operations out of their homes or on portable platforms like kiosks or table tops (Asravor, 2018). Transportation services, livestock production and trading, and the infrequent migration to the southern region of the country in quest of comparatively greener pastures are the main occupations of men in the north, while the majority of women work in agro processing enterprises, such as groundnut paste and shea nut butter production, retail or wholesale rice trading, and so on (Dagunga, 2020).

A similar strategy is known as "off-farm diversification," which entails working in several economic sectors that are unrelated to farming. Aspects of diversifying livelihoods are addressed by each of these dimensions. According to FAO (2015), rural households are able to better manage risk and enhance their well-being by diversifying their livelihoods. According to Asravor's (2018) empirical research, the country's northern belt has less diversity than its southern stretch. As for resource poor households in northern Ghana, Dzanku (2015) and Dagunga (2020) both found signs of increased livelihood diversification.

2.3.5 Artisanal and Small-Scale Gold Mining

While the precise nature of ASM is up for debate, most agree that it refers to the manual, oversimplified processes involved in mining and processing minerals. Similar to informal e-waste recycling, ASM is mainly engaged in by individuals who are unable to find other ways to earn a living. Prospecting, excavation, mineral processing to increase the concentration of the targeted metal, and, in cases where technology is available, extraction and recovery of the metal are all part of ASM processes, which vary depending on the commodity mined. Over 44.5 million individuals

are directly involved in ASM on a global scale, with around 30% of that workforce being female (Moyo, Chitaka, Lotter, Schenck & Petersen, 2022).

The mining industry provides a living for more than 60 million people in sub-Saharan Africa, and more than 13 million of them work as artisanal miners (Girard, V., Molina-Millán et al., 2022; Moyo et al., 2022; Adranyi et al., 2023). According to the International Gold Forum IGF (2017) and Moyo et al. (2022), ASGM accounts for 20% of the world's gold supply. ASM is a major contributor to the gold production of several African countries, including Zimbabwe and Ghana. There has been tremendous growth in the ASM sector, with the number of people employed rising from 13 million in 1999 to 30 million in 2014, and now it sits at little over 44.5 million (Moyo et al., 2022). There will likely be an increase in the use of ASM in the near future due to rising unemployment and urban-to-rural re-migration caused by the COVID-19 pandemic's accelerated shrinkage of the job market (Telmer and Kroll, 2020; Moyo et al., 2022).

2.3.5.1 Global View on Artisanal and Small-Scale Mining

As a global issue, ASGM has caused worry in many regions, particularly in developing countries. Through the development of jobs, it significantly contributes to the reduction of poverty. But it comes with a slew of negative environmental and health effects, including land degradation, water pollution, loss of vegetation cover, exposure to harmful particulate matter, and workplace accidents (Zollo, 2019). The employment of outdated methods, a lack of trained personnel, and ineffective leadership are all to blame for these negative outcomes (IGF, 2018). Many regions of the world, particularly in the southern hemisphere, engage in this activity. Central America, Asia, Oceania, sub-Saharan Africa, and South America make up the bulk of it. Due to inadequate government statistics, seasonality of some individuals in the sector, and the informal character of most ASM activities, the exact number of individuals working in ASM is simply an approximation (Zollo, 2019). There were around 6 million ASM participants in 1993. An estimated 13 million were living in the area in 1999.

As of 1999, ASM was also providing assistance to over 80 to 100 million dependents (Zollo, 2019; ILO, 1999). In 2009, ASM was directly used by 5-20% of the population in nearly every African nation; by 0.1-1% in Asia and 0.15–5% in Latin America (Dorner et al., 2012). The number of individuals directly involved in ASM increased to approximately 20 to 30 million in 2014. Reasons for this growth in population could be the scarcity of other means of subsistence and the skyrocketing prices of minerals, particularly gold (Seccatore et al., 2014). With an

estimated 40.5 million people actively participating in ASM in 2017, the numbers are clearly on the rise (IGF, 2018). The formalisation of the ASM sector has been a significant difficulty as the industry is perceived as casual and has been for some time (Banda, 2023; Zollo, 2019).

Millions of people in about 80 countries rely on artisanal and small-scale mining for a substantial portion of their income (World Gold Council, 2017; Siaciti, 2022). ASM occurs in many different parts of the world, but it is most common in the southern hemisphere, which includes parts of Asia, Oceania, Central and South America, and sub-Saharan Africa. A number of factors, including the number of miners, a mine's production capacity, the amount of mechanisation, and the size of capital investments, have been used to characterise "artisanal and small-scale" mining (International Labour Organisation (ILO), 1999; The World Gold Council, 2017; Siaciti, 2022).

The rising cost of minerals and the growing challenges in making a livelihood in other fields, such as agriculture, are the reasons behind the sector's increased activity (Seccatore et al., 2014; Siaciti, 2022). Nearly 44.75 million individuals are directly engaged in the ASM subsector, as per the most recent data from the Artisanal and Small-scale Mining state of the sector report (Siaciti, 2022). The ASM subsector indirectly helps around 150 million people (Levin, 2014). Figure 2.3.5.2 shows that not all African, Latin American, and Asian nations have the same number of individuals participating in ASM. In 2009, 5–20% of the population in most African countries relied on ASM; in Latin America, 0.1–5%; and in Asia, 0.1–1%.

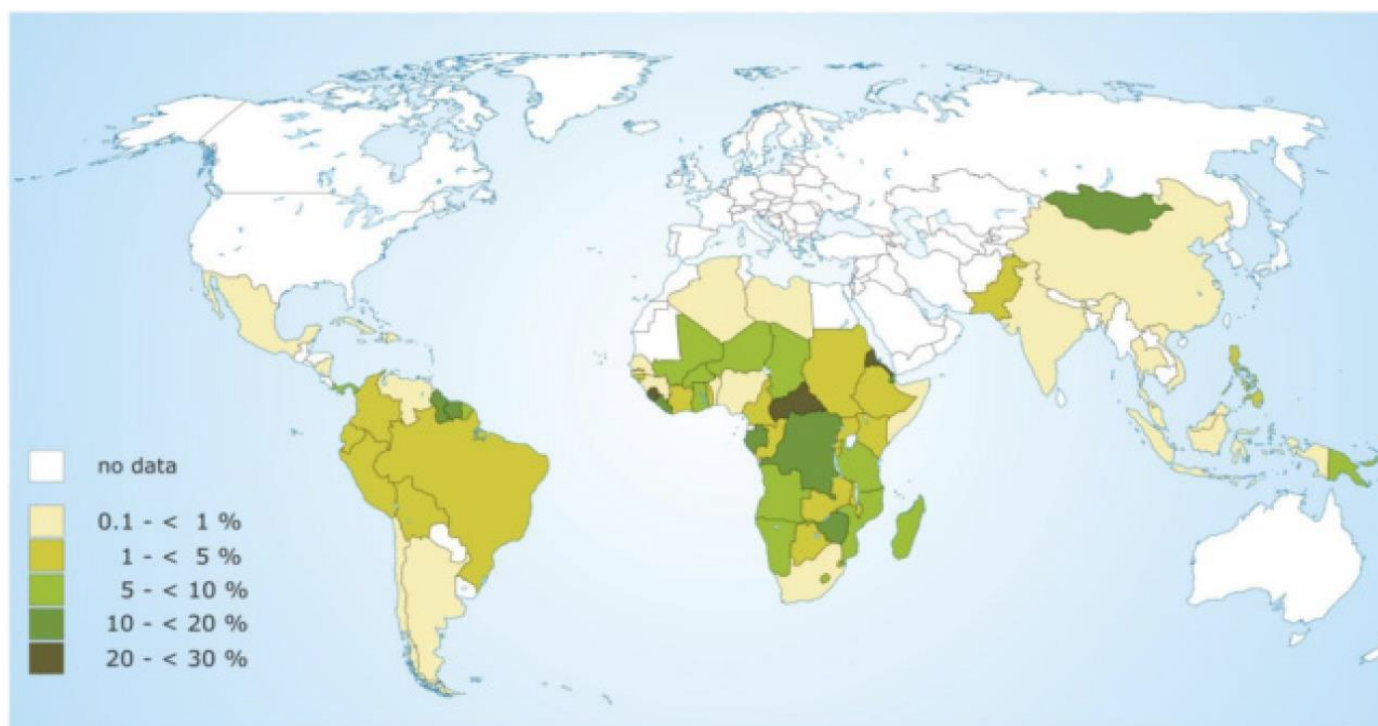


Figure 2.3.5.2: Percentage of population that depends on ASGM (Dorner et al, 2012; cited in Siaciti, 2022)

2.3.5.2 African Perspective on Artisanal and Small-scale mining

Particularly in the sub-Saharan area, ASM is widely used in Africa. Apart from supporting a large number of dependents, ASGM also provides millions of people with direct and indirect jobs and income (Zollo, 2019). As said in artisanal mining, there are little limits on admission, but a lack of economic possibilities in most African nations is a contributing factor to the large number of people participating in ASGM (Ejigu, 2011; Zollo, 2019). Low levels of expertise, shoddy infrastructure, low starting capital, and simple entrance and exit criteria characterise the industry. Because of this, ASM estimates are subject to change (Zollo, 2019; UNECA, 2011). Sub-Saharan Africa's ASM mines a variety of minerals, just like mines in other parts of the world. Gold is the most widely used mineral, although other valuable minerals include diamonds, coloured gemstones, and industrial minerals including tin, tantalum, tungsten, limestone, clays, and iron ore (Dorner et al., 2012; Zollo, 2019). Among the populations of sub-Saharan Africa, ASM employs millions and indirectly supports millions more (Hilson, 2016; Zollo, 2019). These statistics are shown in table 2.5 below:

Table 2.3.5.2: Number of ASGM Operators and Estimated Dependents

Country	Main Minerals Mined	ASGM Operators	Estimated Dependents
Burkina Faso	Gold	200,000	1,000,000
Tanzania	Diamonds, colored gemstone and gold	1,500,000	9,000,000
Ghana	Sand, diamonds and gold	1,100,000	4,400,000
DR Congo	Coltan, diamonds and gold	200,000	1,200,000
Chad	Gold	100,000	600,000
Uganda	Gold	150,000	900,000
Guinea	Gold and Diamonds	300,000	1,500,000
Madagascar	Gold and Colored Gemstone	500,000	2,500,000
South Sudan	Gold	200,000	1,200,000
Ethiopia	Gold	500,000	3,000,000
Niger	Gold	450,000	2,700,000
Cote D’voire	Diamonds and Gold	100,000	600,000
Mali	Gold	400,000	2,400,000
Liberia	Diamonds and Gold	100,000	600,000
Mozambique	Colored gemstones and gold	100,000	1,200,000
Angola	Diamonds	150,000	900,000
Central African Republic	Diamonds and Gold	400,000	2,400,000
Malawi	Gold and Colored Gemstones	40,000	Not Available
Sierra Leone	Gold and Diamonds	300,000	1,800,000
South Africa	Gold	20,000	Not Available
Zimbabwe	Diamonds, colored gemstones and gold	500,000	3,000,000
Eritrea	Gold	400,000	2,400,000
Nigeria	Gold	500,000	2,500,000

Source: UNECA, 2011 as cited in Zollo (2019)

2.3.5.3 Ghana’s Perspective on Artisanal and Small-Scale Gold Mining

Kessey and Arko (2013) as cited in Fianko (2021) opined that in Ghana, ASGM has become a persisting through the period of colonial rule despite an introduction of large-scale mining by Europeans. A dominance of ASM in Ghana's mining industry has spanned traditional, colonial, and post-independence periods, the Small-Scale Mining Law, 1989, saw a temporary ban lifted in 1989 (Sarpong, 2017).

Ghana has over 1.1 million inhabitants that are employed directly within artisanal and small-scale mining (ASM), with an additional 44 million dependent on this sector (Dauda, 2023).

Nevertheless, the activities of AGSM have led to water pollution within the nation (Afum & Owusu, 2016; Fianko, 2021). Challenges faced by Ghanaian communities and small-scale gold miners include limited access to equipment, difficulties in obtaining formal finance, and challenges in securing licenses (McQuiken & Hilson, 2016).

Gold remains Ghana's leading export, contributing significantly to the country's economy. In 2018, ASGM accounted for approximately 43% of the overall documented gold output, providing livelihoods for over five million individuals either directly or through indirect means (Adu-Baffour et al., 2021).

Ghana's artisanal and small-scale mining (ASM) sector has undergone a shift from artisanal methods changing to a mechanized, more sophisticated industry over the past two decades, with the introduction of advanced equipment and machinery (Ofosu et al., 2017). However, this growth has also led to environmental concerns, including, pollution of water supply sources, the destruction of arable lands and forest reserves. The activities of both foreign and local illicit mining have witnessed a surge over the past decade, contributing to environmental degradation. The government has implemented interventions, such as the ban on activities of ASM between April of 2017 and December of 2018, enforced by Operation Vanguard, comprising military and police personnel (Hilson and Maconachie, 2020b).

While Operation Vanguard reported success in clamping down on illegal mining, there were challenges, including violent confrontations and allegations of corruption within the security task force (Adu-Baffour et al., 2021). The government's strategy and intentions behind these interventions have been subject to scrutiny, with debates about the long-term prospects for formalizing the ASM sector (Dery Tuokuu et al., 2020; Hilson and Maconachie, 2020b).

2.4 Large Scale mining in Ghana

Due to its regulated phases, sophisticated equipment, and knowledgeable personnel, large-scale mining which warrants a license for conducting reconnaissance across a thousand Km² (Square kilometres) or more—is regarded as the best technique for extracting minerals (Hentschel, 2003; Kazapoe et al., 2023). Technology, geology, legal, marketing, work force, finance and organizational structure, and are just a few of the many facets it covers. Large-scale mining is directly linked to multinational firms participating in worldwide capital and finance markets, and it is essential to the global supply of commodities and mineral metals (Kemp and Owen, 2019).

Ghana is home to a number of large mining companies, such as Azumah Resources, Chirano Gold Mines, Asanko Gold Ghana, Golden Star Mining Company, and Perseus Mining Ghana Limited.

By using state-of-the-art technologies and knowledge on the ore body, the large-scale mining business runs effectively. Large-scale mining, as opposed to informal mining, is governed by organizations, keeps accurate books, pays taxes, supports national development, and offers social amenities like roads, schools, health care facilities, and more (Hentschel, 2003; Kazapoe et al., 2023). By using Standard Operating Procedures (SOP) to reduce accidents and carry out land reclamation for environmental restoration, the industry complies with safety regulations.

A 10% free stake and supplementary 20% stake may be owned by the government in Ghana's about 19 large-scale gold mining companies, which are primarily privately held (Akabzaa and Darimani, 2001). There have been cases of negative environmental repercussions, such as the release of Water that has not been treated entering bodies of water on the surface because of financial concerns, despite laws controlling large-scale mines water use (Sunkari et al., 2021).

2.5 Historical Overview of Small-Scale Mining in Ghana

Although precisely the period regarding the metal's discovery in West Africa is unknown, it is most likely that it occurred about 500 BCE. Based on historical evidence, it is possible that the Romans obtained some of their gold from West Africa and used it to produce coins in Carthage, which is today Tunisia (Iliffe, 2017). The advent of camels made it easier for people to commerce over the Sahara, granting accessibility for the marketing gold from West African (Griffis et al., 2002; Kazapoe et al., 2023). Arabic traders were drawn to the coast of West Africa by Ghana's alluvial gold mining, which dates back to the sixth and seventh centuries AD (Hilson, 2002). This operation, which usually took place near rivers, entailed washing sediments thought to contain valuable minerals in order to separate gold (Hilson, 2002; Kazapoe et al., 2023).

Ghana's economy was mostly based on agriculture, but gold mine produced significant riches that fueled the growth and spread of civilizations (Kevane, 2015). Between the sixteenth and nineteenth centuries, Europeans were drawn to the allure of gold, which increased competition for trade along the coast. More than thirty castles and forts that are remnants of the slave and gold trade are evidence of this legacy (Griffis et al., 2002). Following the colonization of the Gold Coast in 1874, the "modern mining" period really got underway, bringing with it highly mechanized and

organized mining along with exploration and technologies from other gold mining zones (Griffis et al., 2002; Kazapoe et al., 2023).

Approximately 90% of Ghana's mineral income comes from the mining of gold, which is done on both large and small scales. Individuals and organizations working in small-scale mining employ simple tools and minimal machinery (Hentschel, Hruschka, & Michael, 2002). The World Bank Group characterizes ASGM as a "poverty-driven activity", carried out in isolated rural locations by a poorly educated population with few options for employment (Goetz, 2022). Ghanaians have been engaged in artisanal gold mining since the 5th and 6th centuries BC, long before colonization (Ministry of Lands and Natural Resources, 2017).

Artisanal and small-scale mining, which can take both legal and illicit forms, are terms that are interchangeably used to describe small-scale mining (Bansah, 2017). Galamsey, the term for illegal mining in small scale in Ghana, involves various methods., including operating without a permit, utilizing unauthorized equipment, neglecting to restore damaged land, and subleasing licenses to foreigners (Samuel, Oladejo, & Adetunde, 2012). Galamsey is another term that can be used in place of informal or illegal small-scale mining.

Small-scale mining continued unofficially as an industry driven by poverty for approximately thirty-two years after Ghana gained its independence (Ministry of Lands and Natural Resources, 2017). Ghana approved the Small-Scale Gold Mining Law in 1989 to legitimize and regulate activities after realizing its potential to reduce poverty (Mineral Commission, 2015). Yet, because of alleged difficulties with the registration procedure, illicit mining continues (Ghana News Agency, 2015).

As a result of the influx of foreign nationals with funds and machines, small-scale mining operations now employ sophisticated machineries, in contrast to the original definition that relied on basic equipment (Mineral Commission, 2015; Laari, 2018). As of 2017, there were around 50,000 illegal miners in Ghana, which increased galamsey operations and social and environmental problems (Burrows & Bird, 2017). On April 1, 2017, in response to public uproar, the government outlawed small-scale mining in all its forms (Ministry of Lands and Natural Resources, 2017). Galamsey is still unlawful, nevertheless, as evidenced by the covert operations of small-scale illegal miners, which have resulted in documented instances of illicit mining occurrences (Abdulai, 2017; News Ghana, 2017).

2.6 The poverty trap and ASGM

Researchers such as McQuilken and Hilson (2016) examine the potential connection between the sector of ASGM and development in Ghana, addressing the challenges faced by policymakers of Ghana in formalizing the sector, including the prevalence of galamsey. They also explore potential connections to both urban and rural poverty in Ghana. The criminalization of galamsey impacts how practitioners operate and deters them from obtaining licenses to formalize their businesses. Key legal instruments governing the formal mining sector in Ghana include the Minerals and Mining Act (an updated version of the 1986 law), Ghana's 1992 constitution, the Precious Minerals and Marketing Corporation Law of 1989 and the Minerals Commission Act of 1993, which is applicable to activities of ASGM. In 2016, the Ghana's Minerals and Mining Policy enacted provide an overall framework for mining regulations, aiming to guide the government's management of the sector and ensure growth that is sustainable. (Li et al., 2021).

Formal small-scale mining is defined as "mining by any method not involving substantial expenditure," According to the 2006 Minerals and Mining Act, mandating licenses for operators for mining a maximum of 10 hectares of land over a three-to five-year period (Li et al., 2021). Miners operating with no required permit are considered illegal miners or galamseyers. However, the formalization process itself is complex and cumbersome, serving as a significant barrier for galamsey operators to obtain licenses, as highlighted by authors Afriyie et al. (2016). Teschner emphasizes a complexity and efficiency in the process of registration, which discourages miners due to unreasonable fees and excessive paperwork (Teschner, 2012).

The fact that those involved in galamsey are entangled in a perpetual state of impoverishment highlights the poverty-driven aspect of artisanal and small-scale mining (ASM), which has its roots in grassroots communities. The claim is that the entry of large-scale mining companies and the legality of small-scale mining led to the uprooting of indigenous peoples, stripping them of their homes and land and compelling them to participate in informal operations. This cycle of poverty in Ghana gets worse by the use of mercury in ASM, which exposes miners to health risks, dishonest gold purchasers, and debt. According to the authors, the informal economy and poverty that are typical of the ASM sector are made worse by a dependence on mercury. The pervasive association of galamsey with poverty in the dominant discourse is emphasized by scholars like Hilson and Pardie, underscoring the importance of understanding the

social and economic factors influencing individuals' participation in galamsey (Hilson & Pardie (2006; Faanu, 2017).

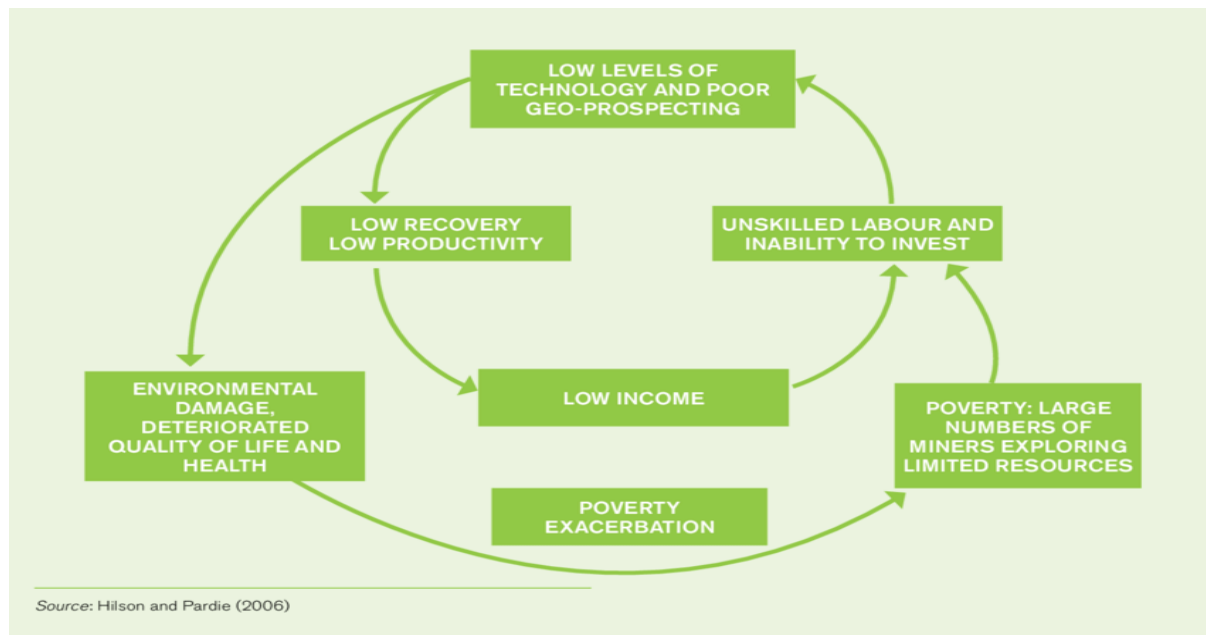


Figure 2.6: Artisanal and small-scale mining poverty-trap

Source: Hilson and Pardie (2006) as cited in McQuilken and Hilson (2016).

2.6 Importance of Artisanal and Small-Scale Mining in Ghana

According to ICMM (2015), more than 95% of Ghana's mining profits come from gold. It was the second-largest African producer in 2012, behind only South Africa, with total exports of US\$5.64 billion, accounting for 3.3% of the world's gold (McQuilken & Hilson, 2016). According to several sources, including the Ghana Chamber of Mines (2014), Minerals Commission (2015b), ICMM (2015), and McQuilken and Hilson (2016), mining was a significant contributor to the national economy in 2014. Specifically, large-scale mining (LSM) operations accounted for around 65% of production.

Although large-scale gold mining is still a major part of Ghana's GDP and a source of wealth creation, mining code liberalisation in West African competitor countries and a decline in the price of gold have led to less investment, lower production volumes, and the mothballing of operations, resulting in the layoff of thousands of workers (Mustapha, 2014; McQuilken & Hilson,

2016). The economic and development potential of Ghana's ASM sector is coming into sharper focus against this backdrop, as well as the International Council on Mining and Metals' long-term life-cycle projections of stagnant production volumes, sales revenues, and expenditures for large-scale mining (International Council on Mining and Metals, 2015). To paraphrase one interested party, "Its time is now" when asked about ASM.

One of the most vital economic and livelihood activities in Ghana today is ASM, which has grown steadily over the last 20 years. The impact of ASM on the labour market is far greater than that of LSM, which employs around 16,000 people directly and indirectly supports 66,000 jobs (ICMM, 2015; McQuilken & Hilson, 2016). ASGM also generates up to five million job opportunities in downstream industries and markets (Ghana Chamber of Mines, 2014; MinCom, 2015b; McQuilken and Hilson, 2016) all state that ASM contributed 2.2% of Ghana's total gold production in 1989, but by 2014, that percentage had risen to 35.4%, equivalent to nearly 1.5 million ounces of gold.

The scholarly literature generally attributes this increase to ASM being driven by poverty. It also acknowledges the many pull and push factors that influence people's livelihoods and draw them to the sector, as well as the recent trend of an increasing number of well-connected, educated, and financially-positioned entrepreneurs seeing it as a business opportunity (Hilson and Hilson, 2015; McQuilken & Hilson, 2016). Academics, politicians, and ASM stakeholders in Ghana are now divided on this issue; some see the sector as mostly driven by poverty, some think it's filled with businessmen, and yet others think it's a little of both. The policy ramifications of this difference are worrisome, as explored by Hilson and Hilson (2015) and McQuilken and Hilson (2016).

Numerous studies have shown that the fast expansion of ASM initiatives during the last 20 years is directly attributable to the widespread economic reforms that took place in sub-Saharan Africa (including Ghana) in the late 80s. The sector offered a quick economic haven for the tens of thousands of people laid off by structural adjustment and farmers who were having trouble adjusting to liberalized markets. The low barriers to entry meant that low-income communities could find regular, well-paying jobs (Hilson & McQuilken, 2014; Hilson and Hilson, 2015; McQuilken & Hilson, 2016). Although ASM has many positive economic and development traits and is becoming increasingly important in Ghana, the industry is nonetheless overshadowed by the negative social and environmental repercussions of its operations. This is mainly due to the

fact that most small-scale miners do their business in an informal and unlawful manner, without the protection of a licence. There is an urgent need to seize the chance to formalise Ghana's ASM sector in a way that is inclusive and based on rights. This would have a profound impact on the country's economy and development.

2.7 Empirical Literature Review

2.7.1 Mode of Operations and Causes of ASGM

2.7.1.1 ASGM Processing Methods

Due to its capacity to produce an alloy with gold, which helps separate the precious metal from rock, sand, and other materials, amalgamation is a method used by artisanal and small-scale miners to extract gold (Dreschler, 2001; Magodi, 2017). The amalgam is then heated to evaporate the mercury and leave just the gold, usually in a metal pan or shovel over an open flame (Kessey and Arko, 2013). Whole-ore and heavy mineral concentrate amalgamation are two examples of amalgamation techniques.

Artisanal and small-scale miners process gold via sluicing techniques in addition to amalgamation (Malehase et al., 2017). Water is used in sluices to wash alluvium or ore down sloped platforms. Gold particles drop as silt is carried downstream and are caught by materials—often carpets—that cover the sluice's bottom (Magodi, 2017). The majority of the gold is collected at the sluice's beginning because the water's force as it descends prevents the gold particles from sinking easily. Sluices are normally slanted between 5 and 15 degrees (Dreschler, 2001).

Small-scale and artisanal gold miners also use shaking table methods for processing gold. Elevated tables with raised ridges running horizontally and a slight lean to one side are called shaking tables. At one end, water, crushed ore, and specific grooves lead the gold to collection spots on the table's side while lighter minerals are washed away (Obiri et al., 2010). The process continues as the material washes down the table. A motor continuously agitates the shaking table to help separate the gold particles (Arah, 2015; Magodi, 2017).

2.7.1.2 Factors Contributing to Illegal Mining Activities

In this section, we'll look at the many things that motivate people to engage in artisanal and small-scale gold mining. Illegal mining is a problem in the country for many reasons. Because of these considerations both skilled miners and regular, untrained people from all over the world, as well as criminal organizations, flock to the mining sector. Some of these factors that make people join AGM are discussed into detail below:

Unemployment rate

The majority of people living in rural areas of Ghana work in agriculture, as mentioned above. In addition to farming, individuals augment their earnings by other economic activities like fishing, animal rearing, basketry, charcoal burning, and other fast-income-generating pursuits. The galamsey operation is a quick way for people living in areas rich in mineral deposits to make money. Therefore, the main reason galamsey activity starts in Ghana is to provide jobs. According to Citifmonline (2014) and Laari (2018), the residents of the legal mining areas have been motivated to engage in galamsey operations as a main source of income due to the ongoing rise in the price of gold. About 170,000 persons in Ghana are involved in galamsey operations, despite the fact that only 30,000 people work in the legitimate mining sector (Samuel, Oladejo, & Adetunde, 2012; Laari, 2018).

Poverty

One way to diversify one's income is through artisanal and small-scale mining, which is often characterized as an activity driven by poverty (World Bank, 2013). According to Persaud, Telmer, Costa, and Moore (2017), this industry helps supplement the income of Senegalese farmers. As a result of economic hardship, many rural Sierra Leoneans have turned to illicit gold and diamond mining as a means of subsistence (Carier & Burge, 2011). Similarly, Aidoo (2016) and Laari (2018) also list poverty as a factor that pushes people into galamsey in Ghana. The idea that illicit small-scale mining cannot be abolished until the miners are given alternate means of subsistence is based on the claims that poverty forces people to engage in galamsey (Laari, 2018).

Evidence from studies by Cilliers and Aucoin (2016) and Lebitso (2021) shows that both industrialised and developing nations have experienced poverty. Illegal mining is just one example of how low-income families, individuals without access to formal education, and other factors can drive people to engage in criminal activity (Holtman & Swart, 2007; Lebitso, 2021). This is

supported by the findings of Cilliers and Aucoin (2016), which discovered that when people are poor, they are more likely to engage in illegal businesses like drug sales, which in turn increases crime. From what has been said thus far, it is clear that the illicit mining industry provides a financial boon to individuals who are desperate and living below the poverty line.

Easy Access to Old Mines

Illegal mining activities pose a threat to mining industries worldwide, but another major concern is the ease of access to mines. Olawumi (2011) and Lebitso (2021) state that the mining industry struggles with the oversight and regulation of easy access to both operational and decommissioned mines. The reason behind this is that these mines have larger holes that need to be sealed, which requires substantial financial resources that may be better utilized in many sectors, such as enhancing security measures, among other things. Illegal miners use explosive chemicals to blow their way into pits that have been sealed, as shown by Olawumi (2011). Because illicit miners are typically armed with powerful weapons, police authorities get terrified to police such locations.

Nature of licensing process

One of the apparent complexities of the licensing process is another element that favors galamsey (Laari, 2018). Although it is said that small-scale mining is driven by poverty, the procedure for obtaining a licence is seen as costly and exclusive to the well-off in Ghana. The low-income residents of the mining towns are the ones who will benefit most from the permit, yet they cannot afford the steep fees associated with getting it. Consequently, many small-scale gold miners work illegally because to the bureaucracies, the cost of acquiring a licence, and other setbacks (Bansah, 2017; Laari, 2018). Just as local authorities in Ghana are supposed to help prospective miners through the regulatory process, the power remains with the high authorities, which makes the process even more drawn out, according to McQuilken and Hilson (2016), who argue that centralised authority is a hindrance to formalising small-scale mining in the country.

Inadequate enforcement of Mining Regulations

According to the Ministry of Lands and Natural Resources (2017), one reason for the increase in illicit mining activities in Ghana is the lack of strong rule enforcement by the appropriate institutions. Consequently, many Ghanaians feel emboldened to conspire with their

Chinese accomplices to increase their illicit mining activities due to the mining regulations that are both lenient and poorly enforced (Agric in Ghana Media, 2017; Fick, 2017; Laari, 2018).

2.8 Socio-Economic Implications of ASGM

The following sections will examine the positive and negative impacts of artisanal and small-scale gold mining (ASGM) on both society and the economic environment:

2.8.1 Child Labour in ASGM

Child labour refers to the practice of hiring children in any type of job that deprives them of their childhood. Child labour is widespread in numerous small-scale mining operations as a result of pervasive poverty (Adranyi et al., 2023). Children participate in artisanal and small-scale mining without receiving sufficient remuneration, or frequently without any remuneration whatsoever (Hoedoafia et al., 2014). Artisanal and small-scale mining have negative effects on children, such as harmful repercussions on their health, stunted growth, and limited access to education (Nkomo & Mpofu, 2022). According to Lui (2021), most child labor in artisanal and small-scale enterprises is classified as the most extreme forms of child labour as described by the ILO Convention (No. 182). Employers and organisations should support artisanal and small-scale mining in improving efficiency, production, and prosperity while eliminating child labour.

Kumar et al (2020) documented the involvement of youngsters, ranging from 6 to 17 years old, in artisanal and small-scale mining endeavours, regardless of their gender. These children are involved in all aspects of artisanal and small-scale mining, including the processing and sale of the commodities. Hilson (2002; Magodi, 2017) assert that the utilisation of children in any capacity, including formal artisanal and small-scale mining, is strictly forbidden. A considerable number of youngsters involved in artisanal and small-scale gold mining lack fundamental reading skills as a result of their prolonged presence at mining sites, which hinders their ability to attend school. Many artisanal and small-scale mining businesses in underdeveloped countries hire young children, either as part of their family's workforce or as individuals wanting to support themselves, such as orphans (Magodi, 2017). In addition, this factor leads to a considerable proportion of young individuals dropping out of school and a few completely refraining from attending school since a young age.

2.8.2 ASGM and Conflicts

The ASM sector is often associated with conflict. This phenomenon can be discerned through multiple avenues, including discontent within the community stemming from the displacement of ancestral land and the preferential treatment bestowed upon large-scale mining enterprises. Additionally, localized instances of hostility can be linked to the procurement and administration of land, resources, and gold (Crawford & Botchwey, 2016). The main forms of conflict typically occur between LSM (Large-Scale Mining) and ASM (Artisanal and Small-Scale Mining). Oftentimes, instances of violence occur when unlicensed and informal miners encroach upon the concessions of large-scale mining businesses. Large mining and exploration companies often lag behind small-scale miners, employing them as scouts to discover new mining locations. Nevertheless, these firms then pursue licences and evict the miners from the area, which ultimately transforms into their own region (Luning, 2014).

Regions where artisanal and small-scale mining (ASM) occurs often see recurrent conflicts related to land ownership. Incidents of land conflicts pertaining to mineral resources have surfaced in Taita Taveta County. The occurrences can be ascribed to the lack of land ownership rights in the gemstones mining areas, leading to conflicts between miners and local residents due to the absence of title deeds (Anyona and Rop, 2015b). In Ghana, the occurrence of artisanal and small-scale mining (ASM) operations, which are sometimes short-term, has led to disputes over land among artisanal miners, mining corporations, local populations, and the government. This phenomenon arises when informal miners trespass onto the territories of established mining corporations or the territories of indigenous populations without getting prior consent (Nyame and Grant, 2014).

2.8.3 Employment and Income Generation

Artisanal and small-scale mining (ASM) is widely acknowledged as a vital source of income for millions of individuals in around 80 countries globally (Verbrugge & Thiers, 2021; the World Bank, 2013). ASM has undergone substantial expansion. It is estimated that the global Artisanal and Small-scale Mining (ASM) sector involved approximately 40.5 million individuals in 2017. Artisanal and small-scale mining (ASM) is acknowledged as a vital source of livelihood

in rural areas, as it provides both direct and indirect sources of income for local inhabitants (Barreto et al., 2018a; Oramah et al., 2015).

Loayza and Rigolini (2016) argue that the mineral and oil extraction business has not only resulted in increased employment, population growth, and per capita income, but has also enhanced infrastructure quality. As stated by Hunter et al. (2015) and Subouru (2019), the mining industry experienced a decrease in the employment of indigenous people throughout the early 1990s. Nevertheless, the condition experienced a substantial improvement by 2011. This was attributed to a substantial increase in the magnitude and ongoing growth of mining operations, leading to the emergence of numerous job prospects. In addition, mining businesses acknowledged the necessity of using local labour as a prerequisite for upholding their social credibility.

2.8.4 Occupational Safety and Health Hazards

ASM operations pose several occupational and health hazards, including the risk of being exposed to dangerous compounds including mercury, dust, silica, and other toxic particles. The variables responsible for these conditions include insufficient air circulation, prolonged work hours, lack of protective equipment, absence of health or life insurance, and high temperatures (de Oliveira and Ali, 2011). The inhalation of dust, silica, and other detrimental particulate matter has been associated with several respiratory ailments that commonly arise in occupational settings, such as emphysema, asthma, acute and chronic bronchitis, silicosis, and pneumonia (Ayaaba et al., 2017). The researchers have discovered several health problems related to this condition, such as decreased lung function, skin inflammation, eye irritation, hearing loss, and kidney failure (Henry et al., 2017). In a study conducted by Gottesfeld et al. (2015), it was discovered that the levels of airborne crystalline silica originating from artisanal gold mining activities in Tanzania surpassed the specified exposure limits. Hence, the mining communities are exposed to a substantial health hazard due to the high incidence of both acute and chronic silicosis, as well as tuberculosis.

2.8.5 Inadequate Compliance with Hygiene and Sanitation Protocols

Artisanal and Small-Scale Mining (ASM) is a prevalent and perilous practice that presents substantial difficulties in maintaining cleanliness and hygiene. Artisanal and small-scale mining (ASM) refers to the extraction of minerals via uncomplicated and occasionally manual methods, performed by individuals or small collectives. These enterprises often suffer from a lack of official

infrastructure and control. The unstable living and working conditions in ASM communities give rise to a range of health and environmental problems, as emphasized by Basu et al (2015; Landrigan et al, 2022).

The lack of proper sanitation and hygiene practices in ASM communities can lead to the issue of contaminated drinking water, posing a risk to public health. The availability of clean and untainted drinking water is a crucial issue in regions where artisanal and small-scale mining (ASM) takes place, as water is essential for both mining activities and human survival (Landrigan et al, 2022).

2.8.6 ASGM on Adverse Social Behaviors on Human Security

In addition, galamsey worsens social issues in the mining areas (Adu-Gyamfi, Brenya, & Abakah, 2016). The arrival of people from diverse backgrounds with different values in mining towns frequently leads to the growth of social vices, such as prostitution and child labour. Agbesinyale (2023) states that the existence of a galamsey activity in the Tarkwa region has resulted in a rise in the indigenous population. This is due to a significant influx of residents relocating to the mining villages within the area in search of employment opportunities. Consequently, the expanding population leads to conflicting norms and customs, thereby contributing to the development of social vices like drug abuse and prostitution, resulting in an upsurge in sexually transmitted illnesses. Artisanal and small-scale mining activities in ASGM operating areas also result in child labour, absenteeism, and school abandonment.

2.8.7 Health Issues Emanating From ASGM

Miners, as a whole, face a range of health hazards when working underground. The health concerns in the mining industry are considered a significant matter that requires the involvement of several stakeholders. The International Labour Organisation (ILO) has played an active role in addressing health concerns that impact miners (Jennings, 2001). The safety of workers in the mining sectors has frequently been overlooked, resulting in a negative reputation for these industries. Hermanus (2007) highlights significant health hazards associated with mining, including noise-induced hearing impairment, respiratory illnesses, dermatological disorders, and ergonomic strain. These ailments are categorised as chronic diseases, meaning that even with

treatment from experts, they persist in the body indefinitely. The health challenges faced by unauthorised miners are as follows:

2.8.7.1 Auditory impairment caused by exposure to excessive noise

Noise-induced hearing loss (NIHL) is a significant and widespread problem in the mining industry due to the usage of large and heavy machinery and equipment underground to carry out necessary tasks. Noise remains a significant worry in the mining industry, nevertheless seen as a current risk factor. Noise-induced hearing loss (NIHL) is a significant worry for miners who are worked on a permanent basis, as it is considered a chronic condition. Noise-induced hearing loss (NIHL) is a condition that arises as a result of prolonged exposure to loud and excessive noise, which impacts the inner ear. In the context of illicit mining, this can occur when miners utilise shovels and explosives to extract natural resources (Viljoen, 2007). The utilisation of large machinery in mining operations results in an overwhelming amount of noise that is intolerable. There is a hypothesis that miners often spend between ten and eleven hours working underground. Consequently, this issue has a significant impact on a large number of miners who are working legally. According to Hermanus (2007), 90 percent of miners worldwide experience hearing loss caused by exposure to loud noise.

2.8.7.2 Pulmonary disorders

Occupational lung disease (OLD) is a prevalent ailment in mining industries that is caused by work-related factors. A significant number of individuals employed in the mining industry have been impacted by the disease (Ross & Murray, 2004). The disease arises from elevated levels of airborne hazards, subterranean environmental conditions, inhalation of dust and chemicals, and prolonged work in mines. The sickness has persisted for over four decades in the mining industry. It is worth noting that a total of 128,575 cases has been reported to the Mineral Bureau for Occupational Diseases (MBOD). The annual growth in the number of infected individuals is a cause for concern, leading to the occurrence of tuberculosis (TB) as lung illness (Hermanus 2007). Furthermore, a significant proportion (ranging from 9 to 50 percent) of mineworkers were subjected to dust due to the predominant tasks carried out within these industries. Hermanus (2007) additionally indicates that these personnel are afflicted with lung cancer, a chronic condition.

2.8.7.3 Occupational Skin Disorder

Mineworkers are frequently exposed to a multitude of hazardous chemicals, which can result in the development of incurable illnesses such as occupational leukoderma. Hermanus (2007:534) defines occupational leukoderma as a skin disorder caused by occupational factors that result in a change of skin tone from brown to rose pink. The primary issue with occupational leukoderma is its incurability. The sickness is caused by the use of cutting blades, razors, and mercury during work, as well as the use of cleaning detergent and hand washes detergents after completing particular underground duties (Hermanus 2007). Occupational skin disorder (OSD) is a prevalent condition that affects workers in the mining industry. Furthermore, a staggering 2.9 billion individuals worldwide are afflicted by the harmful effects of toxic substances, leading to various skin ailments (Hermanus, 2007).

2.8.7.4 Musculoskeletal Disorder at Work

Work-related musculoskeletal disorders (MSDs) are another health condition that can arise from working in the mining industry. Dias (2014) defines work-related musculoskeletal ailment as a pathological condition that affects the nerves, joints, blood vessels, and overall body structure. This condition is prevalent in several mining industries globally, resulting in sick leave, disability, and reduced productivity. In addition, a significant number of mineworkers are experiencing musculoskeletal disorders due to the poor condition of roads in mining areas, which are uneven, rough, and muddy (Dias, 2014). During the production process, mineworkers often encounter constrained underground spaces that need them to assume prolonged bent positions due to restricted heights. The danger factors in the human body accumulate as a result of height limitations.

2.9.0 Implications of ASGM on Rural Livelihoods Diversification, Assets and Activities

2.9.1 ASGM's Impact on Livelihoods

Small scale mining introduced technical, environmental, socio economic and legal issues in the context of the small-scale operation in the early 1990s. Measures that featured the relationship between the large and small mining companies, issues of gender, and child labour tremendously evolved from mid to late 1990s. From 2000, it became more of controversies circling

the community and the existent livelihoods in relation to the industry (Botchwey, Nest & D'Emidio, 2023).

Researchers stated that the poverty level serves as the main driver to the small-scale mining exercises and an index linking a country's Human Development Index or HDI to the proportion of the workforce in small scale mining exercises. Thus, it is forecasted that the small-scale mining sector and its actors will also increase in accordance with the growing poverty rate in developing countries (Hilson & Hu, 2022). As much as mineral mining is important as source of income for many people, it most of the time leads to negative impacts on the environment which may in turn hurt people's livelihoods. This is even more worrying in areas that are rich in biological diversity and poor in human resource whereby the majority of the people survive on meager earnings (Magidi & Hlungwani, 2023).

A survey on evaluation of Alternative Livelihood Projects (ALPs) in the Ghanaian mining towns revealed that people moved to mining areas to find employment or in case of others invited by employees in the mining firms (Temeng & Abew, 2009; as cited in Owusu, Afrifa & Obeng, 2022). Nevertheless, post the mining industry and more so after the closure of mines, the community or the people draw ejection as they get impoverished for the same reason – the mining industry (Dikgwatlhe & Mulenga, 2023). Mining activities do not create enough diversity of economic development to support such societies (Magidi & Hlungwani, 2023).

Again, Hoadley and Limpitlaw (2004; as cited in Hilson & Hu, 2022) conducted a study on the development of small scale mining for effecting improvement of poverty levels in Africa. They found out that although this form of mining has the capability of decreasing poverty in the society, it is within smaller folds and cannot be achieved when there are no efficient measures put in place.

Studies done on the effects of small scale gold mining migration in the Talensi-Nabdam area of Ghana were conducted by Awumbila and Tsikata in 2004. They stated that earlier on farming, sheanut gathering and fuel wood collection were the major economic activities practiced in northern Ghana (Awumbila & Tsikata, 2004; Baddianaah et al., 2022; Baddianaah et al., 2021). In a nutshell, due to the arrival of an enormous number of gold miners, the local economies concentrated on mining resources were reshaped. This stream of migration ensured gold mining's gendered benefits while providing economic prospect and possibly may help reduce patterns of north south migration (Awumbila & Tsikata, 2004; Arthur-Holmes & Busia, 2022).

To show the connection between Small-scale mining and Livelihoods, Temeng and Abew (2009) conducted research on the various ALPs in Wassa West and Upper Denkyira Districts in Ghana. They examined the sources and uses of livelihoods among mining communities' pre-mine, at the mine, and post-mine, and prescribed the use of a framework for mining's sustainable substitutes. From their study, they identified that the subjects' programs ranged from small enterprises to farming. Men before mining engaged in small-scale mining, trading, and farming; women also in trading and farming only. Males either got employment with the mining firms or kept on with small scale mining, while women went on with their activities.

Nevertheless, Amoako and Abew (2009) revealed that many of the community members failed to participate in other economic activities after mining, thereby supporting Awumbila and Tsikata's (2004) findings that before the mining sector, the livelihoods in the north-eastern parts of Ghana were mostly engaged in the collection of fuel woods and farming.

2.9.2 Drivers of Livelihood Diversification: Pull versus Push Factors

There is no universally accepted explanation for why households diversify their income streams, but research by, Agyeman et al. (2014) has identified two main types of drivers of diversification: demand-pull factors and distress-push factors. So, if the return on investment (ROI) is greater than the cost, households are motivated to invest in livelihood activities. A family may be forced to engage in other economic activities in order to mitigate the risk of failure associated with a single source. These considerations for diversification are dubbed opportunity-led and survival-led factors by Lay and Schöler (2008).

In contrast, "push factors" are extreme circumstances that "push" households to diversify their assets in order to weather the inevitable storms of life. People in Northern Ghana often move to larger cities, particularly during the dry season, according to Lay and Schöler (2008) and Asravor (2018). Households on farms often diversify their income streams in response to economic uncertainties, such as price fluctuations (Asravor, 2018). Since most agricultural products have a shelf life, a drop in their pricing poses a threat unless farmers learn to deal with price shocks intelligently. Other causes that force people to diversify their livelihoods include pest and disease outbreaks, climate change (e.g., drought), land fragmentation, and asset depletion (UNCTAD, 2015).

2.9.3 ASGM versus Agriculture

According to Hilson and Garforth (2012) and Persaud (2015), many countries in Sub-Saharan Africa still prioritise agriculture when it comes to development plans and resources. This is because agriculture has traditionally been seen as the main engine of rural economic growth and development in developing nations. As Hilson and Garforth (2012) point out, there is a common misunderstanding of data based on agriculture's contribution to GDP, which does not accurately reflect a household's quality of life or level of agricultural capacity. However, this misunderstanding is often the basis for development policies that prioritise agriculture, despite its crucial role in rural household and national economics. As a sector employing over 65% of the population and contributing over a third of the region's gross domestic product (GDP), agriculture presents a compelling case for reducing poverty in Sub-Saharan Africa from a macroeconomic GDP perspective (World Bank, 2014; Persaud, 2015).

According to Maconachie (2011) and quoted in Persaud (2015), rural household economics in Sub-Saharan Africa are increasingly influenced by de-agrarianization and diversification. The trend of non-farm incomes accounting for 40-45% of average household incomes in the region has likely increased since 2001, when estimates were made, as small-holder farming in Sub-Saharan Africa has grown more competitive and less able to support rural households (Barrett, Reardon, & Webb, 2001; Hilson & Garforth, 2012; Persaud, 2015). While prior research does separate agricultural income from non-farm sources, it blatantly ignores ASGM and its relevance. Because ASGM was not widely recognised as a substantial non-farm rural livelihood until very recently, and because there was a dearth of knowledge on the topic prior to that time, this error occurred. It was previously believed that marginalised populations, such as the poor and the uneducated, would face barriers to upward mobility due to the uneven distribution of non-farm earnings among those with the most agricultural assets and incomes. Consequently, previous studies on rural non-farm income diversification did not include ASGM (Barrett, Reardon, & Webb, 2001; as cited in Persaud, 2015). The poor and unskilled, including many subsistence farmers, have access to low-capital, entry-level livelihoods through ASGM (Hilson & Garforth, 2012). Thus, previous findings about the uneven distribution of non-farm wages might be incorrect, since ASGM affords the lowest-class and most-marginalized agricultural workers a chance to diversify their earnings and climb the economic ladder.

Actually, according to Cartier and Bürge (2011; as cited in Persaud, 2015), mining and agriculture form a strong and closed-off rural economy. This is because local traders, farmers, and miners all work together, which benefits agricultural producers through higher prices and establishes connections among these groups. Local miners and people making good money in the secondary ASGM economy have helped farmers in certain parts of Ghana get better prices for their crops, thanks to the thriving economies that ASGM has helped to create (Okoh & Hilson, 2011). Furthermore, in Sierra Leone, studies have shown that mining dependents purchase food from nearby farmers, which helps sustain and increase agricultural production in mining districts (Maconachie, 2011; as cited in Persaud, 2015). Agricultural markets and secondary economies are also boosted by ASGM in rural areas.

The second way in which ASGM and agriculture are economically related is through the diversification of livelihoods they provide. The ability to weather economic storms and recover quickly is a key component of a sustainable living, and rural households can benefit from this diversity (Maconachie, 2011; as referenced in Persaud, 2015). The ability of households to feed themselves adequately and with dignity is lower among those whose sole occupation is agriculture (Okoh & Hilson, 2011; as cited in Persaud, 2015). Governments in developing nations redirected their attention from staple crops to large cash crops that could be sold to wealthy countries as part of structural adjustment programmes, which led to a 60% drop in the global price of agricultural raw materials from 1980 to 2003 (Hilson & Garforth, 2012; as cited in Persaud, 2015). On the other hand, small-holder farmers are unable to compete and earn due to the oversaturation of poor country marketplaces with subsidized staple products from wealthy nations. For instance, according to Cartier and Bürge (2011), as cited in Persaud (2015), there have been instances in Sierra Leone where the cost-income ratio for agricultural production is as low as 1:2 or, worse, 2:1. More than half of Mali's families go hungry in the months of August, July, and September, when the dry season ends (Teschner, 2014). Researchers in rural Malawi found that families' ability to fight poverty was higher in areas where ASGM was a varied source of income (Kamlongera, 2011). According to Hilson (2010; as cited in Persaud, 2015), people often turn to ASGM because farming cannot support them and they are in a state of "agricultural poverty." However, as this study will demonstrate, diversification into ASGM can be driven by more rational considerations than pure desperation.

In Ghana, agro-ecological zones are where farming and mineralization take place. Since both farming and small-scale mining rely on natural resources like land and water, living in close proximity to one another becomes challenging. In particular, according to Owusu Aborah (2013; as cited in Botchway, 2018), small-scale mining operations are common in agriculturally productive regions like the Western, Ashanti, Central, Brong Ahafo, and Eastern regions. This has a number of detrimental impacts on agricultural livelihoods, as shown in the literature.

According to Danyo and Osei-Bonsu (2016; as cited in Botchway, 2018), illegal small-scale mining in Ghana has several negative effects. These include: *"deforestation, reduction of soil fertility through striping of topsoil and subsoils, aggravated soil erosion, chemical contamination of surface and underground water, physiological disorders in crop plants and low yield leading to increases in food prices and high cost of living..."*. This claim is supported by research done in Kyebi, which is located in the Eastern region, by Ocansey (2013; as cited in Botchway, 2018). Also, plants, like crops, can experience stress from pollutant uptake, which shows up as stunted or dwarfed growth (Owusu-Aborah, 2013). Unauthorized small-scale mining has reduced crop yields and income for cocoa producers, according to a survey by Boateng et al. (2014; Boakye et al, 2020). These claims are more likely to cause severe instability in places where small-scale mining is practiced.

The African Centre for Economic Transformation (2017; as cited in Botchway, 2018), assessed the impacts of small-scale mining on small-holder farmers in three West African countries of which Ghana was part. It was identified that small-scale mining has five major implications on small-holder or subsistence farmers and the third impact was on arable lands. It was asserted that: *'There is the growing threat to food security, the reduction in available arable land and consequent reduction in food and cash crop production. In all three study countries, increasing land degradation (symptomatic of neglect and lack of reclamation of mined-out sites) is seriously threatening efforts at promoting commercial agriculture.'*

Botchway (2018) cites Danyo and Bonsu (2016), which further supports the assertion made by the African Centre for Economic Transformation. They argue that surface mining is to blame for the disruption of agricultural land, the loss of vegetation and soil, the disruption of ecosystem service flows, the degradation of agricultural lands beyond what is necessary for intensive post-mining reclamation, and the permanent loss of farmland. Damage to farmland forces farmers to abandon traditional methods of subsistence farming in favour of less environmentally friendly ones

(Botchway; 2018). Another way in which small-scale mining impacts farmers is by destroying arable land and making it unusable for years to come. This deprives farmers of access to already-scarce farmland.

There is often overlap between mining zones and agroecological zones, which are designated for agricultural purposes. For instance, according to Diao et al. (2019) and Obodai (2022), the forest zone accounts for 61% of Ghana's gold-bearing landscapes and generates 57% of the country's total food crop tonnage. To rephrase, the same topography that makes it easy to grow food also makes it easy to mine for gold. So, it is possible to create direct connections between small-scale mining and agricultural by smallholders.

The strong demand for food and other products, along with the influx of small-scale mining workers in prosperous mining towns, creates a market for farmers, according to empirical findings (Maconachie 2011; Hilson and Garforth 2013; Obodai, 2022). They also found that small-scale miners can reinvest their profits in small-scale farming, agricultural businesses, and trade, and vice versa. Although there are some beneficial synergies between small-scale mining and smallholder farming, they are mostly economic and don't take into account the other side of the coin. A more comprehensive analysis of the environmental and other critical aspects of the connections between small-scale mining and smallholders is necessary to complete the topic. The reason behind this is that solutions that are based on a one-sided argument seldom offer thorough answers when put into action. Therefore, society as a whole may end up paying for the expenses of these interactions, while only a select few individuals stand to gain from them. In addition, small-scale mining operations invading farmed areas has the same social ramifications as deforestation in and of itself (Hausermann et al., 2018; Obodai, 2022), which in turn encourages farmers to encroach on forest reserves, speeding up the rate of deforestation and its associated consequences, including a worsening of the effects of climate change that we all endure.

2.9.4 Household Determinants of Livelihood Diversification Choices

According to Ellis (2000) and Gidey et al. (2023), who reviewed relevant literature, rural residents are compelled to diversify their livelihoods due in large part to external shocks and trends, but their diversification decisions are also deeply influenced by the micro-economic reasoning of farming households. In this context, certain factors should be taken into account.

2.9.4.1 Key Assets Availability

It is clear that the capacity of rural households and individuals to diversify depends on the availability of important assets like savings, land, labour, education, and access to markets or jobs, as well as common property, natural resources, and other public goals (Kassegn & Abdinasir, 2023). An individual's first step towards becoming self-sufficient is to invest a suitable combination of the aforementioned resources. To relocate, one often needs savings, and one's educational background and labour force capabilities dictate one's employment prospects. However, diversification can also emerge as a way to deal with the lack of resources necessary to engage in traditional on-farm agriculture. Important drivers towards diversification may include declining arable land supply, rising producer/consumer ratio, loan delinquency, and environmental degradation. Frequently, political and economic upheavals play a significant role.

2.9.4.2 Maximization of return per unit of labour

An additional crucial aspect of livelihood diversification choices is the optimisation of return per unit of labour (Ewebiyi, 2014; Seifu, Haji, Keno & Diriba, 2023) among other things. According to this theory, a rural home will always choose the option that will keep its consumption level the same, regardless of how much it costs. There are various methods to further develop this formulation. A high producer/consumer ratio, for example, or an abundance of free labour within the household, could impact the choice to hire someone to work for pay. Similarly, the relative importance of self-consumption production, wage labour, and income-generating ventures can be influenced by local food availability and food price volatility. Alterations in focus from earning money on the farm to doing so in other ways may also occur seasonally as a result of seasonality.

2.9.4.3 Managing Risks

Another common argument advanced to justify diversification practices is the need to mitigate risk (Ezeanyika, 2023). The premise of this argument is that households can mitigate the effects of a complete or partial crop failure on their consumption by diversifying their income streams, which can be prompted by past experiences with market or crop failures. In order to diversify, the reasoning goes, you have to pick the second-best option that can still make money. As long as the overall failure hazard is reduced, risk-averse farmers don't care how much money they lose by diversifying their revenue sources. The maximisation of profit per unit of labour is complemented and balanced, from this point of view, by risk management through diversification.

2.9.4.4 Strengthening the household asset basis

Enhancing the foundation of home assets can also play a significant role in diversification decisions. Specifically, individuals from more affluent backgrounds have more opportunities to save money, which they can use to do things like start businesses, save up for retirement, or invest in their children's education (Ewebiyi, 2014). On top of that, diversification can happen when households consolidate their natural capital to make a livelihood plan more environmentally sustainable.

2.9.4.5 Opportunities

Local market contingencies, development projects, infrastructure development, and personal contracts are examples of site-specific options that could encourage rural people to diversify their livelihoods (Goetz, 2022). For instance, a relative or friend may serve as a go-between for the family and an employee in town or overseas, a tourist resort may be founded, a cooperative venture may be established, or a new market for unconventional agricultural commodities may be created. According to these made-up cases, chances for livelihood diversification are frequently generated by the interaction of market dynamics, social capital assets, and supportive policies.

2.9.5 Constraints to rural livelihood diversification

Diversifying income streams is an important strategy for rural households in developing countries like Ghana to deal with economic instability and other forms of poverty. But there are a lot of obstacles to this plan's implementation, and they differ in kind and degree based on where you live and what you do for a living (Salifu, 2019). Identifying the unique challenges faced by each agro-ecological region is crucial for developing policies that will help rural residents maintain their standard of living in the long run (Kandel et al., 2023). A lack of rural infrastructure, a lack of knowledge and skills development, a poor asset base, limited access to finance services, and a fear of taking risks are the key obstacles that rural Ghanaian communities face when trying to diversify their livelihoods. In order to build a rural economy that is more robust and diverse, we must overcome these challenges.

Inadequate Asset Pool

It is the single biggest obstacle that rural communities in Ghana face when trying to diversify their income sources. Households can seize possibilities in the non-farm sector,

especially in self-employment, when they possess even a minor asset (Ezeanyika, 2023). A person may be inspired to launch a tailoring business after acquiring a sewing machine, for instance. Similarly, if the worker has a bicycle, they may be able to go to the neighbouring town for jobs that aren't related to agriculture. A household's ability to access and use its livelihood assets is inversely related to the size and nature of the household's livelihood activities in rural areas. There is a significant obstacle to livelihood diversification for the majority of landless and small farmers in rural Ghana because they do not own any assets (Edaku et al., 2023).

Insufficient access to Financing

Diversified livelihoods are made possible by easy access to institutional financing. Without the financial backing from institutional sources, low-income households cannot launch their own non-farm businesses or ventures. Namayengo, van Ophem, and Antonides (2023) highlight this limitation and demonstrate how credit is critical for fostering livelihood diversification. Research by Ewebiyi (2014) also show that loan support is important for diversifying livelihoods. Credit resources can help lessen dependency on a single income source and provide economic options, particularly for marginalized communities.

Insufficient Education and Information

Despite numerous government initiatives meant to support rural economic growth, many rural households remain in the dark about these opportunities. There isn't a good system in place for the government or non-governmental organisations (NGOs) to let people know about livelihood diversification, which makes their ignorance even worse (Sindani, 2023). Kundo et al (2023), this lack of knowledge keeps rural areas from participating in government programmes that could help them make ends meet. When agricultural production falls short of meeting their fundamental needs, their inability to work in non-agricultural fields is directly related to their lack of skills. This makes rural communities more susceptible to economic shocks and less resilient because their livelihoods are dependent on agriculture and they lack the skills and knowledge to transition to other revenue sources. Closing this skills gap and raising public knowledge of government programmes will help rural households in Ghana better their economic chances.

Infrastructural Deficit

The improvement of rural livelihoods is greatly aided by infrastructure. Enhanced communication networks, for instance, can facilitate access to markets, which are critical for the exchange of products and services and the creation of non-agricultural employment opportunities.

The significance of better communications in rural development was demonstrated by the research conducted by Hilson and Hu (2022).

But basic infrastructure is out of reach for many rural populations in poor nations. Good roads, clean water, power, and contemporary communication facilities are not available to them. According to Mbelu and Ifionu (2023), individuals relying on these amenities for their livelihoods find it extremely difficult due to the lack of infrastructure.

2.10. Adverse Effects ASGM on the Physical Environment

The harmful impacts of ASM on the environment and public health in the surrounding communities have been highlighted by authors (Armah et al., 2013; Otoo, 2021). Armah et al. (2013) interviewed many different types of people—framers, community members, foreigners, traditional leaders, and others—in order to analyse fifty communities in Ghana where ASM is common. They discovered that the government's neglect of the industry worsens the environmental damage commonly linked to galamsey, or ASGM. The ASM sector is being neglected because the Ghanaian government seems to favour large-scale mining over ASM. This is because the government views the ASM's informality as a given, which makes efforts to formalise it politically difficult (Armah et al. 2013; Otoo, 2021). They contend that it is critical to try to understand the business's economic effects on the wider national economy while examining the politics and discourse of Ghana's galamsey industry.

Although small-scale mining offers rural populations in developing nations a chance to make a living, there is ample evidence that it has negative impacts on the environment (Boakye, 2020; Persaud et al., 2017). Due to a lack of regulation and formalisation, it is typically difficult to improve the environmental implications of artisanal and small-scale mining (Mulaba-Bafubiandi et al, 2023). The discharge of chemicals like cyanide and mercury, as well as deforestation, dust emissions, improper waste storage, acid mining, and rehabilitated excavations are some of the negative environmental effects linked to uncontrolled mining operations (Laari, 2018). The following are some of the ways through by which ASGM negatively impacts the physical environment:

2.10.1 Degradation of habitats and biodiversity loss

Deforestation destroys habitats, which in turn threatens and reduces biodiversity. Some species are at risk of extinction due to the prevalence of abandoned mines and open pits that have not been restored (Anyona and Rop, 2015a; Mwakumanya et al., 2016). The loss of quality for

particular ecosystems is known as habitat degradation. Damage to natural landscapes and changes to hydrologic functions are two examples of habitat degradation (Oblokuteye, 2010; Magodi, 2017). Mathada (2014) found that small-scale mining disrupts processes that build, connect, and preserve habitat, which in turn affects the structure and function of habitat. In order to make way for fuel and infrastructure development, small-scale gold miners who operate on an artisanal basis destroy vast habitats (Phiri et al., 2015).

The surface artisanal and small-scale mining practice frequently leads to the extraction of significant amounts of topsoil, resulting in the exposure of the land and making it vulnerable to erosion (Bansah and Bekili, 2015; Magodi, 2017). Extensive tracts of land and plant life in numerous mining villages are cleared to make room for surface mining operations (Kitula, 2006; Mensah et al., 2023). Unrestored artisanal and small-scale mining pits that have been abandoned contribute to additional landscape deterioration (Adu-Baffour et al., 2023). The issues arising from land degradation encompass soil erosion, siltation, soil compaction, ecosystem devastation, and biodiversity loss (Nwango, 2010; Nwite, 2023).

2.10.2 Problems of dust

The presence of mine dust has significant implications for both human health and the ecosystem (Spitz and Tridinger, 2019; Křibek et al., 2023). The dust generated by artisanal and small-scale mining activities has the potential to disperse in the surrounding area, particularly in dry weather conditions (Kitula, 2006; Wawire, 2023). The presence of hazardous compounds in this dust could pose a threat to both plants and animals. The particulate matter and gases produced by the explosive techniques used in artisanal small-scale gold mining are rapidly diluted and spread out due to the shallow nature of most mining operations (Al-Hassan and Amoako, 2014). The formation of dust and emission of mine gases, particularly during drilling, blasting, grinding, and crushing of ore, contribute to air pollution caused by artisanal and small-scale gold mining activities (Dreschler, 2001).

2.10.3 Noise and Vibrations

The utilisation of explosives and substantial machinery for excavation results in noise and vibrations that can have significant impacts on both mine workers and the surrounding regions. During blasting operations, the levels of noise and vibrations are typically elevated, which can

have a substantial adverse effect on mine workers who do not utilise protective equipment. Additionally, the surrounding infrastructure may experience cracking or even collapse, posing a hazard to human life (Anyona and Rop, 2015a; Mwaguni and Munga, 2015). Prolonged exposure to loud noise can result in temporary or permanent hearing loss. It can also elevate stress levels and have an impact on heart function, potentially leading to cardiovascular illnesses and hypertension (Jariwala et al., 2017). The quality of wildlife habitats and their behavioural reactions may be affected, as stated by Shannon et al. (2016). For instance, certain avian species have been observed to vocalise during night time in locations that are typically loud during the day (Fuller et al., 2007; Scarpelli, 2023).

2.10.4 Soil Erosion

The extraction of topsoil, the erosion of soil, the contamination of soil, and the physical alteration of the environment as a result of artisanal and small-scale mining (ASM) operations have been documented (Mwakumanya et al., 2016). The removal of topsoil may result in the depletion of soil nutrients, leading to a decline in soil quality (Swain et al., 2023).

2.10.5 The effect of ASGM on Water Resources

Nthambi and Orodho (2015) demonstrate that the practice of artisanal sand mining in Kathiani, Machakos County, Kenya has resulted in a decrease in the amount of water in rivers and the drying up of rivers. Nyame and Grant (2014; cited in Sarpong, 2023) observe that the practice of artisanal gold mining in Ghana has resulted in the introduction of mercury into water bodies as a consequence of the gold amalgamation process, hence leading to water pollution. The artisanal gold mining activities in Migori, Kenya have resulted in a significant accumulation of heavy metals (mercury, cadmium, copper, arsenic, chromium, and lead) in water, beyond the maximum limits set by the World Health Organisation (WHO) guidelines (Ngure et al., 2017b).

2.10.6 Presence of high levels of heavy metals

The detrimental impacts of heavy metals on human health are the current area of investigation. The reason behind this is the widespread presence of heavy metals in different environments and workplaces (Mahurpawar, 2015). Because they persist in water for long periods of time and continue to pollute aquatic life, certain metals pose serious problems. Because metals resist natural degradation processes, this is the case (IFC/WHO 2007; Fianko, 2021). The 19 elements that make up heavy metals have comparable chemical and physical characteristics, and

they can bind to important parts of cells, interfering with their regular functions (Rajeswari & Sailaja, 2014).

Amalgamation is a method of gold extraction that releases mercury into adjacent water bodies. Therefore, amalgam combustion can pollute groundwater and surface water (Dreschler, 2001). Mestanza-Ramón et al. (2022) found that mercury pollution can be transmitted from soil to air by evaporation. As depicted in figure 2.10.6, a large area can be covered by the high concentration of mercury in water bodies like rivers and lakes. In sediments, the mercury can transform into methyl mercury, which aquatic creatures can absorb (Kessey and Arko, 2013; Fashya & Suseno, 2023). In artisanal and small-scale gold mining, hazardous chemicals seep into the ground and water, disrupting local fauna by contaminating their food and water sources (Abdulgafar and Ishola 2014).

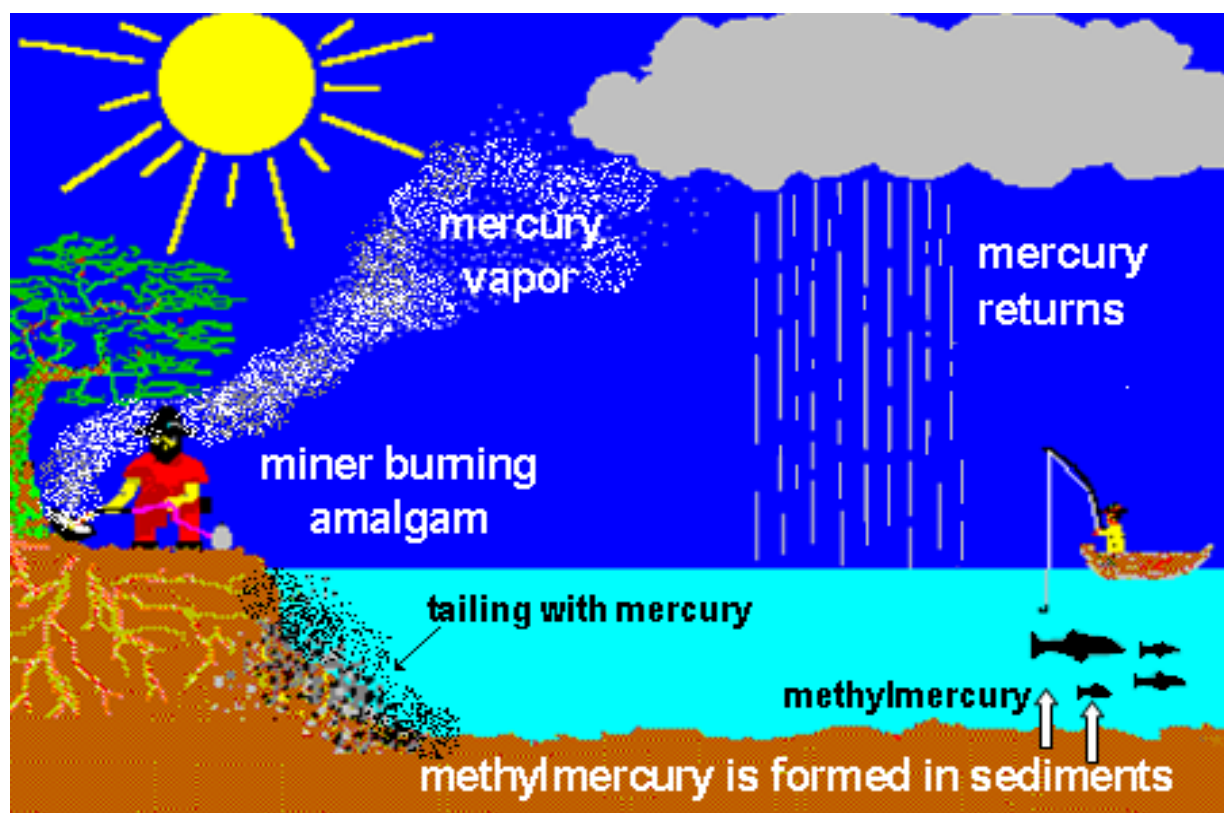


Figure 2.10.6: Amalgamation process contaminating the environment Source: Phiri, 2011

2.11.0 Roles and effectiveness of regulatory institutions, laws and government policies governing the mining sector in the Upper West Region.

2.11.1 Laws and regulatory structure governing unauthorized mining activities in Papua New Guinea

The Papua New Guinea's government has enacted laws to regulate the extraction sector, including the 1992 Mining Act and the 2007 Mining Safety Act and regulations of 2007, which stipulate that licenses are granted to illegal miners (Mek, 2011). According to the Mining Act of 1992, illegal miners must operate in designated areas and register with a license for the purchase of precious metals (Susapu & Collins, 2001; Lebitso, 2021). These licenses not only permit access to specific mining sites nonetheless, equally authorize illicit miners to transport and sell gold to various nations. Also, unauthorized gold operators are required to deliver every month's output information to the Mining Department, contributing to clear records of their extraction activities (Susapu & Collins, 2001; Lebitso, 2021). Mining plays a substantial contribution to Papua New Guinea, where the money made by illicit miners helps to better the economic situation of the nation.

A facility was set up by The Department of Mine (DOM) dedicated to giving illegal miners technical assistance and training. According to Mek's research (2011; Lebitso, 2021), the Mining Act of 1992 advises pertinent authorities to buy valuable metals extracted from unlawful mining operations. Worldwide organizations have provided 6.8 million euros in assistance of illegal miners, which will be used to construct a training facility and finance numerous initiatives aimed at their advancement (Mek, 2011).

2.11.2 Regulatory Structure Governing ASGM Activities in Burkina Faso

In 1986, rules encouraging artisanal miners' initiatives were passed, marking the starting point of the regulation of artisanal mining in Burkina Faso. In order to provide provisions for illegal miners, a pair of significant pieces of legislation was implemented: the Mining Code of 1997 and the Comptoir Burkinabe Des Metaux (Ouoba 2017). To solve a number of issues in the mining industry, the Burkina Faso government, realizing the deficiencies of this legislation, enacted the Mineral Act 36 of 2015 in the same year (Dorin 2018). This law aims to improve working conditions to increase gold extraction, improve social, health, and safety conditions for artisanal miners, reduce the number of unregistered artisanal miners in the industry as well protect and restore the environment while extracting precious metals.

Ouoba (2017) notes that authorization for artisanal mining in Burkina Faso intends to grant rights and licenses to illegal miners for extracting gold, with these licenses valid for a two-year period. However, Dorin (2018) points out those citizens from other nations, including Mali, Benin, Niger, and Togo, are prohibited from engaging in artisanal mining in Burkina Faso under the Mining Mineral Act 26 of 2015. However, despite this restriction, the Act allows Burkina Faso's artisanal miners to sell and export gold to specified areas. The formalization procedure for artisanal miners in Burkina Faso has brought about improved practices within the mining sector.

According to Ouoba (2017), artisanal miners are required to carry and present their licenses at all times, emphasizing the importance of this initiative. Farmers in the northern village of Bakou in Burkina Faso oversee artisanal mining activities, even in the absence of a formal legal framework. As per Ouoba (2017), the Burkina Faso government is keen to establish a framework in this village to enhance safe labor standards, provide more comprehensive information on explosive chemicals, and ensure environmental protection.

2.11.3 Laws and regulatory structure governing ASGM activities in Tanzania

Tanzania and Ghana like African nations have policies that allow informal miners to engage in gold and precious metal mining. Fisher (2007) notes that Tanzania's mining policy emphasizes small-scale mining as a poverty-alleviating activity. Lugoe (2012) claims that Tanzania's Mining Act 28 of 1979 produced advantageous circumstances for small-scale miners. The law promotes small-scale miners to contribute to the mineral commission, especially those who dig for gold and gemstones (UNEP, 2012; Lebitso, 2021). However, challenges arise as small-scale miners are allocated limited sites, making it difficult to avoid interference with neighbouring locations (UNEP, 2012).

Small-scale miners can apply for Primary Prospecting Licenses (PPL) and Primary Mining Licenses (PML) in accordance with the Mining Act 28 of 1979. These permits are initially granted for a year; however, they are renewable (Lagoe, 2012). These licenses authorize small-scale miners to work on areas of up to ten hectares per day, with some miners earning extra income by leasing their licenses to others not registered with the mineral commission. Mwakaje (2012) adds that Primary Mining Licenses specifically grant small-scale miners a designated portion, not exceeding ten square meters, along with geographical coordinates for operational guidance.

2.11.4 Ghana Mining Policies, Institutions and Legal Framework

By the time the decade of the 1980s came to a close, the Ghanaian government saw that a legal framework was needed to regularize and control the free-wheeling of artisanal and small-scale gold mining (ASM) sector. Small scale mining, which was informal and technically illegal in Ghana, enjoyed a lot of popularity even though it was supposedly prohibited (Botchway, 2023). The late 1980's was a period when The Small-Scale Gold Mining Law and the Mercury Law of 1989 which are the two key laws that were adopted at the end of the 1980s.

SML of 1989 is a milestone in the history of the Ghanaian mining regulation which empowered the small players to mine gold on their own. Under the Act albeit it had established hard laws making casual gold mining illegal without a valid authorization from the authority that was concerned. The formalization process was regulated in the law with the condition of issuing official mining licenses and the appropriate mining operations - respecting these licenses and health, security, and environmental requirements (Hilson & Potter, 2005). That was the milestone which laid the foundation of tailoring framework for small scale mining industries.

The Precious Minerals and Marketing Corporation (PMMC) was established in 1989 as an inescapable result of the Small-Scale Gold Mining Law of Republic of Ghana. The all-inclusive PMMC which had been set up to monitor and advise on all the issues connected to the mining activity was instrumental in the formalization of the artisanal mining, context in which all artisanal miners were given the rights to exploit the mineral resources in an organized manner. The law PNDCL 219 of 1989 also defined the minerals and marketing corporation (PMMC) and stipulated that all ASM operations should be under it and that there would be officially recognized gold buyers and this would help to regulate and help the business accordingly (Arnott, 2023).

It is after the introduction of these milestone laws and rules; Ghana Bank of most prominence has been in the field of studying the regulatory environment for the small-scale mining sector. The 2006 Minerals and Mining Act (Act 703), after passing through twice, bring about a completely new shift in the Minerals and Mining Law. In this regard, the bill provides also for a regulation mechanism, encompassing amongst others the practices to be employed by small-scale miners (Hira & Busumtwi-Sam, 2018). The modifications demonstrate a continued commitment to adjusting to changing conditions and guaranteeing the mining industry's long-term development.

Ghana's mining sector is governed by the Minerals and Mining Law of 2006, the Minerals and Mining Law of 1986 (as amended by the Minerals and Mining Act of 1994 - Act 475), and

laws outlined in the 1992 Constitution (Abdul-Rahaman et al., 2025). The mining sector is overseen by the Ministry of Lands and Natural Resources, with specific responsibility allocated to the Minerals Commission. Both organizations were constituted under the 1992 Constitution and the Minerals Commissions Act of 1993 (Hira & Busumtwi-Sam, 2018). Additionally, the Environmental Protection Agency (EPA) works with the Minerals Commission to monitor and mitigate the environmental implications of mining activities, assuring the sector's long-term development. The Ghana's mining policies, institutions and legal framework is depicted in table 2.11 below:

Table 2.11: Ghana Mining Policies, Institutions and Legal Framework

Description in relation ASGM in Ghana	Regulations/laws related to ASGM	Year
The Ghana Small-Scale Gold Mining Law (PNDCL 218) of 1989 oversees all processes of registration, licensing of buyers, distribution of authorizations for gold exploitation to single actors, collectives, and formal unions as well as the creation of district centers for the provision of assistance to mining or prospecting proponents.	Legalization of small- scale gold mining	1989
The Precious Minerals Marketing Corporation (PMMC) replaced the Diamond Marketing Corporation, empowered to participate in the purchasing and selling of gold.	The law governing the Precious Minerals Marketing Mining Corporation, established in 1989, denoted as PNDCL 219.	1989
This legislation revised and consolidated mining and mineral laws, granting the Minister the authority, after consulting with the Mineral Commission, the authority assigns areas for the activities of small-scale mining. The Small-Scale Gold Mining Law of 1989 (PNDCL 218), the Minerals and Mining Act of 1989 (PNDCL 153), among other laws related to mining were cancelled.	Act 703, the Minerals and Mining Act of 2006.	2006
This proposed legislation changed the hitherto Minerals and Mining Act of 2006 (Act 703) to achieve two main goals. The first goal is to give the Lands and Natural Resources Minister the authority as far as setting of the amount of royalties that must be paid were concerned, instead of the 5% that was previously established.	Mineral and Mining Amendments Bill, 2014 (Mineral Development Fund Bill	2015
The regulatory framework is responsible for granting environmental permits and specifying and ensuring adherence to compliance measures with environmental management regulations. It also regulates both commercial and domestic use of water, with the MinCom, in collaboration with the Environmental Protection Agency (EPA), assessing whether the intended water usage necessitates the development of an environmental management plan.	The Water Resources Commission Act of 1996, identified as Act 552, and the Water Use Regulations of 2001.	1994

Responsibilities encompass the issuance of environmental permits and the establishment of guidelines to ensure adherence to environmental management regulations.	EPA Act, (Act 490) of 1994	1994
This is the first comprehensive initiative in this field that integrates various current standards, regulations, and legislation for land. The aim of this holistic approach is to streamline and harmonize the different aspects of land governance, providing a uniform framework for effective and rational land use.	National Land policy	1999

Sources: ICMM (2015) Note: Only regulations and laws governing ASGM are given here

2.11.5 Ghana's Customary Land Ownership System and ASGM

The interaction between customary land title and ASGM is paramount because it affects how regulations are formulated and helps to understand the governance and structure of the industry. But up until now, not much research has been done on this subject. As of 2003, it was believed that 90% of the land in Sub-Saharan Africa was under communal or customary tenure, with written title holding just a minor portion of the land, mostly in West Africa (Chimhowu & Woodhouse, 2006; Kugbega, 2022).

The concept of customary authority over land is commonly perceived as a bottom-up establishment that guarantees equitable and safe access to resources for the underprivileged, with a crucial role being played by local leaders, typically village chiefs (Ibrahim, Akanbang, & Laube, 2022). As shown in Ghana, Senegal, Mali, and Burkina Faso, these leaders administer the customary land tenure systems by granting claims, supervising land transfers, and occasionally collecting royalties or rent from miners (Teschner, 2014; Ofosu, 2022). The Tomboulouma system in Senegal is a notable instance, wherein customary village leaders, like the Tomboulouma, oversee ASGM by settling conflicts, maintaining safety, coordinating, and gathering taxes in the lack of substantial official assistance (Teschner, 2014).

In Sub-Saharan Africa, where customary land rights holders rent and sharecrop with strangers, hence fostering the expansion of land markets, ASGM is frequently linked to rural migration, a phenomenon having roots in traditional movement patterns (Ofosu, 2022). The similarities between ASGM and conventional rural agricultural operations are emphasized by this comparison. In Ghana, where chieftaincies control over 80% of the land, the customary land system is a key factor in ASGM. Despite the fact that the President is legally entitled to mineral deposits on behalf of the people, chiefs nevertheless have a great deal of power over the land. Due

to the split nature of Ghana's land ownership structure, there are two separate licensing systems in place: an official one administered by the government, and an informal one where chiefs and other customary actors primarily provide access to land and mining rights (Abdulai, 2017).

Due to galamseyers' perception of the formal government procedure as being time-consuming and costly, they believe the customary system to be more accessible and less burdensome than the dual licensing systems, which fuel the continuation of informal activities (Hilson 2001). Galamseyers have no motivation to participate in the government's formalization process because of the informal nature of the customary system, which keeps the sector's informal drivers in place (Otoo, 2021).

2.11.6 The Difficulties confronting ASGM Sector Governance

Many obstacles exist in the management of artisanal and small-scale gold mining. While addressing the problems with market governance, state governance, and community governance, this study primarily concentrates on these three topics. Private businesses handle the bulk of mining operations. Concerning government, they too face distinct obstacles. The sections that follow provide a detailed explanation of these ASM failures.

2.11.6.1 ASGM market Failure

The market is considered to have failed when its production processes are unable to meet the demands of society through the provision of goods and services. Negative externalities, such as environmental costs, can occur as a result of mining activities. Banchirigah and Hilson (2010), Hilson (2002b) as cited in Adu-Baffour et al. (2021) found this to be true. The sector's notoriously nomadic nature—along with the presence of harmful compounds—has accelerated land deterioration and contamination. Unfortunately, small-scale miners frequently fail to take reclamation of mined areas into consideration, even though these issues can be resolved by individual management, strict regulation, and the implementation of thoughtful incentives for responsible mining (Hilson, 2002b).

There is little motivation for private miners to take safety measures when the community and the government aren't going to pay for them. Because these processes frequently involve migration and are carried out by people who do not own the land, time-horizon issues amplify the difficulty. The improper handling and discharge of compounds, such as mercury, into the environment can lead to harmful consequences (Prabawa et al., 2024). Direct or indirect exposure

to mercury, such as through the consumption of animals that have accumulated the toxin, can cause harm to humans (Emmanuel et al., 2018).

2.11.6.2 State failures in ASGM

For example, governments might restore land and re-establish vegetation simultaneously to address market failures in environmental protection (Salati et al., 2016). However, there are issues with government attempts to address market failures. One typical example is the issue of information asymmetries, which arises when officials do not possess full and accurate data regarding the activities of the ASM subsector and their environmental impacts. Their ability to craft efficient policies is hampered as a result (Hilson and McQuilken, 2014; Adu-Baffour et al., 2021). If people aren't informed about the sector's operations and how they affect health, safety, and the environment, it could be more difficult to make the necessary adjustments in that area. Rigid policy frameworks fail to appropriately handle the repercussions of expanding complex interconnections, characterising the business as uncontrolled and informal areas (Adu-Baffour et al., 2021; Hilson and Maconachie, 2017).

One reason governments fail is because their leaders lack the political will to enact suitable laws. Research shows that governments in sub-Saharan African nations put an emphasis on mining ore-rich regions for their mineral wealth (Hilson et al., 2019; Hilson and Maconachie, 2020a). This prejudice is a major factor in supporting this stance. Policies that benefit large-scale miners at the expense of small-scale ones, problems getting official licences, and insufficient market, logistical, financial, and technical support services all contribute to the informal nature of the subsector. Hilson and Maconachie (2020b), Dery Tuokuu et al. (2020), and Hausermann et al. (2018) have both published papers that corroborate these findings. According to Hentschel et al. (2002) and Hausermann et al. (2018), the subsector does not attract attention from authorities and other major players because of personal interests tied to money laundering, corruption, land theft, and other illicit actions. For their study, Hausermann et al. (2018) used the terms "big men," "front men," "middlemen," and "secretaries," whereas Hilson et al. (2019) used the terms "majors," "local authorities," and "traditional authorities." The only reason for these unlawful actions is the informal status of the subsector.

2.11.6.3 Third sector failure in ASGM

Artisanal small-scale miners have the opportunity to organize and set industry norms for ore production, commerce, and environmental control. The establishment of active ASM cooperative organizations provides them with access to support services such as training, investment money, and information. Fairtrade International, for example, identifies and certifies small-scale mining cooperatives to ensure that its members follow internationally approved ore extraction and environmental standards. Furthermore, these cooperative members obtain benefits such as higher prices for their products (Mcquilken and Hilson, 2016). Cooperatives may face governance concerns, including common issues in collective action such as free riding (Adu-Baffour et al., 2021).

Siwale (2018) investigated Zambia's ASM and discovered that mine owners prefer informal, trust-based relationships to official miner associations due to difficulties such as lack of transparency, accountability, and democracy, as well as low trust within these groups.

Non-governmental organizations (NGOs) and civil society organizations (CSOs) actively contribute to ASM, notably in areas like as the environment, health, and safety. Their contributions include working with policymakers, regulating ASM businesses, and communicating with affected communities. Some also serve as watchdogs and pressure groups, holding governments and ASM corporations accountable. However, these organizations confront obstacles such as financial sustainability, restricted voice, and outreach. Communities have the ability to organize and solve market and state failures, particularly given the customary character of land management and the distinct cultural impacts on managing resources at an individual level (Adu-Baffour et al., 2021).

sss

2.12.0 Conceptual Framework

2.12.1 The Sustainable Livelihoods Framework

The utilisation of a sustainable livelihood strategy is a comprehensive way for evaluating and comprehending the various intricacies of livelihoods, as well as the constraints and possibilities they encounter (CeDEP, 2020; Majale, 2002; Moyo et al., 2022). The SLF provides an overview of the primary determinants that impact individuals' means of subsistence, as well as the common interconnections among these determinants (CeDEP, 2020; DFID, 1999; Moyo et al., 2022). The study utilised the Sustainable Livelihoods Framework (SLF) as outlined by DFID

(1999) to examine the specific ways in which changes in government structures and institutional procedures have influenced small-scale mining in Ghana.

The SLF, depicted in figure 2.12.1, employs a systems approach to comprehend livelihoods. This is conceptualised through five aspects, as outlined by Hoadley and Limpitlaw (2004). The diagram, depicted as figure 3, is an adapted rendition of the DFID framework that is most suitable for the specific livelihood conditions observed in the study area. There are five distinct components of the SLF. The factors that need to be considered are vulnerability context, livelihood assets, institutions and procedures, livelihood solutions, and livelihood outcomes. The practice of small-scale gold mining specifically produces adverse externalities that have placed livelihoods in significant jeopardy. To elucidate this perplexing situation, the sustainable livelihoods framework has been proposed. This theory offers valuable insights for my research on how artisanal and Small-Scale Gold Mining influences the diversification of rural livelihoods and the transformation of the landscape.

The Sustainable Livelihood Approach (SLA) has been a prominent method for implementing development interventions by major international agencies since the 1990s. The concept of 'livelihood' in the field of international development has a lengthy historical background. Chambers and Conway are recognised for coining the term 'sustainable livelihoods' in their influential paper, *Sustainable Rural Livelihoods: Practical Concepts for the 21st Century* (Chambers and Conway, 1992). According to Zhinan and Yossuck (2023), a livelihood can be described as the combination of abilities, resources, and actions necessary for sustaining oneself financially. Hilson and Banchirigah (2009) state that the Department for International Development (DFID) introduced the concept of livelihoods by creating the Sustainable Livelihood Framework. This framework categorises the resources that poor individuals, households, and communities use to sustain their well-being in the face of changing circumstances.

The sustainable livelihood framework attributes this phenomenon to various elements, including susceptibility contextual factors, as well as social structures and processes (Mihaye, 2013; Ma et al., 2023).

The sustainable lifestyle framework is visually represented in the diagram below:

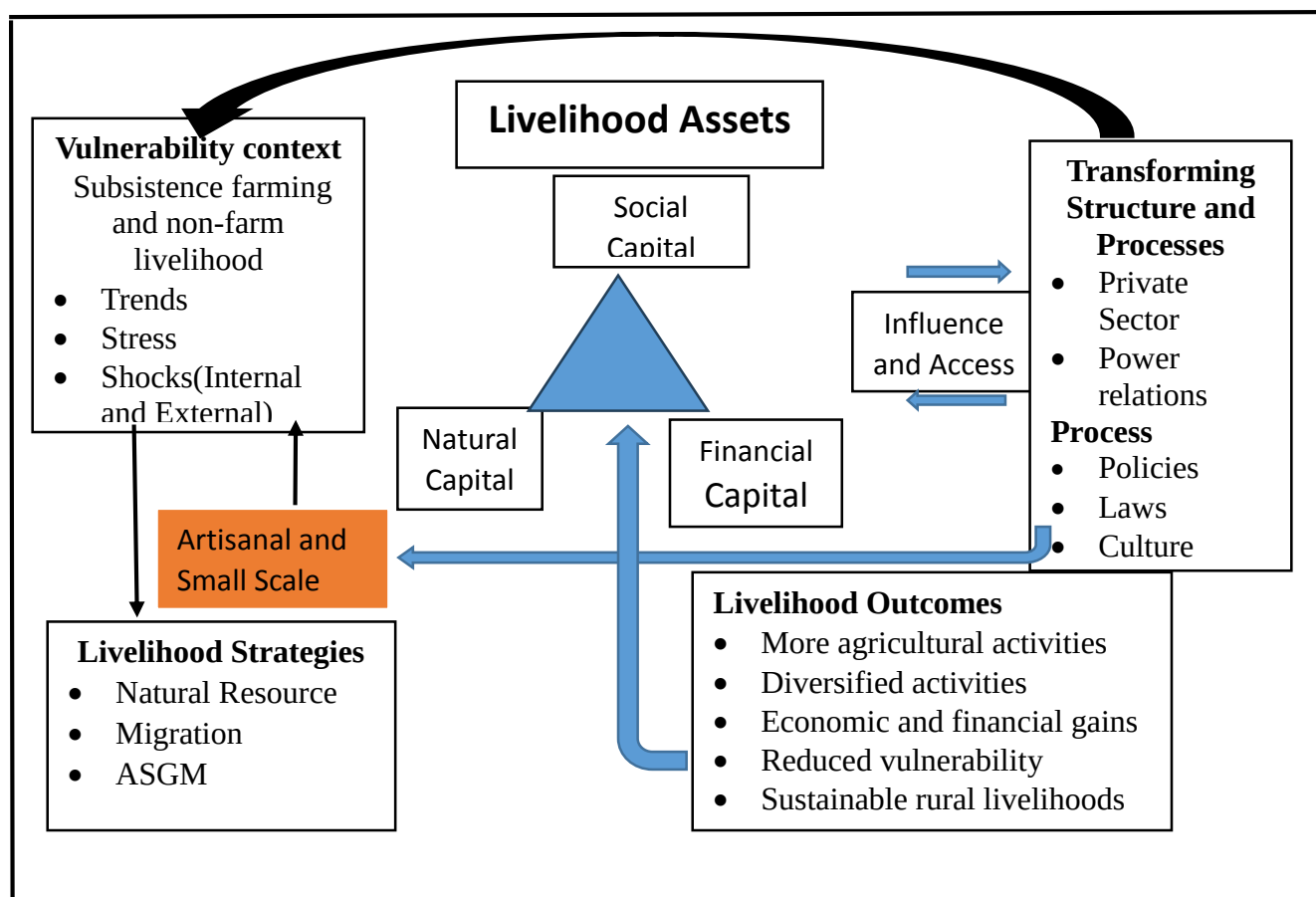


Figure 2.12: Sustainable Livelihood Framework (SLF)

Source: Authors own Construct based on DFID (2000).

Below is a discussion of the various components that make up the Sustainable Livelihoods Framework:

2.12.2 Livelihood Assets

Individuals within a household utilise their skills, expertise, and knowledge in conjunction with the resources at their disposal to generate chances for improved sustenance and well-being for themselves and their families. All the components that contribute to this means of living might be regarded as valuable resources for sustaining one's livelihood. The livelihood assets, which are crucial for the overall well-being of households, exist in both human and non-human forms and are indispensable resources that individuals need to have access to. These assets constitute a collection of resources that can be conserved, expanded, exchanged, or assigned for different

purposes, facilitating the generation of revenue, support, or other benefits. Following the framework outlined by the Department for International Development (DFID, 2002), these assets can be classified into five separate types, commonly depicted as a pentagon symbolising the five fundamental capitals: natural, physical, human, financial, and social assets. It is important to mention that in the field of livelihood studies, the terms "capital" and "assets" are sometimes used interchangeably (DFID, 2002, Scoones, 2015; Sargani et al., 2022). The five capitals are discussed in detail below:

2.12.2.1 Natural Assets

Natural assets refer to the valuable resources obtained from the environment that are essential for maintaining the livelihoods of rural households. The resources mentioned by the Department for International Development (DFID, 2000) encompass land, water, wildlife, biodiversity, and important minerals such as gold and crude oil. In the Ghanaian environment, land plays a crucial role for rural populations, acting as the main platform for both household and commercial agricultural activity. Nevertheless, land is a limited and disputed asset, particularly due to the growing demand from diverse stakeholders, including foreign investors, urban developers, and local elites. These actions have resulted in the acquisition of land, forced relocation, and disputes that endanger the lives and welfare of rural communities (Alhassan et al., 2021). Hence, it is imperative to establish effective natural resource governance that fosters responsibility, openness, engagement, and durability in the administration and distribution of land and other resources.

2.12.2.2 Social Assets

Social assets refer to the invaluable social resources that individuals and households utilise to support their livelihood activities. These resources are expressed in different ways, such as online communities, affiliations with groups, reliable connections, and entry to societal establishments. Individuals utilize these resources to enhance their means of making a living (DFID, 2000). Ghanaian rural communities exhibit a diverse range of social groups, including cooperative societies, work exchange groups, and religious organisations, among others (Forkuor & Korah, 2022). It is crucial to acknowledge that a person's status within a social group can greatly augment their social capital, ultimately resulting in increased social resources. These groups

promote cohesion and intimate engagement among rural households, acknowledging the importance of collective power within their very tiny communities. Moreover, social assets are intricately connected to the sustainable livelihoods approach, which is a conceptual framework used to examine the intricate interdependencies between environmental and socio-economic elements that impact the welfare of rural individuals (Hossain et al., 2023).

2.12.2.3 Human Assets

Rural individuals rely on human assets as fundamental elements of their livelihoods, as these assets serve as the foundation for their productive endeavors, adaptive measures, and overall welfare. Human assets encompass the intellectual, technical, physical, nutritional, and mental well-being of individuals and collectives (Scoones et al., 2020). In addition, human assets encompass the educational and health conditions of rural households, which have an impact on their productivity and overall welfare. Education has a crucial role in strengthening the human capital of rural individuals by enhancing their knowledge, skills, and prospects for diversifying their livelihoods and fostering innovation (Li et al., 2020).

Health is a crucial aspect of human resources that impacts the capacity of rural individuals to engage in various livelihood opportunities and adapt to evolving conditions. Health status is contingent upon a multitude of factors, including diet, sanitation, hygiene, access to healthcare, and exposure to diseases and environmental risks. Impaired physical well-being can diminish the efficiency of work, earnings, and accumulated wealth, while also heightening susceptibility to unexpected hardships and pressures. In contrast, enhanced health can bolster human capital, social capital, and economic prospects (Scoones et al., 2020).

2.12.2.4 Physical Assets

Physical assets are essential elements of livelihood resources, including a diverse array of infrastructure, equipment, and resources that are necessary for varied livelihood activities (DFID, 2000). These assets have a wide reach, encompassing both physical and non-physical aspects, and serve several functions in enhancing the welfare of rural households. The spectrum of physical assets encompasses the essential components that serve as the foundation for livelihood activities. These consist of transportation infrastructure, encompassing roads, paths, and various means of transit. Reliable transportation enables the efficient transfer of products and people, as well as linking rural areas to urban centers, hence improving economic prospects (DFID, 2000).

Furthermore, physical assets encompass concrete resources such as animals, machinery, and agriculture implement. Livestock, including cattle, goats, and poultry, play a crucial role in rural livelihoods by providing revenue, food, and agricultural labor, thereby making a significant contribution to the overall well-being of rural communities. Agricultural productivity is enhanced, labour requirements are reduced, and overall farm efficiency is improved by the use of farm machinery and implements, such as tractors, ploughs, and harvesting equipment (Scoones et al., 2020).

2.12.2.5 Financial Assets

Financial assets refer to the various resources, financial systems, and possibilities that individuals and households have at their disposal to pursue different livelihood options (Scoones, 2015). These assets include savings, credit availability, consistent remittances, informal lending, frugal habits, and informal labour exchange. Financial assets encompass household income derived from the exchange of goods and services, as well as transfers received from rights or obligations, such as pensions, taxes, food relief, and support from family members. The strength and resilience of financial assets, as well as other resources that support people's livelihoods, are crucial in determining households' ability to endure unexpected events, avoid poverty, and get these essential resources (DFID, 2000).

2.12.3 Livelihood strategies

Livelihood strategies are deliberate actions that effectively contribute to achieving targeted outcomes. Researchers in the field have documented various subsistence practices in multiple instances (Septanti, 2023). The categorization widely acknowledged is the one presented in the works of Scoones (1998). These works distinguish between coping strategies and adaptive strategies, which can be described as reactive and proactive livelihood strategies, respectively (Darjee, Neupane, & Köhl, 2023).

Coping strategies, also known as survival strategies, are immediate responses to shocks or immediate strain (Bandurska, 2022). On the other hand, adaptive strategies involve long-term changes in behavioural habits as a result of stress and shock (Özekan & Akan, 2023). Numerous empirical and analytical studies have identified different methods for livelihood strategies, which can be categorised into these broad classifications.

2.12.4 Livelihood Outcomes

Livelihood outcomes are the consequences or achievements of livelihood strategies, and these outcomes are intricate and arise from the combined influence of assets and other components of the framework (DFID 1999; Lisboa-Anderssen, 2023). To enhance the income, well-being, and livelihood security or sustainability of the impoverished, it is necessary to decrease their vulnerability and enhance food security without causing degradation or depletion of their resources.

Necessity pertains to the compulsion and urgency to engage in diversification due to involuntary and desperate circumstances. Instances of this phenomenon include the eviction of a family renting a property, the division of inherited farmland into smaller plots, the deterioration of the environment leading to reduced crop production, and the displacement and abandonment of assets due to natural or man-made disasters like droughts, floods, or civil wars. Additionally, accidents or poor health can also result in the inability to engage in demanding agricultural activities (Ayana et al., 2021).

Choice, on the other hand, pertains to intentional and beneficial reasons for pursuing diversification. For example, individuals actively seek seasonal employment in mining to earn higher wages, willingly travel to remote regions in search of job prospects, prioritise educating their children to enhance their prospects of securing employment outside of agriculture, save money to invest in non-agricultural enterprises such as trading, and utilise income generated from non-farm activities to purchase fertilizers or capital equipment for their agricultural ventures (Ayana et al., 2021). Ultimately, the process of disseminating it among other organisations allows diversification to effectively mitigate risk. Agriculture has a long history of diversification.

2.12.5 Transforming Structures, Processes and Institutions

These are the dynamic structures and processes that influence the way people sustain their lives, such as the intricate social, economic, and political environment in which individuals pursue their strategies for survival (Tapfuma, Musavengane, & Magwaza, 2023). Institutions refer to both formal and informal systems established by humans, which play a role in shaping society and individual expectations, interactions, and conduct (Krasniqi et al., 2023). Institutions possess significant power to shape and control access to natural resources such as gold, land and water, hence impacting the rates at which these resources are acquired and accumulated. Institutions exert

influence on outcomes by means of the acts carried out by individuals and decision makers affiliated with them. The lack of efficient markets in Sub-Saharan Africa (SSA) frequently hinders sustainable development and poses challenges to asset creation by obstructing access to specific livelihood options. Institutions can be categorised into three main types: public institutions (such as local agencies and governments), private institutions (such as seed banks, service organisations, and private businesses), and civic institutions (such as labour exchanges, collective gatherings, membership organisations, and cooperatives) (Chaudhury et al., 2011).

2.12.6 Context of livelihood Vulnerability

Vulnerability, as defined by Mehan (2023), refers to the extent to which a natural or social system can be impacted by disturbances resulting from climate change. According to Mah et al (2023), vulnerability can be divided into two components: an external component, which refers to the exposure of individuals or families to risks and shocks, and an internal component, which refers to the absence of effective coping mechanisms to address these difficulties without significant loss.

Various variables beyond the control of household members can significantly impact their access to sufficient livelihood assets. These variables encompass seasonal fluctuations that either decrease or enhance the accessibility of various resources throughout the year, as well as long-term shifts or patterns that may impact diverse parts of people's livelihoods. These factors may encompass shifts in population, environmental circumstances, modes of governance, economic situations, and technological advancements. Globalisation can lead to changes in the economic environment, which can either increase competition for families' products or generate new opportunities and markets for commodities (Ewebiyi, 2014).

Disruptions, such as calamities, conflicts, or outbreaks of illness, that might abruptly diminish the resources and access to essential livelihood assets of households (Haile, Seyoum, & Azmeraw, 2023). These factors can influence the level of susceptibility to poverty in homes and can be considered as the contextual conditions in which households' function. The setting will shape the manner in which households opt to utilise the many resources available to them. In regions prone to frequent droughts or artisanal and small-scale gold mining, rural farmers may opt to cultivate crops that have lower productivity or venture into mining but are more resilient to such risks. Various factors influence the manner in which individuals utilise assets for their sustenance.

2.12.7 Key Insights Derived from the Conceptual Framework for my Study

This study employs the Sustainable Livelihood Approach (SLA) to examine the impact of environmental risks associated with artisanal and small-scale gold mining on the diversification of rural livelihoods. The research focuses on both miners and non-miners in the three mining areas of Ghana's Upper West Region.

The SLA provides a comprehensive comprehension that certain favorable circumstances might enhance livelihoods. However, the utilization of natural resources in mining villages in the Upper West Region of Ghana also presents significant obstacles that might lead to adverse consequences and exacerbate poverty. The primary objective of this livelihood model is to incorporate rural individuals who primarily rely on mineral resources, such as gold, into development programmes and policy formulation. Development experts must adopt a novel approach and refrain from employing conventional methods to identify and resolve difficulties.

Furthermore, it is crucial to examine the resources possessed by individuals in artisanal and small-scale gold mining regions and analyze how these resources impact their decision-making process when it comes to expanding their sources of income. This approach ensures the inclusion of both formal and informal institutions in the decision-making process for determining the components of livelihood portfolios in the mineral-resource districts of the Upper West Region.

The study incorporated the SLA approach to assess the environmental consequences of artisanal and small-scale gold mining in the Upper West Region of Ghana. This includes analyzing the effects of water pollution, land degradation, destruction of farmlands, and air pollution. These factors significantly influence the livelihood choices of both miners and non-miners in the three mining districts.

The SLA offers a mechanism for development practitioners to incorporate indigenous knowledge into policies and initiatives aimed at alleviating poverty. Their capacity to integrate diverse resources with external variables in generating means of subsistence can significantly alleviate rural poverty. While the primary focus of this study is on small-scale miners and inhabitants of mining communities, it is worth noting that certain respondents in the mining district of the Upper West Region engaged in a range of alternative livelihood activities. These activities included farming, operating provision shops, vulcanizing, running drug stores, rearing livestock, teaching, working as masons or carpenters, vending food, and participating in student activities, among others.

The situation is indeed remarkable considering the extensive duration and resources invested by the Ghanaian government, non-governmental organisations, pressure groups, traditional authorities, and mining regulatory institutions (such as the Environmental Protection Agency, Minerals Commission, Forestry Commission, and Water Resources Commission) in their efforts to combat illegal small-scale mining and address poverty through alternative livelihood initiatives.

A paradigm shift in development techniques is necessary to address the persistent challenges pertaining to livelihoods and environmental hazards arising from artisanal and small-scale gold mining, particularly in rural regions. These measures should prioritise the needs and resources of the impoverished rural population residing in mineral-rich areas of the Upper West Region of Ghana. Mining has increasingly emerged as a means of earning a living in numerous African nations, such as Ghana. The artisanal and small-scale mining industry significantly contributes to both formal and informal employment, serving as a crucial mechanism for addressing and mitigating the adverse impacts of economic challenges. Artisanal small-scale gold mining plays a crucial role in generating revenue and sustaining livelihoods in this particular context.

The SLF has various other connections to this study. I employed the concept of asset-based livelihoods, referring to both tangible and intangible resources that were seen in mining communities, to examine its impact on livelihood strategies. The study aims to determine the vulnerability context, which the DFID utilised in its framework to demonstrate the impact of shocks, trends, and seasonality on livelihood strategies. Next, I discuss the effects of altering frameworks, whether initiated by the government or private sector, on the mining industry. These effects can be both advantageous and disadvantageous. Additionally, the study examined the methods by which laws, policies, culture, and institutions are formulated and controlled to shape the economic and social consequences for small-scale mining communities. While mining appears to be a significant means of earning a living, I examined the alternative livelihood strategies employed by individuals residing in mining communities and how these strategies influenced outcomes such as higher income and well-being, decreased vulnerability, enhanced food security, and a more sustainable utilization of natural resources.

2.12.8 The Fundamental Principles/Presumptions of SLA

Valdes-Rodriguez & Pérez-Vázquez (2011) elucidated the fundamental principles or assumptions that form the foundation of the sustainable livelihood strategy in their research. The individuals were categorised into three distinct groups: those focused on interpersonal relationships, those with a comprehensive approach, and those who connect the macro and micro levels. The following principles are thus elucidated:

Human-centric

Examining the sustenance of individuals and comprehending the manner in which it has transformed over the course of history is an essential initial step for any all-encompassing development plan. This entails a thorough analysis of the economic, social, and environmental factors that influence the means of support for individuals and communities. Through the examination of historical transformations and present-day patterns, it is feasible to discern the primary factors that cause changes in livelihoods. This knowledge serves as the basis for making well-informed decisions and creating specific interventions to improve people's livelihoods.

Holism

Holism refers to the philosophical concept that a system should be viewed as a whole, rather than as a collection of individual parts. An essential element for successful development is to embrace a holistic and all-encompassing viewpoint that takes into account the varied interests and requirements of all societal factions. By adopting this approach, development efforts can effectively tackle the unique obstacles encountered by various societal groups and foster equitable and enduring results.

2.12.9 Weaknesses of the Sustainable Livelihoods Framework

The framework has been criticized as having certain shortcomings various scholars and institutions numerous. Firstly, critics contend that the framework neglects to recognise the presence of certain persons or groups in society.

Moreover, the framework has faced criticism due to its inadequate emphasis on poverty reduction and its lack of direction on effectively resolving the interdependencies between micro and macro level concerns. Furthermore, critics have contended that the framework lacks sufficient

focus on reducing poverty and fails to provide clear instructions for policy analysis at both the micro and macro levels (DFID, 2000; Mdee, 2002).

Marzetti (2001), who attempted to use the SL framework in Brazil and encountered certain challenges, discusses a few of these difficulties. The box labeled "policies, institutions, and processes" is excessively crowded, perhaps leading to the loss of action. Additionally, she discovered that the term "social capital" could not be accurately translated into Portuguese for unknown reasons. Instead, it was modified to refer to "the capacity to exert influence on the formulation of policies." To substantiate the notion that the framework can serve as a cognitive instrument, it is crucial to bear in mind (Neefjes', 2000; Liu et al., 2023) argument that it is merely a tool and should be adapted to suit the requirements of the user.

Additionally, there are individuals who argue that the sustainable lifestyle system lacks utility if assets cannot be readily compared to one another (Maqueen 2001). Bond and Mukherjee (2001; Mdee, 2002) demonstrate that this approach has been attempted by employing a composite of scores for various capital assets. The scores are derived from the participatory assets ranking in Rajasthan. The case study conducted by Davis (2001) provides an intriguing analysis of the impoverished rural population of Cameroon, focusing on two specific regions within the country. She examines the interplay between transportation and livelihoods, as well as the potential synergy between non-transportation-based safeguards and strategies for enhancing food accessibility, with the aim of reducing people's vulnerability. She employs the livelihoods framework and other indicators, including access to education and healthcare, to assess an individual's capital. However, she acknowledges that some of these indicators are rudimentary. Conversely, it can be exceedingly challenging to precisely delineate capital assets, let alone endeavor to quantify them. For instance, social capital facilitates individuals' access to various resources, hence it cannot be accurately characterized as neutral. Furthermore, scholars have noted that the negative aspects of social capital, commonly referred to as the "evil side," are frequently disregarded. This includes instances where elites dominate participation activities, as highlighted by Thin (2000) and Liu et al. (2023).

Another area of worry, and the issue that has received the most negative feedback, is that the SLA lacks adequate political dimensions (Scoones, 2009). While politics was not completely avoided, the SLA's instrumental approach made it seem like background noise: present everywhere, yet lacking significance. Over time, the emphasis in development practice shifted

towards policies rather than politics, and towards good governance rather than inclusion, equity, and social justice. As a result, this issue became even more pressing.

This political reductionism manifests itself in two distinct ways. At the local level, there is a tendency to see the community as a unified entity, neglecting the influence of social class, gender, and other power dynamics that impact people's lives inside the community. According to van Dijk (2011: 101; Natarajan et al., 2022), the field of Second Language Acquisition (SLA) provides limited insights into the underlying factors that shape community dynamics and power dynamics. Understanding these factors is crucial for designing more impactful treatments (De Haan, 2012). When seeking to understand 'community', researchers studying livelihoods may fail to consider the important inquiries about living in the majority of locations.

Lastly, it is worth noting that the DFID sustainable livelihood framework does not address gender and gender-related issues. Inter- and intra-household gender dynamics play a crucial role in shaping the livelihoods of households, particularly for women and their children (Tsehaye, 2007; Michalscheck, Kizito, Kotu, Avornyo, Timler, & Groot, 2023). At the home level, there is a disparity in educational opportunities between girls and boys. Girls are frequently prevented from attending school in order to assist their family, or in cases where finances are limited, boys' education is prioritized as a more beneficial investment. Furthermore, women have been marginalized in relation to men due to gender beliefs that are shaped by culture, resulting in a diminished bargaining power for women (Tsehaye, 2007). In addition, women are limited to domestic responsibilities and are perceived as carers - responsible for cooking meals and taking care of children. Consequently, women are prone to experiencing restricted opportunities to obtain or possess livelihood assets, as well as being excluded from participating in governance and political decision-making processes. However, the evaluated livelihoods framework lacks explicit direction on how to integrate gender interactions and challenges within the livelihood system.

2.13. Summary of Chapter and Knowledge Gaps

The previous paragraphs of the literature review provide substantial evidence of the extensive amount of accessible information concerning the characteristics, intricacies, and driving forces of the artisanal and small-scale mining industry in many locations across the globe. The substantial expansion of the small-scale mining sector has been thoroughly analysed by both scholars and institutions, despite differing opinions.

Moreover, the review reveals the long-lasting connections between small-scale mining and the growth of opportunities for making a living, as well as discussions regarding the nature of these connections (whether they are cooperative or competitive). The divisions primarily revolved around two dominant schools of thought, one emphasising the socio-economic consequences and the other concentrating on the environmental impacts of the industry. The review concluded that these inconsistencies were partly caused by the methodological approaches used to comprehend the correlation. A clear and systematic approach was established, focusing on the specific subject of study. Social scientists utilised qualitative methodologies, whilst physical scientists applied a combination of qualitative and geographical approaches.

Once again, the literature assessment uncovers a lack of research findings concerning the influence of the connection between artisanal and small-scale gold mining and rural livelihoods. The literature has remarkably neglected to examine the influence of this relationship on the expansion of rural livelihoods in the three mining areas of the Upper West Region. This study aims to examine the correlations between artisanal and small-scale gold mining and the expansion of rural livelihoods. The objective is to analyse the impact of these linkages on achieving livelihood outcomes at both the individual and community levels. Its objective is to contribute to the ongoing discussions regarding the correlation between artisanal and small-scale gold mining and rural livelihoods. Furthermore, this study seeks to offer novel perspectives on how connectivity impacts the socio-economic welfare of both individuals engaged in mining activities and those not involved in mining.

Furthermore, despite numerous studies conducted on the topic in different environments, the ever-changing nature of livelihood, as demonstrated in the aforementioned literature, necessitates the examination of issues in various contexts and time periods. The ongoing study in the Upper West Region has a substantial scope owing to the ever-changing nature of livelihoods in the area.

Furthermore, the review demonstrates the spatial correlation between artisanal and small-scale gold mining and rural livelihoods, specifically agriculture, and highlights their mutual requirements for resources. Both entities rely on and compete for the utilisation of the factors of production, which encompass land, labour, and capital. The relationship between artisanal and small-scale gold mining and rural livelihoods (farming) in the Upper West Region primarily centres on the accessibility of land and water resources. These links create a close connection

between the actors in these two subsectors, resulting in varying levels of power in terms of accessing the necessary resources for their activities. Therefore, it is undeniable that there is a dynamic interplay of often unequal power dynamics among various entities.

The interplay between power dynamics and various factors, including socioeconomic, environmental, and personal elements, has a substantial impact on individuals' food security outcomes and overall welfare. Hence, the study employed the political ecology approach as a theoretical framework to thoroughly illustrate the complete dynamics of power among institutions, individuals, stakeholders, traditional authorities, and the governance, management, and ownership of natural resources with the aim of influencing their livelihoods. In order to address the shortcomings in capturing power dynamics and the relationship between humans and the environment, the political ecology approach was augmented by incorporating the classical theory of the informal sector. This theory offers a more thorough comprehension of these aspects by considering historical and multi-scalar viewpoints. Hence, a novel integration of the political ecology approach, classical theory of the informal sector, the tragedy of the commons, and the resource curse paradox was suggested as a viable approach to effectively address the research topics.

This study aims to address the lack of understanding by examining the nexus between environmental threats associated with artisanal and small-scale gold mining and the diversification of rural livelihoods in three selected districts of the Upper West Region.

CHAPTER THREE: STUDY AREA AND METHODOLOGY

3.1 Introduction

The primary aim of this chapter is to provide an overall justification for the selection of the study area. The study area is divided into two sections: the broader geographical area, the Upper West Region, and the more specific sub-geographical study areas, which include the Nadowli-Kaleo District, Wa West District, and Wa East District. This chapter also outlines the research design, research approach, philosophical stance, data sources, sampling methods, data collection methods, data collection tools, data analysis techniques, and presentation of findings. Furthermore, it addresses the potential validity and reliability of the research findings and discusses the ethical considerations involved in this study.

3.2.0 The Study Area

3.2.1 Introduction

The Upper West Region was created in 1983, along with the Upper East Region, when they split from the former Upper Region, which had been formed in July 1960 from the Northern Region. The aim of this decentralization move was to improve regional governance and administration.

3.2.2 Physical Features

The Upper West Region is one of the 16 regions of Ghana and has the smallest population of them all. It borders Burkina Faso to the north, the Upper East Region to the east, the Northern Region to the south, and Côte d'Ivoire to the west. It occupies 12.7% of Ghana's total land area, or 18,476 square kilometers. The region is part of the Guinea Savannah zone, where trees such as shea, baobab, dawadawa, and neem grow. These trees are drought-resistant and provide fuel and wood for building.

The region has a single rainy season that lasts from April to September, with an average annual rainfall of about 115 cm. The rest of the year is divided into two seasons: harmattan and hot season. Harmattan is a dry season with cold and hazy weather that occurs from early November to March, due to the north-east trade winds. Hot season is a warm season that begins with early

rainfall in April and ends with high temperatures of up to 40°C in March, just before the rainy season. The monthly temperatures usually vary from 21°C to 32°C (GSS, 2012).

The region has a mostly flat landscape, especially in the western areas around Wa, the capital, and the Lawra plains (also called the Wa-Lawra plains). The elevation is generally between 275 meters and 300 meters above sea level, except in the eastern part of Wa, where it goes over 300 meters above sea level. The land slopes down to around 150 meters above sea level in the east (GSS, 2012).

The region has different types of soils, such as Savannah ochrosols, tropical brown yeast, terrace soils along riverbanks, and groundwater laterites. These soils support the growth of various crops, such as grains, pulses, tubers, and cotton. Tobacco is grown on terrace soils, which are good for this crop.

3.2.3 Demographics

There were 901,501 people living in the Upper West Region as on the results of the 2021 Population and Housing Census (PHC). Of them, 51.2% (461,185) were female and 48.8% (440,317) were male. People under the age of fifteen made up 37.9% of the total population, while people between the ages of fifteen and sixty-six made up 56.8%. The percentage of the population 65 years of age or older was only 5.3%. In 2021, the proportion of people living in urban areas was 26.4% (234,284), while the proportion of people living in rural areas was 73.6% (663,218). The GSS (2021) estimates that the region's population density was 48.79 people per square kilometer.

3.2.4 Political and Administrative Structure

This study examines the population makeup of the Upper West Region, which plays a crucial role in shaping the country's development strategy. The analysis considers the geographical position of the region, its population characteristics, and the distribution of individuals across different districts (GSS, 2021).

The Upper West Region was established in 1983 through the division of the former Upper Region, which also led to the creation of the Upper East Region. The Upper Region itself was established in July 1960 by splitting the Northern Region. The objective of this decentralization was to enhance regional governance and administration. Wa serves as both the capital and administrative hub of the Upper West Region (GSS, 2021).

The Local Government Act of 1993 governs and regulates the local government system in accordance with the 1992 Constitution, which mandates the preservation of districts established before the 1992 Constitution. The Regional Coordination Council (RCC) is the primary governing body, overseen by the Regional Minister. The RCC includes representatives from each District Assembly, regional leaders of decentralized ministries, and delegates from the Regional House of Chiefs.

The Upper West Region is divided into 10 administrative districts: Wa West, Wa Municipal, Wa East, Sissala East, Nadowli-Kaleo, Jirapa, Sissala West, Lambussie/Karni, Daffiama-Issah-Busie, and Lawra. It is noteworthy that the Wa West District was carved out of the Wa District, with its administrative center located in Wechiau. Funsie serves as the capital of the Wa East District, and Gwollu is the district seat for Sissala West District.

3.2.5 Economy and Living Conditions

The majority of the population in the Upper West Region is primarily engaged in subsistence farming, typically working on an average plot of land measuring about 25 acres. Farming is a daily family endeavor, except for rest days. Agriculture in the region serves as both a means of providing food for survival and a source of economic activity. The region's agricultural productivity relies heavily on rainfall for the cultivation of various crops, including guinea corn, maize, millet, rice, soybeans, groundnuts, cotton, yam, cowpea, and sorghum. Cattle farming are also a prevalent agricultural practice (GSS, 2014).

Maize, sorghum, and peanuts are grown primarily for local consumption, with sorghum being used in the production of the traditional pito beverage. On the other hand, cotton and cowpea are mainly cultivated as cash crops (GSS, 2014).

Given the presence of artisanal and small-scale gold mining in the Upper West Region, the study chose to examine three specific districts. The following sections detail the locations and characteristics of gold mining operations within these three mining districts.

3.2.6 Location and Gold Mining in the Nadowli-Kaleo District

The Nadowli-Kaleo District is located in the Upper West Region of Ghana. It shares borders with the Jirapa District to the north, Wa Municipal to the south, Burkina Faso to the west, and the recently established Daffiama-Issah-Busie District to the east. Established in June 2012 under Legislative Instrument (L.I) 2101, Nadowli serves as the district's administrative center, in accordance with the Local Government Act of 1993 (Act 462). This legislation empowers the Assembly as the supreme political and administrative body in the area, responsible for implementing national policy (Nadowli District Assembly, 2015)

According to Section 10 of the Local Government Act 1993 (Act 462), the Assembly holds deliberative, legislative, and executive powers within the district. It plays a crucial role in the district's development by formulating development plans, budgets, and overseeing other developmental activities. The Nadowli-Kaleo District Capital is situated 41 kilometers from Wa, the regional capital. The district lies within latitudes 10.8° to 28° north and longitudes 2.7° to 10° west, a geographical position that facilitates international trade with its neighboring country, Burkina Faso.

The Upper West Region, including the Nadowli-Kaleo District, has geological formations with significant mineral potential, including gold. Illegal mining activities are common in the district, with signs of trenches, holes, and wells dug in various communities, such as Saan, Sampina, Wuchema, Nanga, and Gabilee, often invading farmlands. Both indigenous and migrant populations engage in artisanal mining as a source of livelihood. Also, the Azumah Resource Mining Company conducts mining activities in the Nadowli-Kaleo District.

3.2.7 Location and Gold Mining in the Wa West District

The Wa West District was established as an independent administrative unit in 2004 through Legislative Instrument (LI 1751), in accordance with the Local Government Act 463 of

1993, separating it from the Wa District. The administrative center of the district is Wechiau, and it is led by a District Chief Executive. Situated in the western part of the Upper West Region, the district spans between longitudes 9° 40' N and 10° 10' N, and latitudes 2° 20' W and 2° 50' W. It is bordered by the Southern Region to the south, the Nadowli District to the northwest, Wa Municipal to the east, and Burkina Faso to the west (Wa West District Assembly, 2015)

Covering approximately 1492.0 square kilometers, the Wa West District makes up nearly 10 percent of the region's total land area. The district's shape is roughly trapezoidal, with Wechiau, the district capital, situated near the western border. Wechiau is about 15.0 kilometers from Wa Municipal and is accessible via an unpaved road. The district's proximity to Burkina Faso offers strategic advantages for various initiatives, including the "Northern Development Initiative," which aims to establish a Savannah-Sahel Regional Market and other development projects.

Geologically, the Wa West District is characterized primarily by Pre-Cambrian granite and metamorphic rock formations. These rocks have undergone minimal weathering compared to similar formations in other parts of the country, due to low precipitation, high evapotranspiration, and sparse vegetation. Borehole water extraction is effective in the district, thanks to well-developed fracture structures in these rocks.

The agricultural, forestry, and fishing sectors employ the majority of the population aged 15 and older, accounting for 84.0 percent of the workforce. Other sectors, although less prominent, include mining and quarrying (0.4%), manufacturing (6.9%), construction (0.2%), accommodation and food services (1.3%), education (1.4%), and others. Notably, artisanal and small-scale gold mining has been occurring in the Polee watershed area for over a decade. In 2023, a new mining site was discovered in Tanina, within the Wa West District, located a few kilometers away.

3.2.8 Location and mining activities of Wa East District

The Wa East District, located in the southeastern part of the Upper West Region of Ghana, was established in July 2004 through Legislative Instrument (L.I) 1746, separating it from the Wa Municipality in accordance with the Local Government Act of 1993 (Act 462). The administrative center of the district is Finsi, situated approximately 115 kilometers from the regional capital, Wa.

The district borders the Momprugu-Moaduri District of the Northern Region to the northeast, the North Gonja District to the southeast, the Sissala East and Wa West districts to the north, and the Wa Municipality to the west.

The Wa East District covers around 1,078 square kilometers, making up 17.3% of the Upper West Region's total land area, which is 18,478.4 square kilometers. The district predominantly features sandy loam soils, which are highly fertile and ideal for cultivating tubers, grains, and legumes. Geologically, it consists mainly of Precambrian bedrock, along with igneous and metamorphic rocks that are rich in gold, iron, and bauxite reserves. These geological resources have attracted artisanal miners, leading to illegal mining activities in communities such as Bulenga, Duu, Joanfian, and Danyokura (Wa East District Assembly, 2015).

Gold mining in the district typically involves extracting gold ore from open pits, although other methods such as beach mining, inland dune mining, and dredging ocean and riverbeds are also used. While gold mining can be economically beneficial, it often has harmful effects on agricultural land, forests, and water bodies. The Wa East District is also known for its lucrative sand-winning activities.

Artisanal and small-scale gold mining operations have been conducted in various communities within the district, including Bulenga, Duu, Joanfian, Danyokura, Goripie, Buna, Baayiri, Kande, and Manwe. Additionally, Azumah Resource Ltd is actively exploring gold in the district, particularly in the JULIE concession area (Wa East District Assembly, 2015).

Between 2017 and 2020, the district experienced significant deforestation due to artisanal and small-scale gold mining activities, as observed through earth observation data. These mining activities have raised environmental concerns, particularly regarding the loss of vegetation and the degradation of land and water resources. The study area is depicted in Figure 3.1 below, illustrating the geographical location of mining communities in the Upper West Region:

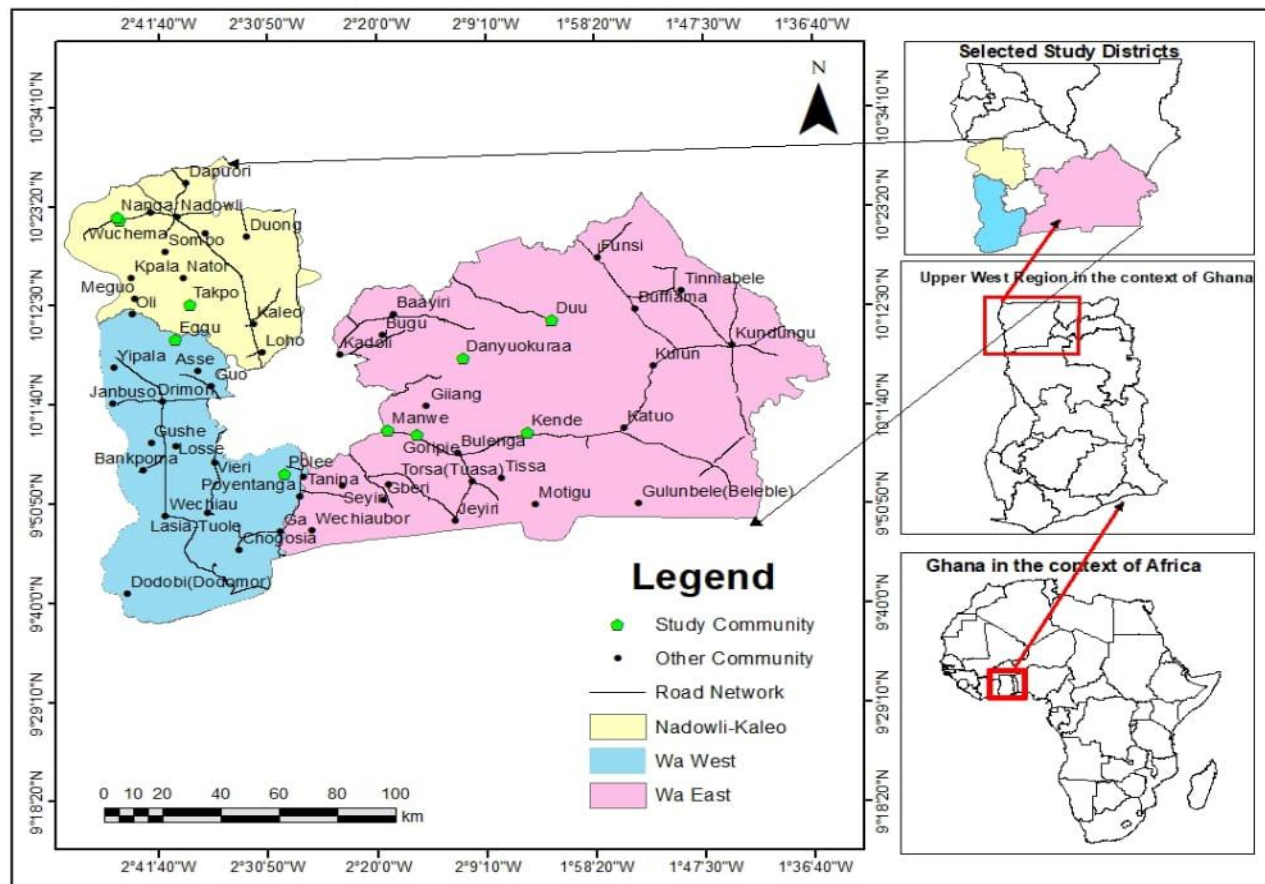


Figure 3.1: Map Depicting the Study Area Source: Author's Own Construct, 2023

3.2.10 Selection of the Study Area

The study focuses on three selected districts within the Upper West Region: Nadowli-Kaleo District, Wa West District, and Wa East District. These districts were chosen due to their significant engagement in artisanal and small-scale gold mining (ASGM) activities, as well as their proximity to key mining operations.

Furthermore, ten mining communities within these districts were selected based on specific criteria. A key factor was their geographical proximity to artisanal and small-scale mining catchment areas, ensuring that the study captured communities directly impacted by mining activities. Additionally, these communities fall within the prospecting concession of Azumah Resources Limited, a major mining company in the region.

Proximity played a crucial role in the selection process, as it allowed the researcher to optimize time and cost during fieldwork, considering the limited resources available for the study.

Selecting communities closer to each other and to mining activities helped ensure efficient data collection while maintaining the study's feasibility.

Another important criterion was the homogeneity of livelihood activities among the selected communities. These communities share common economic practices, particularly a reliance on farming, mining, and other natural resource-based activities for sustenance. This uniformity ensures a more consistent comparison of the impacts of artisanal and small-scale mining on rural livelihoods.

By carefully selecting these districts and communities based on their mining involvement, location, and economic activities, the study aims to provide a comprehensive understanding of how ASGM affects both the environment and livelihood diversification in the Upper West Region.

3.3.0 Methodology

Methodology is the structured and methodical methodology employed to carry out research or examine a specific topic or inquiry. Research methodology refers to the comprehensive framework encompassing many methodologies, tactics, and processes employed for the purpose of gathering, scrutinizing, and comprehending data within the context of a research investigation (Rahi, et al., 2019; Rahman, 2023).

3.3.1 Research Philosophy and Paradigms

Research is founded on philosophical assumptions, which are related to the researcher's view or perception of reality (Turyasingura, 2011). These assumptions form the basis of a research paradigm, which defines what constitutes 'valid' research and the appropriate methods to be applied (Myers & Avison, 2002; cited in Ansong et al., 2017). A research paradigm denotes the framework or viewpoint that researchers adopt to guide their research endeavors. It encompasses the researcher's perspective, views, assumptions, and methods. A research paradigm helps researchers understand the appropriate approach to conducting research, select suitable methodologies, and effectively interpret the obtained outcomes. The choice of a research paradigm employed in a study is significant because it influences the research design, data collection, data analysis, and interpretation of the findings (Davies & Fisher, 2018; Park et al., 2020). Although paradigms share several components, they differ in their approaches to various aspects (Creswell & Clark, 2011;

Phan, 2022). These aspects include the nature of reality (ontology), the process through which researchers acquire knowledge (epistemology), the methods used in research (methodology), the role of values in a study (axiology), and the language employed (rhetoric) (Creswell & Clark, 2011; Denzin & Lincoln, 2018; Phan, 2022). The following section focuses on the various philosophical paradigms adopted by researchers based on their specific areas of study.

3.3.1.1 The Positivist Paradigm

Positivism, a well-recognized research paradigm, posits that knowledge can only be considered valid if it is confirmed via sensory experiences (Bryman, 2012; Dawadi, Shrestha, & Giri, 2021). Quantitative researchers predominantly adhere to the principles of positivism and employ quantitative methodologies to obtain objective outcomes in their investigations. Throughout history, the predominant research methodology has been characterized by the application of quantitative research design or the positivistic approach. Post-positivism, conversely, can be characterized as a less stringent variant of positivism that adheres to similar principles while affording greater opportunities for interaction between the researcher and the individuals involved in the research (Taylor & Medina, 2011).

Ontologically, positivist researchers hold the common belief that social reality is singular, external, and objective (Collis and Hussey, 2014). This perspective implies that the research "object" (social reality) exists independently of the researchers, who can study these objects without affecting them or being influenced by them. Positivist researchers aim to maintain emotional neutrality, clearly distinguishing between reason and feeling, and between science and personal experience.

From an epistemological standpoint, the belief that the world exists independently of our knowledge allows positivist researchers to be both dualists and objectivists. This dualistic and objective approach is considered essential for conducting rigorous inquiry (Creswell, 2009; Phan, 2022).

3.3.1.2 The Paradigm of the Interpretivist

Interpretivism, as an alternative paradigm to positivism, espouses a divergent epistemological perspective by acknowledging the existence of various realities. Hence, proponents of this paradigm express scepticism about the utilisation of the scientific (or positivist) framework in doing research (Bryman, 2012). The paradigm followed by social scientists emphasizes the need of acknowledging the subjective meaning attributed to social behaviour (Taylor & Medina, 2011). Interpretivists, consequently, possess a comprehension of social phenomena and engage in their interpretation. Interpretivists rely on qualitative approaches employ many instruments, including interviews, focus groups, and participant observation, in order to comprehend the context and elucidate the significant findings. According to this paradigm, the major objective of research is to discover and address significant disparities in power within society (Taylor & Medina, 2011; Phan, 2022). In this particular paradigm, the researcher assumes the role of an advocate and change agent, actively promoting and spearheading the advancement towards a society that is characterized by equity, fairness, and sustainability (Taylor & Medina, 2011, p. 6; Phan, 2022).

Suffice it to say, the two separate philosophical paradigms commonly perceived as inherently contradictory are positivism/post-positivism and constructivism/interpretivism. Positivism/post-positivism is associated with quantitative technique, whereas constructivism/interpretivism guides qualitative research. Qualitative research has evolved as a necessary complement to quantitative research due to its ability to address research topics that quantitative methods alone cannot adequately answer hence the emergence of the paradigm of pragmatism which is discussed in the ensuing paragraphs.

3.3.1.3 Pragmatism

The final paradigm explored in this thesis is pragmatism, which does not align with any particular philosophical stance (Creswell, 2007; Dawadi et al., 2021). The argument suggests that the opposition between positivism and interpretivism should be abandoned, as it views reality as both unified and diversified. Creswell and Plano Clark (2011) define pragmatism as a philosophical approach that embraces diversity and emphasizes the importance of practicality and real-world implementation. Pragmatism utilizes different approaches; however, it is crucial that these approaches are applied within the specific study environment. To accomplish research

objectives, it is crucial to incorporate both objective and subjective knowledge. Scholars who embrace a pragmatic perspective possess the freedom to select research methods or strategies that are most effective in addressing their research inquiries (Creswell, 2007). Feilzer (2010) assert that pragmatism dismisses the dichotomy between quantitative and qualitative approaches, so resolving the paradigmatic conflict. Pragmatism posits that the primary concern should be whether the research has effectively addressed the researcher's inquiries.

It is feasible to work with differences in your ontology, axiology, and epistemology, according to the pragmatist research philosophy (Saunders et al., 2019). Pragmatists are a good philosophical fit for individuals who want to encourage the combination of approaches since they look for evidence that fits the study goal and problem (Bell et al., 2022). Three key principles of pragmatism are that research is an experiential process, that practical knowledge is important, and that experience is linked to knowledge (Kelly and Cordeiro, 2020). From a pragmatic perspective, researchers can arrive at actionable results and conclusions by integrating data from many sources while acknowledging the experiences of research participants.

Drawing insights from the aforementioned major research paradigms this study relied on the thinking pragmatism. Hence, this study acknowledged the importance of gathering both quantitative and qualitative data simultaneously from research participants. Therefore, this following section details the use of pragmatism as a research paradigm for this study.

When studying the 'how and why' artisanal and small-scale mining gold mining is influencing rural livelihood diversifications of people in mining areas in the Upper West Region, it was decided that the most effective underpinning research philosophy was pragmatism. Therefore, overall whilst the study sought some amount of objectivity, it still recognized the significance to collect miners and non-miners' qualitative data for the component of the study research where it was more effective, hence the reliance of the study on pragmatism as philosophical position.

3.3.1.4 Pragmatism as a Research Paradigm of the Current Study

The belief of pragmatists is problem-centred, practice-oriented and pluralistic (Creswell & Plano Clark, 2011; Dao, 2021). It is not restricted to any one philosophy or reality system, thus researchers is free to select the procedures, methods, and strategies that best fit their research. Put differently, as stated by Creswell (2014 p. 9; cited in Dao, 2021), "pragmatism opens the door to

multiple methods, different worldviews and assumptions, as well as different forms of data collection and analysis."

Regarding the research paradigm, the study was grounded in the pragmatic viewpoint, which asserts that designs and methodologies are chosen depending on their effectiveness in addressing the research problems at hand (Tashakkori & Teddlie; Dao, 2021). The research encompasses the identification of all components of a pragmatic worldview, including ontology, epistemology, axiology, methodology, and rhetorical assumptions.

Based on the above, all elements of a pragmatic worldview regarding ontology, epistemology, axiology, and methodology and rhetorical assumptions could be identified are discussed in the following paragraphs:

To start with, this research drew upon both plural and singular realities, as informed by ontological considerations. As an academic researcher studying the nexus of environmental treats and rural livelihoods from the perspective of artisanal and small-scale gold, I have developed a personal perspective on the diverse factors that drive people to participate in this form of mining, as well as the ways in which is affecting their physical environment and overall livelihoods. The study gathered perspectives from various respondent groups, including artisanal miners, state institutions mining regulation (such as the Environmental Protection Agency and Minerals Commission), traditional authorities of mining communities (such as Chiefs, elders, and tendambas), and other opinion leaders like assembly members. The focus is on exploring the relationship between environmental threats and rural livelihood diversification in the context of artisanal and small-scale gold mining activities to see whether there are any variations, sameness and clashes of responses between the various categories of respondents.

During the study, I took careful efforts to identify the motivations that drive individuals to participate in artisanal and small-scale gold mining. These motivations, as already elaborated in the literature review, encompass factors such as high unemployment rates, limited agricultural opportunities, and the desire of rapid financial gains. Furthermore, the survey aimed to investigate the impact of artisanal and small-scale gold mining on the physical environment, as well as its potential influence on the diversification of rural livelihoods. Initially, I adopted a positivist perspective. Nevertheless, I have transitioned my philosophical perspective to interpretivism in order to have access to a multitude of viewpoints and develop a more profound understanding artisanal and small-scale gold mining, as observed through the views of different types of

respondents. The attainment of this goal prompted me to employ a combination of open-ended and close-ended inquiries in order to elicit both quantitative and qualitative information, as advocated by the pragmatist philosophical perspective.

Epistemology, this study places significant emphasis on the practical aspects of data collection, particularly. This entails careful consideration of various crucial factors, such as ensuring the reliability of the sample for the quantitative study, securing opportunities to conduct focus group discussions, interviews, and observations as means of gathering data. The selection of appropriate participants for the interviews is also of utmost importance in effectively addressing the research questions, and accurate identification of these participants is a critical aspect of the paradigm. This study included participants engaged in artisanal and small-scale gold mining, as well as stakeholders within the mining communities, such as chiefs, elders, and assembly members. Recruiting miners proved to be a challenging task due to the illicit nature of their occupation. Consequently, the snowball or referral sample strategy was utilised. In the initial phase, I endeavor to identify a miner inside each community by means of an informant. Subsequently, I conduct interviews with the identified miner, wherein they are requested to identify a fellow miner. This process is repeated until the point of recruitment saturation was reached.

Additionally, the research employed many perspectives (axiology). During the study process, I incorporated value-laden perspectives and acknowledged the presence of some biases when interpreting information provided by respondents, as these align with the fundamental tenets of the pragmatist philosophical worldview. The study participants were afforded the opportunity to respond to research questions in a manner that minimized the researcher's influence, promoting autonomous thought and decision-making. The purpose of this action was to enhance the scientific and empirical nature of the research data. Nevertheless, I actively engaged with the subject matter at hand during the interviews and openly acknowledged my subjective viewpoints by interpreting the respondents' comments.

Furthermore, within the realm of philosophy, methodology pertains to the manner in which the research process is undertaken. This study included an integration of quantitative and qualitative data collection methodologies and equipment. Simultaneously, the study gathered data of both quantitative and qualitative kind. The study performed a separate analysis of both

quantitative and qualitative data and then combined these two data sets during the interpretation stage. The research accorded equal significance to both qualitative and quantitative data.

The study's rhetorical presupposition was demonstrated by the utilisation of both formal and informal language in the presentation of the research outcomes. The utilisation of informal language was employed to document direct quotations from key informants as a method of presenting qualitative data, whilst formal language was employed to present quantitative data obtained through the administration of a questionnaire. The utilisation of both formal and informal reporting styles serves the purpose of effectively convincing, involving, and enlightening readers about the credibility of the research findings (Jonsen, Fendt & Point, 2018).

Although the study underscores many merits of the pragmatic philosophy as a research paradigm for this study, it is not exempt from challenges. To start with, critics argue that pragmatic philosophers are subject to criticism due to their alleged failure to fully acknowledge the substantial influence of philosophical assumptions on research methodologies (Maxwell & Mittapalli, 2010; Goetz, 2022). Insufficiently investigating this effect may also lead to insufficiently investigating how the ontological and philosophical perspectives that researchers employ are influenced by their training.

Again, there exists a group of scholars who advocate for the adoption of critical realism (CR) as a shared philosophical foundation for mixed methods research. They contend that researchers should engage in clear discussions regarding the philosophical principles that underlie their chosen research methodologies. Critical realists conceptualize reality as being characterized by structure, openness, and differentiation. Maxwell and Mittapalli (2010) and Goetz (2022) claim that critical realism ontology encompasses the notion that an objective reality exists autonomously from our subjective perceptions, theoretical frameworks, and conceptualizations (p. 145). Critical realists place significant focus on the explicit discussion of the connection between qualitative and quantitative approaches in research, as a result of their critique of pragmatism research designs (Maxwell & Mittapalli, 2010).

After careful examination of the various approaches to mixed methods research, this thesis refutes the notion that qualitative and quantitative research methodologies are fundamentally incompatible, and instead recognizes their potential to mutually enhance one another. Simultaneously, it recognizes the realism criticism that the explicit discussion of connecting and integrating two strands of research approaches is necessary. In a research design that combines

both qualitative and quantitative methods; qualitative research approaches aid in understanding the phenomenon through indicative results obtained through instruments such as participant observation, focus group discussion and interviews. On the other hand, quantitative approaches facilitate the production of objective findings through the utilization of tools such as surveys. This thesis argues that by thoroughly examining the ontological basis and evaluating the strengths and weaknesses of both techniques of inquiry, the use of mixed methods research (MMR) is advantageous in the analysis of intricate social phenomena.

3.4.0 Research Design

The term "research design" encompasses the strategies and procedures employed to gather data and the methodologies employed to analyse this data, with the ultimate aim of accomplishing the study objectives (Kapur, 2018). The selection and implementation of a research design are of paramount importance for the successful execution of any research endeavour. This is due to the fact that a well-designed research plan facilitates a comprehensive comprehension of the research procedures, hence enabling the efficient and thorough collection of information.

3.4.1 The Case Study Design for the Current Research

According to Creswell (2009), a case study is a research method in which the researcher conducts an in-depth investigation into a programme, event, activity, process, or one or more individuals. According to Creswell (2014) and Mohajan (2018), a case study often follows a structured format that includes the identification of the problem, the contextual background, the difficulties at hand, and the derived lessons gained.

Within the context of this research, the justification for employing a case study design is to investigate the interconnection between environmental threats associated with artisanal and small-scale gold mining and the diversification of rural livelihoods in the mining areas of the Upper West Region, Ghana. Due to its status as a developing nation, the Upper West Region is vulnerable to the risks associated with artisanal and small-scale gold mining, which in turn impacts rural lives. Ghana is an active signatory to the Minamata Convention, along with other countries. Consequently, there is a significant emphasis on conducting research in various areas related to artisanal and small-scale gold mining, diversification of rural livelihoods, environmental risks, the influence of policies, laws, and institutions in the governance of the mining sector, as well as analyzing changes in land use and land cover within the mining districts of the Upper West Region.

A case study investigation also gives room for the investigator to empirically examine theoretical underpinnings (Yin, 1994; Schipper, 2004; Sango, 2013). This study was conducted over a period spanning from July 2022 to July 2023. It is vital to facilitate the researcher's acquisition of in-depth knowledge about the realities and salient factors triggering artisanal and small-scale gold mining, as well as its impact on the diversification of rural livelihoods at the local level. Three mining districts in the Upper West Region were chosen as a case study to gain a deeper understanding of the various aspects related to artisanal and small-scale gold mining. This study aimed to examine the impact of ASGM on rural livelihoods, environmental concerns, mining policies, institutional implications, and the changes in land use and land cover within the selected mining districts.

In order to fulfil the requirement for case studies, a variety of data collection tools and methods were utilized to accomplish the objectives of the study. These included observation, semi-structured and unstructured interviews, household questionnaires, official documentations, and focus group discussions. This action aligns with the perspectives of Yin (2004; Sango, 2013), who argued that case study evidence can be obtained through six premises, namely archives, interviews, observation, documentation, participant-observation, and physical artifacts. In the context of this study, these premises are utilised to examine land use patterns and changes in the diversification of rural livelihoods among mining communities in the Upper West Region.

Jimu (2022) have both contributed to the relevance associated with this particular study design. To start with, the research questions of the study may be modified during the course of the investigation if the researcher deems the initial ones to be inconsequential. This idea was demonstrated in the study, as several research questions were modified subsequent to the preliminary testing of the data gathering tools. Several questions were either removed or modified once it was determined that they did not violate the research objectives. Additionally, this provided the researcher with increased flexibility to formulate novel research questions that were aligned with the research objectives.

Again, due to the design's strength of capturing a rich array of data, they yield "richer, more contextualized, and provide a more context-specific, and genuine understanding of the phenomenon under investigation in comparison to other research designs" (Bhattacharjee 2012; Jimu, 2022). The utilisation of the case study methodology provided the researcher with a valuable opportunity to collect a substantial amount of data that were highly contextualized. As a result,

this approach facilitated the generation of authentic interpretations pertaining to the phenomenon of artisanal and small-scale mining, as well as the ways in which it is impacting the composition of rural livelihood portfolios within selected mining communities located in the Upper West Region.

The case study is widely recognized as a valuable design in numerous social science studies, particularly in relation to topics such as poverty, employment, and community-based difficulties (Zainal, 2007; Jimu, 2022). In this regard, since artisanal and small-scale gold mining is intricately linked rural livelihoods it has a close link to poverty, availability of employment opportunities, community-based such as environmental consequences associated with artisanal ad small scale gold mining. Therefore, the adoption of a case study research approach was well fit for this study

However, despite the perceived advantages of employing the case study research design, it is not devoid of its inherent limitations. To begin with, the dependability of measures in case studies has been subject to scrutiny, as stated by Hall & Hall (1996; Sango, 2013). The applicability of case study findings is generally limited to specific contexts, and therefore may not be generalizable in many circumstances (Yin, 2004; Sango, 2013). This idea is characteristic of the present study, as the findings regarding the impacts of artisanal and small-scale gold mining on the diversification of rural livelihoods may not be readily applicable to comparable studies conducted in different research contexts characterized by distinct political, historical, socioeconomic, and geographical conditions (Stake, 1995; Sango, 2013).

The purpose of employing a case study approach in the context of artisanal and small-scale gold mining activities in the Upper West Region, is to focus on three specific mining districts (Nadowli-Kaleo, Wa West, and Wa East Districts) as a localized geographical unit, rather than considering the broader global perspective of this phenomenon. In the process, the case study seeks to unearth in detail the nexus of environmental threats and rural livelihood diversification from ASGM perspective in ten (10) selected mining communities in three (3) districts. The present study does not aim to generalize its findings. Furthermore, in the interpretation of the research data, there is no inclination to generalize the findings regarding the vulnerability of the three mining districts to environmental threats, rural livelihood diversifications, and land use land cover changes. The subsequent section delves into the details of the choice of mixed methods strategy for this study:

3.5.0 Research Strategy/Approach

3.5.1 Mixed Methods Approach

The preceding discourse pertaining to pragmatism as a philosophical standpoint has established the foundation for the utilization of a mixed methods research design, which can be defined as "a research approach in which the researcher gathers and analyses data, combines the findings, and draws conclusions by employing both qualitative and quantitative methodologies within a singular study or programme of inquiry" (Tashakkori & Creswell, 2007; Dias-Barbosa et al., 2022). The utilization of the Mixed Methods Research (MMR) approach has gained significant recognition and acceptance within the social behavioural sciences for almost half a century, as evidenced by the works of Creswell and Plano Clark (2007), Teddlie and Tashakkori (2009), and Dias-Barbosa et al. (2022).

This approach is grounded in the principle that integrating both qualitative and quantitative data leads to a more comprehensive and mutually beneficial use, as opposed to the separate collecting and analysis of quantitative and qualitative data. The field of mixed methods research methodology has had notable advancements in recent years (Creswell and Plano Clark, 2018; McBride et al., 2019).

3.5.2 Rationale for Employing Mixed Methods Approach in the Present Study

Greene et al. (1989) as cited in Dao (2021) outlined five overarching justifications for employing mixed techniques, whereas Bryman (2006; Dao, 2021) presents a complete compilation of sixteen explanations derived from researchers' methodologies. In addition, Creswell and Plano Clark (2011) delineate the categories of research topics that are suitable for mixed approaches. In their study, Dawadi et al. (2021) provided a list of six primary rationales for employing a mixed method research approach. It is therefore based on the above scholarly literature; I proffer the following reasons for using mixed method approach approaches in this study:

To start with, combining two methodologies offer greater advantages compared to utilizing a single methodology, since it is more likely to yield an overall insight into the studied phenomena that cannot be fully grasped by employing either qualitative or quantitative methods alone. A mixed-methods approach enables the researcher integration and synergistic use of numerous data

sources, facilitating the examination of intricate problems (Poth & Munce, 2020, Dawadi et al., 2021).

Within the scope of this study, depending exclusively on quantitative approach may lead to a limited understanding of the perspective's methods of artisanal and small-scale gold mining, as well as its impact on environmental threats and rural livelihoods. Conversely, relying solely on qualitative data may hinder the ability to draw general conclusions from the study's findings. The household survey results provided an overview of the factors that drive participants to engage in artisanal and small-scale gold mining. It also identified the types of rural livelihoods impacted by mining, the environmental consequences of such mining activities, and the coping strategies employed by residents in the selected mining districts of the Upper West region. Nevertheless, the preceding two chapters have highlighted the contrasting perspectives of miners and non-miners regarding the significance of artisanal and small-scale gold mining in expanding livelihood options. However, there is a dearth of research conducted from the miners' standpoint.

To understand the impact of artisanal and small-scale gold mining on rural livelihoods and the environment, it is necessary to gather individual perspectives and experiences through the use of both quantitative and qualitative data collection methods. This provided insights into how ASGM is shaping rural livelihoods and its effects on the physical environment (air, land, and water), and the factors that drive individuals to engage in artisanal and small-scale gold mining. Therefore, the integration of two strands of data offered a more effective means of conveying a complete narrative on the interconnection between environmental risks and the diversification of rural livelihoods in the of ASGM in the Upper West Region of Ghana.

Another rationale for integrating the two methodologies is the conviction that both forms of approaches include inherent merits and, to some extent, are mutually reinforcing. The researchers use both data sets to answer the same research question which can produce greater certainty and wider implication in the conclusion (Maxwell, 2016; Dawadi et al., 2021). In other words, mixing two methods helps to produce a more complete picture and provides an opportunity for a greater assortment of divergent or complementary views; which are valuable as they not only lead to extra reflection and enrich our understanding of a phenomenon, but also open new avenues for future inquiries (Teddlie & Tashakkori, 2009; Dawadi et al., 2021).

Furthermore, this study relied on mixed-method because of the component of triangulation. Data triangulation in a mixed-methods study is generally accepted as a strategy for validating

results obtained with the single method (Bergman, 2008). Operationally, my study seeks to generate a more accurate and valid picture of the extent to which certain rural livelihoods has been diversified as a result of the emergence of artisanal and small-scale gold mining popularly known in Ghanaian parlance as ‘galamsey’ in the three mining districts of the Upper west Region. To achieve the above, I compared directly the findings generated from one method to (qualitative or quantitative method) other findings obtained from another method (quantitative or qualitative method) for convergence at the interpretation stage of the research as opined by Plano Clark and Ivankova, (2016). Similarly, collecting two strands of data (quantitative and qualitative) grants this study a more insights on the subject of study (Artisanal and small-scale gold mining) that each method singularly cannot grant, hence, offers my study greater valid and stronger findings than a single method would have done (Teddlé & Tashakkori, 2009).

Despite the recognition given to mix methods research for its numerous advantages, it is not without challenges. These challenges are discussed in detail in the following paragraphs:

To start with, the process of data collection and processing can be somewhat time-consuming. Consequently, it could be more costly in terms of both financial resources and time allocation. Researchers often face challenges when attempting to design their research projects within the constraints of their allotted time and budgets (Fauser, 2018; Hauken et al., 2019). Several researchers suggest that the process of recruiting participants and collecting data is time-consuming and requires a significant amount of effort (David et al., 2018).

Moreover, the process of combining qualitative and quantitative data is a challenge for numerous researchers (Wisdom & Creswell, 2013). Casey et al. (2016) had a comparable situation where they were uncertain about a method to combine their data sets. Additionally, they suggest that the current body of literature offers less direction on the process of integrating data from various sources. In their study, Youngs and Piggot-Irvine (2012, (Pg 195).) posed a similar inquiry regarding data analysis: "at what point should one cease analysing, comparing, and contrasting the data”

In addition, quantitative and qualitative methodologies are influenced by distinct epistemological and philosophical paradigms, presenting integration challenges. These challenges stem from the need to give equal importance to the assumptions of each paradigm and address whether the data from both approaches are compatible. Ensuring that quantitative measures align with qualitative findings is a key challenge in this approach, which requires identifying clear and

accurate themes in the qualitative data (Yu & Khazanchi, 2017). Although researchers recognize the value and complementarity of both methods, a major issue arises when findings from one method contradict those from the other, raising concerns about the reliability and validity of one method (Salehi & Golafshani, 2010).

Finally, primary problem for a mixed-method researcher is determining the right MMR design for a specific study. The suitability of a design will mostly rely on the study's objective and the perceived importance assigned to the qualitative and quantitative aspects. This refers to whether equal importance is given to both data sets or if one is more dominant than the other. Hence, this study employed the concurrent triangulation mixed method approach, which involved the simultaneous collection of both quantitative and qualitative data strands, followed by independent analyses. The next sub-section discusses the concurrent triangulation mixed method:

3.5.3 Concurrent Triangulation Mixed Methods Approach (Convergent Parallel Design) for the Present Study

The concurrent triangulation also known as the convergent parallel design is a research methodology that involves simultaneously implementing both quantitative and qualitative components, assigning them equal importance, and maintaining their independence during analysis. The findings from both aspects are subsequently merged throughout the comprehensive analysis of the research (Creswell, 2013; Jimu, 2022). This design technique involves the concurrent implementation of both quantitative and qualitative research phases. Research with a triangulation design gives equal importance to both quantitative and qualitative methodologies. Nevertheless, the results derived from each approach are initially examined independently and later merged, or triangulated, at the interpretation stage (Tashakkori & Creswell 2007; McBride et al., 2019).

One of the primary objectives of employing concurrent triangulation mixed-method in my study is to produce a variety of data strand on the same subject (Morse, 1991a; McBride et al., 2019) and to combine the advantages while mitigating the limitations of individual quantitative and qualitative research methodologies.

Another reason that prompted the use of the concurrent triangulation design for my study was to achieve efficiency in terms of time (the simultaneous collection of both qualitative and quantitative data). Instead of the study using different time period to collect different kinds of data

(qualitative or quantitative data) same time was used to collect the two strands of data synchronously which resonates the idea of Creswell and Plano Clark (2018) as cited in McBride et al. (2019).

Again, the strength of conducting the analysis of one strand of data independently from each other was one of the reasons why I adopted a concurrent triangulation mixed method for the study (unlike sequential designs). After the data collection, each strand of data was analysed independently and the results merged at the interpretation (Creswell and Plano Clark 2018; McBride et al., 2019).

Notwithstanding its numerous strengths, the concurrent triangulation mixed method is not without a setback hence was challenging to work with in this study. First of all, in the process of using the concurrent triangulation mixed method I encountered some complexities in the interpretation stage as the study tried mixing different data sets (qualitative and Quantitative data), sample as well as conflicting data

Secondly, the issue of discrepancies between the quantitative and qualitative findings was a daunting task in my attempt to reconcile them. This was evident in this study as contrasting views of the factors that led to illegal miners operating without valid mining licenses between miners and the minerals commission. The operationalization of the concurrent triangulation mixed method is diagrammatically depicted below:

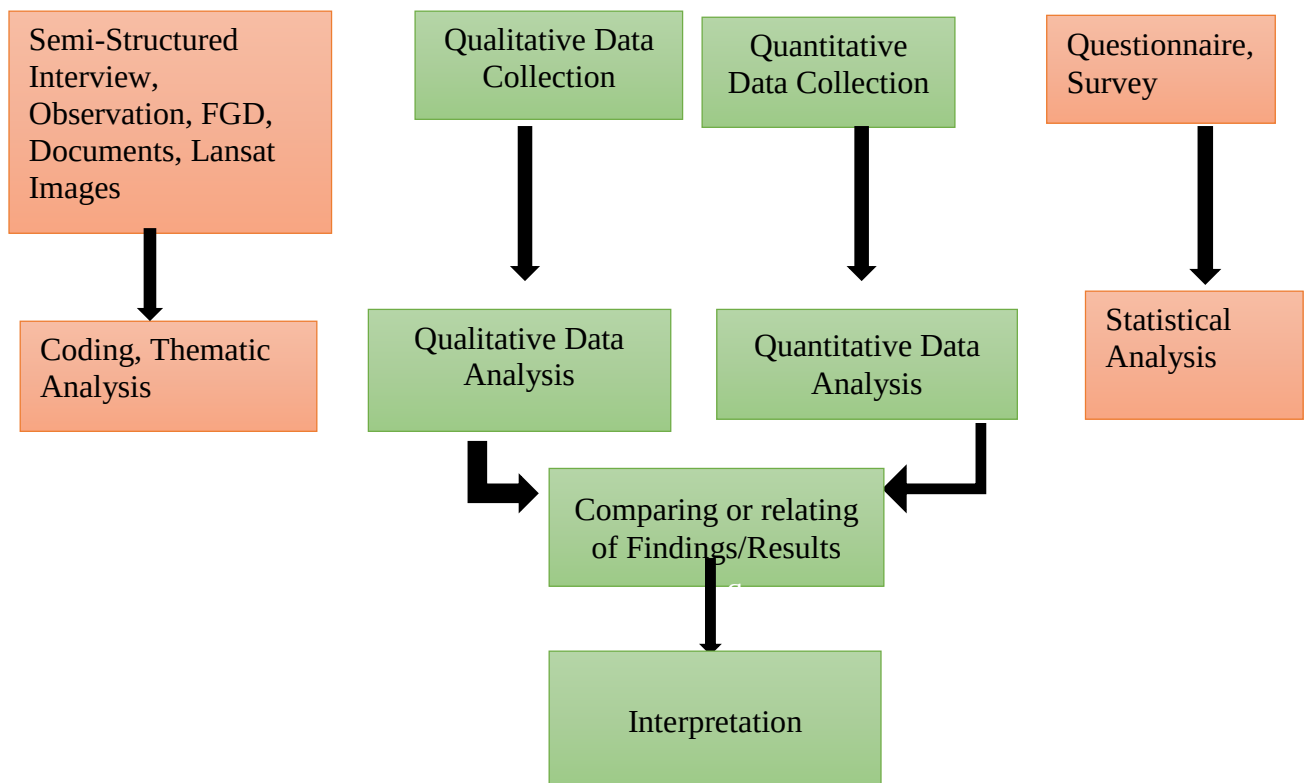


Figure 3.2: Diagrammatic View of Concurrent Triangulation Mixed Method

Source: Adapted and modified from Creswell, 2013

3.6. Data Types and Sources

Primary data refers to newly data gathered obtained by the researcher specifically for the purpose of this study. On the other hand, secondary data is pre-existing information that has been previously gathered by another person, organization, or institution for a reason unrelated to this research. The study utilized a combination of primary and secondary data sources (Kapur, 2018).

3.6.1 Primary Data

The primary data was sourced using key informant interviews, questionnaire survey (open-ended and close-ended questions), focus group discussions and observation to gather data from ASGM leaders, household heads, chiefs and elders, assembly members, landlords, gold buyers, leaders of youth groups, mining association and opinion leaders based on empirical information through an intensive field work in selected mining communities of the Upper West Region. Again, primary data was also collected from the Environment Protection Agency (EPA), the Minerals Commission, the three Districts Assemblies and the Ministry of Food and Agriculture and the district assemblies

3.6.2 Secondary Data

Secondary data was gathered from academic publications, reports, documents, relevant books on desk research as well as government publications were consulted for secondary data generation. Finally, secondary data was also obtained from Land Satellite Imagery interpretation of the three mining districts (Wa West, Wa East and Nadowli-Kaleo Districts) for 2002, 2010 and 2022(Landsat TM 2002, Landsat TM 2010 and Landsat TM 2022).

3.7.1 Sampling

Sampling refers to the statistical procedure of choosing a subset from a specific population in order to gather data and make statistical conclusions about the entire population. The primary importance of sampling in this study is to enhance the accessibility of the population, reduce costs, and save time, thereby enabling the researcher to conduct this study on a subset of participants or samples from the population (Martinez-mesa et al., 2016; Mulisa, 2022). This approach allows for the generalization of study findings and the drawing of conclusions or inferences that are

representative of the entire population. Once again, it must be noted that the time frame provided for this thesis was insufficient for the researcher to have covered all mining communities, miners, and other stakeholders in the Upper West Region. Therefore, it was necessary to utilize a sample for this research.

The sampling process encompasses multiple stages, beginning with the identification of the target population. Subsequently, a sampling frame, representing the accessible population, is established. From this sampling frame, a sample size is determined using a well-defined sampling procedure. The subsequent sections delved into a detailed discussion of these stages:

3.7.2 Target Population

The target population for this study therefore encompasses a diverse group of individuals, namely artisanal and small-scale gold miners operating in the Upper West Region. Additionally, the sponsors of gold mining, chiefs of the mining communities, gold buyers or dealers, non-miners, miners, elders of the mining communities, assembly members, the Minerals Commission, the Environmental Protection Agency (EPA), District Assemblies, and the Ministry of Food and Agriculture directorates of the Upper West Region. This directs the study to the next section termed sample frame which was derived from the target population described above.

3.7.3 Sample Frame

The term "sampling frame" refers to the specific set of units, typically humans, from whom participants will be selected for inclusion in the study. (Casteel & Bridier, 2021). The relationship between the sampling frame and the sampling method is closely intertwined, as the sampling frame serves as the operational framework for recruiting the sample (Prandner & Weichbold, 2019). The sample frame for this study was a total of 1,593 representing the entire population of households in the ten selected mining communities earmarked for the study (Ghana Statistical Service, 2021).

3.7.4 Sample Size Determination

Kumekpor (2002) defines sample size as the predetermined number of units from a population that a researcher selects for a certain study. The study sample frame was obtained by adding all the households in the selected communities as presented by the Ghana Statistical Service (2021). The number of households in the selected communities is shown in table 3.7. The population of households in each of the ten (10) selected mining communities was utilized to contact the heads of the households (Table 1). However, if the GSS (2021) report did not include

the household size of any community, the assembly member representing the community was consulted to obtain an estimated value. Consequently, the gathered list of homes was used as an estimate to determine the sampling frame and sample size for the household heads (HH). Therefore, using the sample frame of 1,593 households in the study area, the sample size was calculated using a statistical formula proffered by Miller and Brewer (2003):

$$n = \frac{N}{1 + N(e)^2} \dots\dots\dots \text{Equation [1]}$$

- Where **n** is the sample size, **N** is the population size or sample frame (1,593) and **(e)** is the level of precision (5%) with confidence level of 95%.

$$n = \frac{1593}{1 + 1593(0.05)^2} \dots\dots\dots \text{Equation [2]}$$

$$n = \frac{1593}{1 + 1593(0.005)^2} \dots\dots\dots \text{Equation [3]}$$

$$n = \frac{1593}{4.9825} = 319.7$$

$$\therefore n = 320$$

Therefore, the sample size for this study was 320 household heads. Again, forty (40) miners were sampled using snowball sampling technique hence making the total sample size of 360.

3.7.5 Proportional Distribution of Sample Size among Communities

After then, procedures of proportionate sampling were utilized in order to distribute the sample size of 320 households across the ten communities that were purposefully chosen. This was done on the basis of the total population of each of the neighborhoods. In accordance with the methodology described by Alreck and Settle (1985), this was accomplished by dividing the population of each village by the overall population and then multiplying the result by 320. Simply put, the sample population for each community was proportional to the number of households in that community.

From the sample size determined from the above formula, the number of households from each community was uniformly distributed to the size of households in each community using the formula below:

$$C_p = \frac{\text{Number of households in a community} \times n}{\text{Total number of households}}$$

Where **C_p** refers to community proportion and **n** refers to sample size. Statistically, proportional distribution of the sample size among the selected communities was operationalized below:

Table 3.7: Sample Frame and Proportional distribution of sample size among study communities

Selected Community	No. of households (Sample frame)	Sample size	Sample Size Percentage
Nadowli-Kaleo District			
Nanga	75	15	5%
Wuchema	69	14	4%
Wa West District			
Takpo	250	50	16%
Eggu	101	20	6%
Polee	141	28	9%
Wa East District			
Manwe	257	52	16%
Goripie	335	67	21%
Danyuokuraa	141	28	9%
Duu	129	26	8%
Kende	95	20	6%
Total	1,593	320	100%

Source: Field Data, 2023.

3.7.5.0 Sampling Techniques

In order to select the individuals who would take part in the research, the study utilised a sampling method that consisted of multiple stages. This study makes use of a combination of probability and non-probability sampling techniques Alvi (2016) as cited in Kapur (2018). The following section therefore contains a detail explanation of the sample methods that were relied on in this study

3.7.5.1 Stratified Sampling

As a result of the mixed research approach and the heterogenous nature of the respondents, the study employed stratified random sampling to account for the heterogeneous characteristics among respondents (Akkaş & Meydan, 2024). The stratification was based on three key groups: artisanal miners, non-miners, and key informants, ensuring accurate and proportionate

representation of each subgroup. This approach was essential in enhancing the reliability of the study and facilitating the generalization of findings across the communities.

One significant advantage of stratified sampling is its ability to increase precision and representativeness in research findings. By dividing the population into distinct strata such as miners, non-miners, opinion leaders, and other key informants, this method ensures that all relevant groups are adequately included in the sample (Hossan et al., 2023). Stratified sampling also helps minimize bias and improves the accuracy of estimates by reducing variability within subgroups, leading to more reliable and generalizable conclusions, particularly in heterogeneous populations (Sadaiyandi et al., 2023).

Another key strength of this method is its ability to facilitate meaningful comparisons between different subgroups within a population. Since each stratum is proportionally represented, researchers can analyze variations in characteristics, behaviors, or responses across different segments with greater confidence (Iliyasu & Etikan, 2021). This is particularly useful in social sciences and health research, where demographic factors such as age, income, or education level significantly influence study outcomes (Akkaş & Meydan, 2024). By capturing these variations, stratified sampling enhances the ability to identify patterns and relationships that might otherwise be overlooked in non-stratified sampling approaches.

Despite its advantages, stratified sampling can be complex to implement due to the need for prior knowledge about the population. The researcher ensured that all relevant strata were accurately identified and that appropriate sample sizes were determined for each subgroup, a process that was both time-consuming and required extensive preliminary data collection. Improper stratification, as noted by Rahman et al. (2022), can lead to errors, resulting in the underrepresentation or overrepresentation of certain groups, which ultimately affects the validity of the findings. Ensuring that strata are well-defined and mutually exclusive is therefore crucial in maintaining the integrity of the research process.

3.7.5.2 Simple random sampling

A sampling method known as simple random sampling ensures that every member of a population has an equal opportunity of being selected as a participant (Rahman et al., 2022). Precise results are acquired through the utilisation of this methodology in social science research

studies. Simple random sampling is a viable approach in research situations where the aim is to derive a conclusion that can be extrapolated to the entire population.

Singh and Masuku (2014) asserts that this particular sampling technique is deemed to possess greater accuracy and should be regarded as superior when the population exhibits homogeneity. One possible explanation for this phenomenon is the tendency of researchers that employ a quantitative approach to regularly utilize this particular methodology (Sargeant, 2012; Mulisa, 2022). When employing simple random sampling techniques, the predominant methods commonly utilized include lottery methods and random number methods (Elfil & Negida, 2017; Mulisa, 2022).

This study utilized the simple random sample technique to sample the 320 households. The research study included various sampling procedures to engage with the participants. The initial phase of the sampling process entailed the clustering of the Upper West Region, utilising the pre-existing administrative Metropolitan, Municipal and Districts Assemblies (MMDAs) as the basis for grouping. Three districts were chosen from the 11 MMDAs based on their documented history and current activities in the field of artisanal and small-scale gold mining (ASGM). These districts include the Wa West District, Wa East District, and Nadowli-Kaleo District.

The researcher created a comprehensive list of sample sizes and utilized a computer programme, specifically the Excel tool pack, to produce random numbers. This approach was employed to establish a population list for the study (Rahi, 2017).

The lottery method of simple random sampling was then utilized to select the target respondent (household head) in cases when many households coexisted within a dwelling unit. In this procedure, numerical values were transcribed onto sheets of paper, which were subsequently folded and placed within a receptacle for subsequent selection in accordance with the principles of probability. A household was picked at random for interaction in each sampled dwelling. Furthermore, in cases where the head of the household was not present, the survey was conducted with any adult who was deemed suitable and informed of the requirements of the study.

One of the notable advantages of employing simple random sampling was its minimal requirement for prior knowledge about the target groups prior to selection. Additionally, when carefully planned, this sampling method is entirely free from bias, allowing for the possibility of obtaining a sample that is representative of the entire population. Furthermore, the utilisation of a

basic random sampling technique in participant selection enables the collection of data that can be subjected to both inferential and descriptive statistical analyses (Kothari, 2004).

According to Stockemer (2019; as cited in Noor et al., 2022), randomization in research serves to mitigate the influence of both known and unidentifiable variables. By employing a random selection procedure, researchers can achieve a more deliberate and thoughtful approach to sample selection for their intended study.

Despite the advantages of simple random sampling, it is important to acknowledge that this method also possesses certain disadvantages. One potential challenge in conducting a study with a broad geographical scope is the significant expense associated with getting the sample. Additionally, it is worth noting that the standard errors of estimators may be considerably high in such cases (Ghuri & Gronhaug, 2005).

Moreover, in cases where the population size of a specific demography is undefined, the proper execution of this procedure becomes unfeasible. And for this, different areas such as research on animal field, this method are not that feasible. However, it is worth noting that this approach may have limited utility (Rahman et al., 2022; Noor et al., 2022). Furthermore, it should be noted that the utilisation of random selection may lead to the formation of subsets that fail to sufficiently encompass the entirety of the data within more intricate datasets that exhibit non-uniform distributions. Consequently, this can give rise to a substantial variance in the estimation of the model error, as highlighted by Reitermanova (2010) and Noor et al. (2022).

3.7.5.3 Purposive Sampling

The purposive sampling which is a non-probability sampling techniques was used in this study. In this approach, I intentionally selected individuals or subjects who have in-depth knowledge in the bjectives of the study, guided by their own judgment and conviction. Under this sampling technique I used own discretion in selecting participants within and outside the mining communities but believe to possess vast knowledge of ASGM operations and its effects on environmental threats and rural livelihoods. Qualitative research often utilizes this method when the researcher aims to obtain thorough insights into a specific issue, valuing detailed comprehension over statistical generalizations. This method was particularly suitable as few key informants were the targeted as compared to a larger sample size of household heads.

Firstly, the study employed the purposive sampling, to sample the ten mining communities for investigation. These communities are Nanga, Wuchema, Takpo, Eggu, Polee, Danyuokuraa, Duu, Kende, Mengwe, and Goripie. The rationale for selecting these localities stems from the prevalence of artisanal and small-scale gold mining activities inside in them. Again, it is impracticable to conduct the fieldwork in all the communities where small-scale mining operations are carried out within the Upper West Region. Besides, the selection of these communities was based on specific criteria, including their geographical proximity to the artisanal and small-scale mining catchment areas, as well as their being within the prospecting concession of Azumah Resources Limited.

The proximity of the selected communities had a significant role as a criterion, as it enabled the researcher to optimise time and cost during fieldwork, given the limited resources available for the study. Furthermore, a crucial aspect taken into account throughout the selection process of these mining communities was their homogeneity with regards to the livelihood activities they engage in for sustenance.

Furthermore, the purposive sampling technique was relied on to recruit key informants from various stakeholders, including staff from district three district assemblies, the Environmental Protection Agency, Minerals Commission, chiefs and elders, land owners, assembly members, gold buyers, mining sponsors, leaders of mining groups and youth group leaders. These respondents were chosen on the basis of their extensive expertise about the interconnection between artisanal and small-scale gold mining, its impacts on the physical environment and the rural livelihood. The study participants were deliberately chosen based on their exceptional skill to provide answers to the research questions pertaining to the specific research objectives (Etikan & Bala, 2017; Mulisa, 2022).

The use of purposive sampling provides notable advantages in for this research. Firstly, it is a cost-effective method for selecting samples, as researchers apply their expertise to intentionally choose participants who are highly suitable for the study. This approach effectively eliminates any irrelevant members of the population that would have otherwise been included in the sample. Finally, this approach significantly reduces the amount of time that would have been allocated to the process of selecting each individual within the population. The utilization of participants who closely align with the study phenomenon and its objectives allows the researcher

to obtain data that is highly pertinent to the research environment, hence reducing the margin of sampling error.

Nevertheless, the utilization of purposive sampling is accompanied by some limitations owing to its nonprobability nature. First and foremost, the technique can lead to unreliable statistical inferences due to potential researcher manipulations, sample biases, and errors. Moreover, this sampling method may inadvertently exclude individuals from the community who would have made valuable contributions to the study. Finally, according to Obilor (2023), the utilisation of purposive sampling as a sampling technique becomes ineffective when dealing with large population.

3.7.5.4 Snowball Sampling Technique

The Snowball sampling, also known as "chain referral sampling," was employed as an additional sample strategy in the study. This technique involves the recruitment of future study participants by existing participants from within their social networks, including peers, friends, or acquaintances. Snowball sampling is a method of sampling wherein a study participant refers or recommends another individual as a potential participant in the study. In this approach, researchers commonly request individuals to grant them access to additional participants who possess the required characteristics (Taherdoost, 2016; Mulisa, 2022). Snowball sampling is a viable approach for researchers seeking to recruit people who are challenging to access or who must satisfy specific criteria (Berndt, 2020; Mulisa, 2022).

In the light of the above, the study recruited illegal miners known in the Ghanaian local parlance as ‘galamseyers’ because of the illicit and dangerous nature of their work using the snowball sampling technique.

This technique was used to select forty (40) illegal mining site leaders. Again, artisanal and small-scale gold miners are the hard-to-reach category of respondents for this study because of the Government of Ghana’s policy at completely flushing out their activities using military and the police special forces to clamp down on illegal miners. This decision was prompted by the consequences of their activities on our water bodies, forests depletion, farmland destruction, ill-health problems in mining communities among others. These among other reasons made illegal miners to always be on the alert when meeting strangers for their first time hence their incessant unwillingness to share information with total strangers. At some communities the research team were mistaken as criminal investigation officers (CIDs) attempting to syphon vital information

from them and to later come for their arrest and possible prosecution. It was through the use snow ball sampling method that helped the researcher to have access to hitherto hard-to-reach mining sites and miners themselves.

3.8.0 Methods and Tools for Data Collection

The process of data collection plays a crucial role in research, as it serves to mitigate potential errors that may arise throughout the course of a research project, hence enhancing the overall quality of the obtained results (Kabir, 2016; Taherdoost, 2021). However, while an appropriate data collection methodology contributes to the effective planning of research; it does not inherently ensure the overall success of the research endeavour (Olsen, 2012; Taherdoost, 2021).

3.8.1 Data Collection Methods

Gathering data is a crucial stage in the research process as it enables the gathering of essential information needed to address research questions. Data collection is the methodical procedure of obtaining, measuring, and examining accurate data from many sources to investigate a research question. The phrase "data collection method" refers to the procedure by which research data is obtained and employed for the objectives of a study (Sekaran & Bougie, 2016). Within the context of this study, the study utilised data collection methods including questionnaires, observations, Focus Group Discussion, interviews, documents review, photography, and Landsat imagery and maps. These methods of data collection methods are then discussed into detail in the ensuing paragraphs below:

3.8.1.1 Survey Questionnaires

The study utilised questionnaires as the primary tool for collecting data in the investigation. The development of this instrument was based on a thorough evaluation of relevant literature, in accordance with the study's objectives. Prior to developing the questionnaire, a thorough literature analysis was conducted to examine the impact of artisanal and small-scale gold mining on the diversification of rural livelihoods and the physical environment. The questionnaire was employed as an instrument for data collection as it gives higher assurance of confidentiality and anonymity to respondents (Sarantakos, 2005).

The study's questionnaires had both closed-ended and open-ended questions. In close-ended questions, respondents are presented with a predetermined set of answer options to pick

from. However, in open-ended questions, respondents are invited to submit their own constructed replies without any predefined options. Qualitative inquiries are characterized by their open-ended nature (Taherdoost, 2019; Taherdoost, 2021b). Thus, when compared to open-ended questions, close-ended questions are pre-coded to facilitate swift implementation (Olsen, 2012; Taherdoost, 2021b).

These inquiries are appropriate when there is a higher level of existing information about the variables of the research question that has been developed over time (using a deductive research approach). Typically, questions were provided with predetermined options, such as Multiple-Choice Questions (MCQ), making it simpler for respondents to provide replies. The utilisation of open-ended questions offered the benefit of facilitating the conversion of qualitative replies into quantitative data, hence simplifying the process of data analysis (HR & Aithal, 2022). The questionnaire includes three types of closed-ended questions: Likert scale options (ranging from strongly disagrees to strongly agree), unordered choices (multiple choice questions), and partly closed-ended questions (with an additional option to define alternate responses).

In much the same vein, in attempt for me to still study and try to comprehend the variables of the research questions better (Inductive approach) to know their familiarity with the phenomenon relating variables the open –ended questions were also applied. This approach proved beneficial as the study aimed to elicit responses from participants in their native language and uncover supplementary perspectives. Although open-ended questions were valuable for eliciting unrestricted responses, they have received criticism due to the substantial time required for analysing the data (HR & Aithal, 2022).

3.8.1.2 Description of the Questionnaires

The first section of the household questionnaires which is for non-mining community members (Section A) was devoted to demographic characteristics of the respondents. This covers age, gender, religion, marital status, educational background, household size, status of membership of community, employment status among others.

The second section of the questionnaire, which is Section B, focuses on examining the effects of mining on household livelihood income, assets, and activities. This section includes some questions that are constructed using a four-point Likert scale which involve individuals indicating their level of agreement or disagreement with a set of statements pertaining to a certain subject. The data collection instrument comprises a set of interconnected Likert-type statements

that pertain to the targeted attitudinal to be measured. The questionnaire comprises a sequence of interconnected Likert-type statements that pertain to the particular attitude being assessed (Tanujaya et al., 2022).

The determination of the optimal quantity of elements to be included in the Likert scale continues to pose challenges (Willits, Theodori, & Luloff, 2016). The inclusion of excessive items in scales might lead to fatigue or response distortions, as well as requiring additional time for construction. Currently, there is a lack of recognized criteria on the optimal quantity of items to be incorporated into the ultimate scale. Therefore, Hinkin (1998) put forth a set of five items that he deemed to be the most appropriate for assessing the concept in question (Hinkin, 1998). According to Diamantopoulos et al. (2012), it is suggested that the Likert scale should comprise a minimum of four items.

This study aligned with the perspective of Diamantopoulos et al. (2012) and Tanujaya et al., (2022) by employing a Likert scale questionnaire consisting of four points. The questionnaire encompassed a range of responses, with 1 representing 'strongly disagree' and 4 indicating 'strongly agree'. Participants were requested to express their level of agreement with the provided statements or questions as items within the questionnaire. The decision to utilize a 4-point scale was based on the understanding that survey participants may exhibit a tendency to avoid extreme responses while answering the questionnaire items (Alrashidi, 2017). Additionally, its ease of use is attributed to its ability to effectively categorize respondents' preferences into four distinct categories, spanning from a severe disagreement to a strong agreement.

Certain items in the study elicited positive responses, while others yielded negative responses. These responses were evaluated using a Likert scale, where participants were asked to indicate their level of agreement on a four-point scale: Strongly Agree (SA) = 4, Agree (A) = 3, Disagree (D) = 2, and Strongly Disagree (SD) = 1. The utilisation of Likert scales is justified due to its widespread usage and their compatibility with many statistical techniques such as descriptive statistics, correlational studies, and analysis of variance methods.

Section 'C' examines the environmental impacts of artisanal and small-scale gold mining (ASGM) and the possible mitigation measures. It asks questions that reveal how ASGM practices affect the natural environment and ecosystem. It also solicits suggestions on how to reduce or prevent any negative environmental effects caused by ASGM activities.

Section ‘D’ explores the socio-economic benefits of artisanal and small-scale gold mining. It uncovers the positive effects that ASGM can have on the economic welfare of individuals and communities. It aims to provide a comprehensive view of how ASGM activities influence the livelihoods and economic security of those who participate in the sector.

Section ‘E’ investigates the role and effectiveness of regulatory institutions, laws, and policies that relate to the mining sector, especially ASGM. It probes how these regulatory bodies and policies affect ASGM practices, environmental protection, and community development. It aims to illuminate the regulatory framework and its efficiency in managing and governing the ASGM sector.

Again, since, the study is dealing with two categories of target group (miners and non-miners) aside its key informants and relevant institutions, a separate questionnaire for ASGM operators. This questionnaire also consisted of both open-ended and close-ended questions. The study utilized a survey approach with questionnaires, which offered several strengths. Some of these are discussed below:

To start with, Cohen et al. (2011, as cited in Asantewaa, 2020) argue that questionnaires are widely used and effective tools for collecting structured, often numerical, data. They can be administered without the presence of the researcher and are relatively straightforward to analyze. Given that research assistants were engaged for this study, questionnaires were deemed the most appropriate tool due to their clarity and precision, allowing administration without the researcher being present.

Moreover, questionnaires are excellent for gathering information on specific variables or personal details, such as educational level, grades, age, income, experience, work performance, beliefs, thoughts, feelings, attitudes, perceptions, personality, behavioral intentions, opinions, desires, and tendencies. As the primary tool in survey research, they are effective in generating a substantial amount of data efficiently, reaching a broad population in various ways and at suitable times. This makes them particularly suitable for larger populations (Alkandari, 2015) and cost-effective compared to observations and interviews.

Despite the advantages of using questionnaires, some limitations persist. Firstly, questionnaires do not allow for probing, prompting, or clarification of questions. Unlike qualitative interviews, where the interviewer can explore responses in-depth, questionnaires are limited in this aspect. Additionally, participants may struggle with understanding specific questions in impersonal administrations, leading to unanswered or incorrectly answered questions (Taherdoost, 2021). During this study, some respondents left questions unanswered or provided incorrect answers due to the lack of assistance in clarifying the questions.

Furthermore, low response rates can be a significant issue if respondents are not interested in participating. Some respondents expressed being too busy or showed little interest in participating, which could lead to a lower response rate if their interest is not sufficiently engaged.

Lastly, questionnaires may highlight trends or attitudes but fail to explain the underlying reasons for these outcomes. The close-ended questions in the research questionnaire did not allow respondents to elaborate on their choices, as noted by Beiske (2007). A multi-method approach, combining questionnaires with interviews to explain the results, is therefore recommended. This approach will be discussed further in the next subsection on qualitative interviews.

3.8.2. Interviews

The study also made use interviews as qualitative data collection methods in soliciting for primary data. An interview may be face-to-face, via phone or nowadays even online with or without videos (Jain, 2021). In the context of this study the face-t-face interview methods were used in soliciting for information from respondents.

This provided the researcher opportunity to directly elucidate the purpose of the investigation. Furthermore, it was feasible to add explanatory comments and pose supplementary questions to enhance clarification. The interview guide consists of research questions that focused on the ‘how’ and ‘why’ of the study phenomenon and therefore did not require the involvement of an expert for designing the list of questions. Other scholars like Adams et al., (2007; as cited in Jain, 2021) have recommended qualitative interviews as one of the suitable data collection tools in the collection of primary data as a result of the shortcomings of surveys.

Interviewing is the predominant method for gathering data in qualitative research (Green & Thorogood, 2014; Foley et al., 2021). The structure and manner of conducting interviews in

qualitative research are influenced by various factors, such as the overall methodology and objective of the study, as well as the relational dynamics between the researcher and participants. This includes the extent to which the researcher and participants collaborate in constructing the interview process (O'Reilly & Kiyimba, 2015; Foley et al., 2021). The choice of qualitative interviews in this study was not only geared towards generating the perspectives and experiences from participants. It equally offers me the opportunity to interpret and in some cases explanation of those experiences-in relation to each other in their natural state as supported by Edwards and Holland (2013).

This study relied on the structured and unstructured types of interviews in the collection of primary data (Islam & Aldaihani, 2022). The structured interview method offered me the chance to prepare predetermined questions (for respondents) then enumerated with no scope of follow-up questions. Thus, in this type of interviews, all interviewees were approached with the same set of standardized questions which were pre-prepared before the interview session. The inflexibility nature of the structured interview disallowed me to probe for more information from my participants as it resonates the view of Mwita (2022).

However, this method was very instrumental or useful as it contributes to the standardization of responses since all participants were asked the same set of question from the interview guide. This consequently gave me the opportunity to make comparisons and easily detect patterns from the varied responses provided by the participants. The use of this method also played a very vital role in indicating the required data to be collected and consequently making known in advance the scope of this study (Mwita, 2022). Despite, the fact that the structured interview was carried out with ease, it was still deficient in function as it offered the me less opportunity to probe deeper in order to explore more issues or responses surrounding artisanal and small scale gold mining (Islam & Aldaihani, 2022).

Again, the current study also employed semi-structured interviews, which involve list of leading questions prepared in advance that a researcher refers to during interview sessions, with room to add more questions based on the participants' responses. The researcher also has the flexibility to add more questions based on the participants' responses (Mwita, 2022). Semi-structured interviews are characterized by their formal nature and adherence to an interview guide. This method made it possible and easy to include some key questions relating to the topic; it further allowed me (interviewer) and interviewee to digress to explore an issue or response in deep as

recommended by (Saunders et al., 2009; Islam & Aldaihani, 2022). Thus, unlike the structured interview method, the semi-structured interview was more flexible in terms of the line of questioning as far as the subject of study was concerned.

The interviewer employs a semi-structured interview method, wherein I pose questions in accordance with a predetermined framework. However, if I require further information, I have the flexibility to extend the conversation beyond the pre-established questions. For instance, it is a suitable option when you are unable to conduct multiple interviews and need to collect unambiguous, comparable, and dependable qualitative data at the initial encounter (Kabir, 2016; Taherdoost, 2021b).

This method was used on the leaders of artisanal and small-scale gold miners, minerals commission, environmental protection agency, District Assemblies chiefs and elders of mining communities, assembly members, mining leads, sponsors and health personnel as it was very difficult meeting these participants as a result of the critical nature of ‘galamsey’ which is currently a priority to the government of Ghana in terms of its ban.

As a strength of the semi-structured interview, it allowed me to suggest or consult the interviewees or the participants on their responses in relation to the topic, on condition that interviewees digressed from the subject under study. Thus, the semi-structured interview serves as a useful method for both interviewee and interviewer to keep themselves within the corridors of the topic domain.

Once again, this interview served a dual purpose in gathering primary data for the study. It facilitated a two-way communication between the researcher and participant, enabling the use of open-ended questions. This approach allowed the researcher to obtain more detailed responses pertaining to the research topic or issue. Semi-structured interviews are the predominant qualitative research data collecting methodology. Therefore, the semi-structured interview as a most useful interview technique for rich data exploration was recommended by Islam & Aldaihani (2022).

Before the commencement of the face-to-face interviews, the participants were initially contacted personally while others via phone. The purpose of the research was explained in short and participants were given the opportunity to indicate their own time for the interviews to be fixed for convenience’s sake. In order to gather accurate data, it is imperative for a researcher to inquire about the preferred time from the participants (Egan, 2020). An interviewee who is interviewed at an inconvenient time may hastily provide responses that are unrelated to the subject of research.

During interview sessions, research participants were advised not engage in other activities for purposes of absolute concentration without and without distractions.

In contrast to quantitative data collection methods, qualitative data collection methods typically employ much smaller sample sizes. Although qualitative interviews demand small sample sizes, the issue of what defines a suitable sample is essential due to how it might affect the overall quality of the study. A study with a small number of subjects might restrict the volume of data gathered. On the other hand, adding too many subjects in one study may result in resource waste, the collecting of unneeded bulky data, and an elaborate analysis procedure.

In this study, the targeted participants were discovered, and then followed by their recruitment that continues until a level saturation was attained. It suggests that the appropriateness of data, and thus the sample size, is established by saturation. My point of participant saturation occurs when no additional relevant data were acquired from the participants in the research during data collection. I brought the sample size of my participants to an end when I realized that no surprising information was coming up.

The Research questions for the qualitative interviews emanated from the research objectives and were also informed by the theoretical framework (Sustainable Livelihoods Framework) and relevant literature reviewed in general. This idea has resonated the thinking of Fanai and Mohammadnezhad (2022; Mwitak, 2022), as the interview guide of their study was developed based on relevant reviewed literature.

Significantly, the selection of a sample size for a qualitative interview has the tendency making research more scientific. Some studies (Vasileiou, Barnett, Thorpe, & Young (2018); Knott et al., 2022) advise 12 to 20 interviews per participant category, while researchers have documented saturation with samples both smaller and greater than this. In the review, the study of Mwatik, *2022) had the smallest sample size ($n=2$) while that of Fanai and Mohammadnezhad (2022) had the largest sample size ($n=31$). The above insight influenced my study to interview 31 participants which was within the range of 2 to 31 as suggested by some researchers. Many qualitative researchers, however, have criticised the concept of saturation since it presupposes that meaning exists in the data and must be discovered--and confirmed--once saturation is reached (Vasileiou et al., 2018; Mwatik, 2022).

A total of 31 participants were contacted for the interview and all agreed to participate in the personal face to face interviews. Before the interview, participants were given the opportunity

to choose the venue for the interviews. With this participant chose their homes, school premises, shades under trees as well as at their workplaces. Majority of the interviews were conducted at their workplaces and under trees as such place were very conducive and quiet for the conduction of interviews. During the scheduled interview appointment, the purpose of the interview was reiterated to the individuals being interviewed. The participants were provided with a reminder that the audio of the interview would be recorded, and it was emphasized that the confidentiality and anonymity of the participants would be upheld. Subsequently, an informal conversation was initiated.

Most of the interviews in this study were conducted using waale and dagaare to capture the best responses as these were the dominant native languages spoken in the study areas. The local dialects were used as a result of the inability of some respondents to speak the English language. This made it very easy to for the researcher to interact with most respondents as he (researcher) and his research assistants speaks same local dialects fluently. Respondents or participants that had their interviews in the local dialect were the community chiefs and elders, some assembly members, chairmen of mining sites, miners as well as gold buyers.

However, it was very difficult interviewing most of the gold buyers because most of them were foreigners from neighboring Burkina Faso, Ivory Coast and Cote D'voire therefore could neither speak fluently neither the English Language nor the commonly-spoken local dialects (Waale and Dagaare). To surmount this challenge, the researchers try as much as possible to speak the 'pidgin' English to their understanding since that was the main language they normally relied on when transacting their gold buying business with the artisanal gold miners. However, some of the foreigners who stayed in the mining communities for at least five years were able to manage the Waale and dagaare in the process of the interviews.

Again, the English Language was used to conduct the interviews of institutional respondents such as the environmental protection agency, mineral commission, Ministry of food and agriculture of the studied districts, some assembly members as well as the district assemblies.

The key-informant interviews lasted between 30 minutes to about 60 minutes. The difference in the duration of the interviews was partly due to the personalities of the interviewees as well as their differences in the mode responding to questions. Some participants chose to go in detail, include examples and stories to highlight their answers, while some answered the questions concisely. It is recommended that study subjects be informed of the expected duration of the

interview sessions in advance so that they can plan their schedule accordingly to avoid any hassles or disruptions (Mwita, 2022).

Despite the significant value and knowledge generation associated with the acquisition of primary data through qualitative interviews, it is important to acknowledge that these interviews are not devoid of problems (Majid et al., 2017). Firstly, it is worth noting that qualitative interviews hold significance in both qualitative and quantitative studies. However, it is vital to acknowledge that from a positivist perspective, these interviews are regarded as less scientific (Anyan, 2013). The uniformity of data interpretation across researchers is subject to variation, leading to skepticism over its veracity, particularly among individuals who adhere to a positivist perspective.

Moreover, the efficacy of qualitative interviews in facilitating generalizations of data obtained from qualitative interview-based research has been questioned by certain scholars (Vasileiou et al., 2018; Mwita, 2022) hence the responses of fewer than 37 individuals to make generalizations for a group exceeding one thousand is not scientifically valid.

Finally, qualitative interviews invariably result in the generation of voluminous data, which, if not appropriately handled, might impede the study's efficacy and pose significant challenges (Mwita, 2022). Significant amounts of data were derived from the qualitative interviews, encompassing both voice recordings and written transcripts. On average, each participant generates fewer than 4 pages of A4 sheets, wherein they express diverse opinions, feelings, and values regarding the impact of artisanal and small-scale gold mining on the diversification of rural livelihoods within mining communities in the Upper West Region of Ghana. The key informant interviews were applied to the following participants displayed in table 3.2 below:

Table 3.2: Key informant interview Participants

Institution/Informant	Number of Respondents
Minerals Commission	1
Environmental Protection agency (EPA)	1
District Assemblies	3
Districts' MOFA	3
Traditional Authorities (Chiefs and elders)	5
Tendambas	4
Assembly Members	3
ASGM leaders and sponsors	7
Health Practitioners	3
NGO	1
Total	31

Source: Author's Own Construct, 2023.

3.8.3 Focus Group Discussion

The research also used focus group discussions as a main data collection method with the aid of a focus group discussion guide for gathering information from a group of respondents. This tool was used to explore concerns and questions of concern, with the goal of better understanding concepts and issues, increasing engagement in the data collection session, and relying on the knowledge, expertise, and experience of the study participants. The focus group discussion was a two-way conversation and interaction between the researcher, who served as moderator, and the participants, who served as discussants.

The determination of the appropriate number of focus groups to be conducted is contingent upon the specific characteristics and intricacies of the research topic, as there is no universally prescribed guideline governing this matter. Focus group talks should produce enough data to allow for comparisons as well as the generation and testing of theoretical concepts (Barbour 2005; Yayeh, 2021). Most researchers suggest that the appropriate group size ranges from 4 to 12 participants (Bourgeault, de Vries, & Dingwall, 2010; as cited in Muijeen et al., 2020).

According to previous studies conducted by Prince and Davies (2001; as cited in Yayeh, 2021), small groups consisting of 4 to 6 individuals have been found to be effective in promoting active participation and generating a diverse range of ideas within a given time frame. However, Krueger (1994; as cited in Yayeh, 2021) argues that focus group research should ideally involve a minimum of three groups. Additionally, the size of the focus group can be determined based on the number of participants who share similar experiences, as certain experiences may require more

time for discussion. This aligns with the findings of Nagle and Williams (2013). In the context of this study, seven (7) participants were used per every group of discussants (Muijeen, et al., 2020). The participants for the focus group discussion were selected from the community's samples for the study.

In order to gather comprehensive data, the researcher conducted meetings with one group of men and one of women and one group of youth (both male and female) in each village. These groups were categorized based on criteria such as age and social standing, ensuring a diverse representation. The participants were given the autonomy to select the time and location that suited them best. Prior to each session, the researcher introduced themselves and their assistant, providing a clear explanation of the discussion's objectives. Emphasizing the voluntary nature of participation, it was explicitly stated that no records were kept regarding the attendance or departure of individuals.

The study recruited participants for the focus group discussions based on their homogeneity. Groups often exhibit common characteristics that contribute to their dynamics and outcomes. These shared attributes can include factors such as a shared background, similar age range, common gender, comparable social status or occupation, and relevant experience with the topic at hand. These characteristics are important to consider as they have the potential to significantly influence the nature and quality of group discussions.

Again, focus group discussion groups were segregated into three (3) males, females and the youth. This separation of same category of people in the same group was necessary to do away with the issue of some participants not been able to express themselves as of a result of the presence of other participants with different characteristics. In addition, it is crucial to ensure that the individuals participating in the focus group do not exhibit any conflicts or incompatibilities with each other. Pawi and Buncuan (2010; as cited in Muijeen et al., 2020), For instance, the differences between research outcomes obtained from homogeneous and heterogeneous groups were examined, along with the distinctions between groups of individuals who shared a personal or familiar relationship and those who were unfamiliar. Thus, adult males were separated from adult females and same from young males and females. This separation was also necessitated by the cultural values of the study communities where females were not allowed to mix with their husbands in meetings. The fallout out of females and males in the same meeting is that most women may not able be to fully express themselves in the mist of their husbands as they sometimes

feel intimidated and feel shy. In all 9 focus group discussions were held with each mining district hosting three (3).

Irrespective of the quantity of focus group discussion meetings, it was critical to minimise the extent of the deliberations. This is because I felt some participants would likely fall out due to exhaustion and fatigue when discussions were longer. The duration of each focus group interview was approximately 60 minutes contingent upon the group dynamics. This was within the range of duration for focus groups as (Yayeh, 2021) stated that the rule of thumb for a focus group discussion is 1–2 hours, based on the complexity of the topic under investigation, the number of questions, and the number of participants.

The success of conducting a focus group heavily relies on the moderator's interpersonal skills. According to Shaha et al. (2011) and Muijeen et al. (2020), interpersonal and group leadership skills are considered crucial. At the start of the group interview, I had to greet all participants and introduced myself along with my research assistants. Next, I asked the participants to introduce themselves even though it was not compulsory so that I could easily refer to them when discussing their responses. Then the purpose of the interview was always discussed. I begin by posing an initial question to set a comfortable tone and express gratitude for their willingness to share their experience. In addition, Krueger and Casey (2014) proposed that providing light refreshments and encouraging group meals can foster conversation, discussion, and communication among focus group participants. According to a study by Nagle and Williams (2013; as cited in Muijeen et al., 2020), the moderator's communication skills include effectively managing interruptions during opinion sharing. Regarding this matter, it would be helpful to offer some cues for them to hold on, assuring them that they will have a chance to speak quickly.

As an important aspect of focus group discussion, I made an effort to avoid being judgmental and instead be adaptable. As a moderator, I understood that the participants might deviate from the anticipated answers or thought patterns when responding to the questions I asked them during the focus group discussion. In a study conducted by Mack et al., (2005; as cited in Muijeen et al. (2020), it was noted that an effective moderator should have the belief that all participants possess valuable insights on the topic. Furthermore, the moderator should maintain impartiality when expressing their own opinions. According to a study conducted by Nagle and Williams (2013; as cited in Muijeen et al., 2020), it is advised that a moderator refrains from using head nods or responses like "yes," "I agree," and "OK." These responses seem to acknowledge the

answers and have a tendency to cut short any future findings, ideas, or opinions that may arise from other group members. A successful moderator should possess a flexible and impartial mindset, treating all group participants fairly and without any preconceived notions or favoritism.

In the process of conducting the focus group interviews I made sure every participant relaxed given them the room to freely share their opinions based on the questions thrown at them. No participant's view was wrong as all views were considered. Participants who were feeling shy were not pressurized to speak to save them from embarrassment. I equally acted as the naïve observer the naïve listener trying not to get involved nor impede the independent flow of the participants in the process of sharing their opinion on the subject of discussion. Jakobsen, (2012) emphasizes the importance of maintaining a neutral role as the moderator in focus group discussions. While it is crucial to avoid personal bias, the primary focus should always be on addressing the research questions at hand.

The investigator approached the situation with caution, ensuring that the discussions remained focused and free from any sense of threat. They worked to create a positive atmosphere for open and productive discussions. Despite my limited personal involvement, I steered the conversations towards addressing my overarching inquiries. During the discussions about the impact of artisanal and small-scale gold mining on livelihood diversifications, I listened to a man sharing a conflict he had with an artisanal miner over payment settlements. I made sure to stay focused on the discussion. In addition, while I was moderating the discussions, the participants were encouraged to openly express their opinions and engage in discussions with one another.

There were no specific questions asked in a sequential manner. Participants were informed that their opinions would be used for academic purposes. They were encouraged to freely contribute to the discussions, as long as their comments were relevant to the topic at hand. I equally tried as a moderator not to ask double-barreled questions as participants cannot answer two questions at once. Having offered a detail description of the composition of the focus group discussion groups and the process of conduction, this study found it imperative to discuss in details some of its strengths below:

First and foremost, with the insights of Asmamaw, Mohammed and Lulseged (2011; as cited in Yayeh, 2021), one of the primary justifications for employing focus group discussions is

the desire to foster dialogue and deliberation on a research subject that necessitates a collective perspective. This approach allows for the exploration of diverse viewpoints, as well as the exploration of the underlying meanings, experiences, and beliefs associated with those viewpoints

Additionally, focus groups provide me an opportunity for interactive exploration with a small group, rather than relying solely on individual survey responses. This offered the researcher the opportunity to detect emotional responses, contradictions, stress, anger, frustration, enthusiasm, and other feelings that may not have been captured in a survey questionnaire (Yayeh, 2021).

Notwithstanding the strengths of the focus group discussion as primary data collection tool, researchers of which am not an exception are befuddled with some setbacks as;

Firstly, it is important to address the concern of certain individuals who have a strong influence in the discussion. Their dominance can potentially steer the conversation in a particular direction and limit the input from less vocal participants.

Once more, it is important to note that the perspectives shared by participants in a focus discussion may not accurately reflect the views of the entire population. When it comes to focus group discussions, it's important to keep in mind that the findings may not be applicable to a larger population. Relying on the viewpoints of just seven participants in a focus group discussion would be insufficient to draw conclusions for the entire population. Surveys or other quantitative data typically fulfill this role (Queirós & Almeida, 2017).

In certain situations, participants may not feel more comfortable sharing personal or sensitive information in a group discussion compared to an individual setting. However, it is important to note that confidentiality may be limited in these cases. This was evident as after a focus group discussion a participant walked up to me and opined that:

“My brother, you see not all of us have the confidence to speak in public. I would have preferred you visit me at home so I can fully express myself because I was born into a mining family and has a lot of information to share with you” (KII, Eggu, June 2023)

To surmount the above challenge, the research relied on the questionnaire surveys or individual interviews, where the privacy of the data collection helped to protect participants' confidentiality (Yayeh, 2021). The focus group discussions of the study were scheduled as depicted in table 3.3 below

Table 3.8.3: Focus Group Discussions Schedule

District	Category/Discussants			Number of FGDs	Date	Duration
	Male	Female	Youth			
NKD	12	10	12	3	17/03/2023	45-60 min. per session
Wa West	10	8	11	3	26/05/2023	45-60 min. per session
Wa East	13	14	10	3	7/06/2023	45-60 min. per session

Source: Author's Own Construct, 2023.

It is important to note that the above schedule and dates experienced some distortions and did not follow the exact timeline due to the sensitive and busy nature of ASGM operations. There were instances where participants who had already been scheduled gave excuses for their inability to partake in the discussions. In other cases, participants had to voluntarily opt out of the groups, as required by the ethical standards of scientific research. To surmount this hurdle, some missed dates in certain communities were compensated for by using the same dates in different communities and districts. Additionally, natural forces, such as rain, further disrupted the strict adherence to the schedule.

3.8.4 Observation

Another equally significant method used in gathering primary data for this study is the observation method aided by an observation checklist. There can be numerous motivations for gathering observational data. Some of these reasons are but aren't restricted to, where the scope of the research question to be addressed in the study focuses on tackling a 'how' or 'what' type of question. According to Erlandson, Harris, Skipper, & Allen (2003), observations can help investigators vividly describe phenomena by engaging all five senses. This allows for a detailed "written photograph" of the subject being studied.

In this study, the researcher used both participant and non-participant observation to gain insights into the activities ASGM. By interacting with, observing, and participating in these activities, the researcher was able to understand them within their natural environment.

This method allowed me collecting in-depth data the processes involved in the extraction of gold by artisanal and small-scale gold miners. It also offered the researcher an opportunity to observe the transaction between gold miners and gold buyers. The same observation was used to have first-hand information about the extraction of gold using mercury. The devastation of the

environment is as a result of small-scale mining activities. Thus, the environmental consequences of artisanal and small-scale gold mining watched and observed. This method was supported by the taking of photographs for pictorial evidence as supported Richard and Lahman (2015), who “feel that field pictures can make a valuable contribution to research practice and presentation”.

Additionally, observation helps to validate the accuracy of situations described by informants in interviews, focus group discussion and surveys, by identifying any potential distortions or inaccuracies in their accounts.

Although observation is a valuable method for collecting data, it has faced criticism due to its complexity. This method often requires researchers to take on multiple roles and use various techniques, relying on their five senses to gather information.

3.8.5 Interpretation of Land Satellite (Landsat) Imagery

Based on Turner et al. (2007; Ontoyin & Agyemang (2014), remote sensing is a significant technique for detecting and tracking changes in land cover. Again, since it provides enormous archives on earth resource data, Landsats enables long-term monitoring, historical records, and research. According to Jeje (1986; Ontoyin & Agyemang (2014), land photographs taken by satellite appear to prove especially beneficial for land degradation objectives.

3.8.6 Documents Review

Government’s policy documents such as; small scale mining legislations, the PNDCL law 218 of 1989, minerals and mining policy of Ghana (2014), the Minerals and Mining Act, 2006, Minerals and Mining (Amendment) Act, 2015 (Act 900), Minerals and Mining Act 2019, the Minerals Commission Act, 1993 were reviewed secondary data. Furthermore, the policy documents on natural resource governance in Ghana, data on evolutionary gold mining governance processes, , policy and legal changes that have occurred, and the livelihoods in general.

Besides, relevant books, newspapers and journal articles, with literature on small-scale mining governance were also scanned through. Through utilizing these, the researcher had the opportunity to capture the systems of governance and practices that were put in place, as well as starting livelihood-related events that occurred prior to the start of this study. These documents aided in the generations of policy flaws that befuddled the effective governance of ASGM operations the study area.

In summary, the diverse data collection methods enabled the study to mitigate biases and gaps that might arise from relying on a single source of data. This approach ensured a well-rounded, comprehensive, and credible understanding of the nexus of environmental threats and rural livelihood diversification from the perspective of ASGM in selected mining communities of the Upper West Region, avoiding "*the danger of a single story*" (Magidi 2018: 97; Jimu, 2022).

3.9. Methods of Data Analysis and Presentation

Data analysis is a systematic process that involves converting the data collected by the researcher into the essential information required to address the specific research inquiries of the study (Babbie & Mouton, 2014). This section involves the physical dissection of raw data into individual components and fragments to make meaning. As a fundamental requirement for conducting mixed methods studies, the research examined both quantitative and qualitative data with the intention of attaining its research objectives, as delineated subsequently in the following subsections:

3.9.1 Quantitative Data Analysis

Prior to the field survey, the subsequent stage involved in the process was data cleaning. Data cleansing, also known as data cleaning, is a well-established study field. The objective of this endeavour is to enhance the caliber of data through the identification and elimination of errors and inconsistencies (Ridzuan & Zainon, 2019). Insufficient or incomplete information might lead to uncertainty in the process of data analysis, necessitating effective management during the data purification phase. The presence of errors or missing values within the dataset might lead to disparate outcomes and can impact the decision-making process within a commercial context.

Quantitative research views field work as a means of generating numerical data, whereas qualitative research perceives field work as a means of generating textual data (Miles and Huberman; 1994). This study examines the relationship between artisanal and small-scale gold mining and rural livelihood diversification and environmental threats in selected mining communities of the Upper West Region of Ghana. The research methodology employed a mixed-method approach, which necessitates the use of both quantitative and qualitative data analysis and presentation techniques.

The cleaned data obtained from the questionnaire survey was processed using the Statistical Package for Social Sciences (SPSS version 23.0) software programme. This programme

was utilised for coding, data entry, organisation, and analysis, resulting in the production of diverse formats for presenting the survey findings. The quantitative data analysis was conducted using the descriptive statistics feature of SPSS version 23.0. The findings were then visually represented through the use of charts, simple percentages, and tables, facilitating the clear interpretation and discussion of the results. This aspect was specifically praised by Microsoft Excel. The statistical techniques of t-tests, and correlations were utilized where appropriate.

3.9.2 Qualitative Data Analysis

The qualitative data obtained from interviews, focus group discussion and participant observation were compiled, organized and classified manually according the specific objectives of the study.

3.9.3 Transcription and translation process

The term transcribing pertains to the act of converting an audio recording into written form for the purpose of analysis or examination. Conversely, "translation" refers to the process of interpreting or converting an audio recording into written words that can be studied (Davidson, 2009).

Protocols and transcripts were designed to facilitate the analysis of the data obtained from interviews, and focus groups. The transcription of interviews and focus groups was conducted in accordance with the research's expectations and perceived significance. This involved accurately transcribing the spoken words, including any accompanying behaviors such as laughter, sobbing, or pauses. The researcher engaged in iterative listening to the audio recordings of study participants, meticulously documenting the findings in both hard copy and soft copy formats. In this process, I took into consideration the impact of both natural mishearing of statements and deliberate choices in punctuation usage on the final analysis.

The process of early transcribing enables the researcher to reference all the information that was hypothesized throughout the data gathering phase. The researcher faced several obstacles during the process of transcribing and translating, which were of significant concern. Certain audio recordings were rendered inaudible due to the presence of respondents engaging in phone conversations on the premises throughout the interview and focus group discussion sessions.

3.9.4 Main Qualitative Data Analysis

The researcher employed a six-phase thematic data analysis approach, as outlined by Braun and Clarke (2006). The research process involves several distinct phases. Initially, the researcher must become acquainted with the collected data, gaining a comprehensive understanding of its content and context. Subsequently, the researcher proceeds to generate initial codes, which serve as preliminary labels or categories for organizing the data. Following this, the researcher engages in a systematic search for recurring patterns or themes within the data, aiming to identify commonalities or significant variations. Once potential themes have been identified, the researcher undertakes a thorough review of these themes, critically evaluating their relevance and coherence. This evaluation process leads to the final step of defining and naming the themes, which involves refining and clarifying their conceptual boundaries. Finally, the researcher synthesizes the findings into a comprehensive report, presenting the results of the analysis in a coherent and structured manner.

The qualitative findings were disseminated through the presentation of textual data and direct quotations obtained from key informants, community leaders, and members. The researcher reliance of this analytical method was grounded in the premise that it allows for the unadulterated representation of respondents' original perspectives, devoid of any researcher-induced biases. Thematic analysis was employed in the examination of qualitative data once more, owing to its efficacy in condensing substantial data sets into more manageable units.

3.10 Methodology for Land Use Land Cover Analysis in Chapter Eight

3.10.1 Pre - Processing Process

Three Landsat photos were obtained from the U.S. Geological Survey (USGS) website (<https://earthexplorer.usgs.gov>) by searching for false color imagery of the entire planet for the months of December in the years 2002, 2010, and 2022. These images were selected specifically for their lack of cloud cover. Therefore, December was selected as the most suitable month to provide the greatest distinction between the spectral characteristics of various land use and land cover (LULC) categories, including areas with no vegetation. The images utilized were Landsat 7, ETM+ for the year 2002, Landsat 5, TM for the year 2010, and Landsat 8 images, OLI for the year 2022. All the acquired data was maintained in the Universal Transverse Mercator (UTM) WGS84

zone 30N coordinate system format. The study utilized these images as geospatial secondary data. Table 3.10.1 presents the attributes of the utilized satellite imagery.

Table 3.10.1: Characteristics of the Satellite Imagery

Years	Spatial Resolution	Sensor	Row	Path	Acquisition Date	Total Bands
2002	30 x 30 m	Landsat 7 ETM+	53	195	24-12-2002	8
2010	30 x 30 m	Landsat 5 TM	53	195	22-12-2010	7
2022	30 x 30 m	Landsat 8 OLI	53	195	7-12-2022	11

Source: Field Survey, 2023

The three datasets were then subjected to picture enhancement and the level of atmosphere was removed through ENVI software version 5. 3. Moreover, the through the application of radiometric correction technique, changes on the surface of land were evident. The several bands were brought together through the technique known as composite layer stacking. The layer stacking was performed using Bands 1-5. Subsequently, the selected images were limited further by overlaying each image with the shape file of the study area which includes; the Wa West district, the Wa East district as well as the Nadowli-Kaleo district defining the Area of Interest (AOI) as depicted in figure 3. 1

The construction of this classification strategy relies on the Ghanaian land use and land cover classification scheme, which is used for visually classifying remote sensing data. This classification scheme was based on the work of Agyepong et al. (1996), as cited in Poku, Issaka, and Ziggah (2023). For the purposes of this study, five types were deemed suitable: Open vegetation, Water Bodies, Closed vegetation, Bare Land, and Built-up. This is shown in table 3.10.2 below:

3.10.2 Description LULC Classes

Table 3.10.2: LULC Classes Description

Land cover/use	Description
Bare Lands/Mining Area	This class includes all the land areas located within or around the forest estate and which have no tree or other plant cover natural or anthropogenic including sand rock and sterile mud. Such areas include eroded areas, cropped areas, areas where sand winning is carried out, mined out areas and other comparable places.
Built-up	All human habitations, including settlements, farmhouses, and cottages. These can be either permanent or temporary. It also includes any physical structure for businesses or store houses.
Closed vegetation	These areas include several forms of land that closely match forest cover in a closely manner including gazetted protected area, forest reserve, planted woodlot, natural growths, and sacred groves
Open vegetation	This category encompasses thick shrubs and fallow lands, featuring less tree cover than the closed savannah. In this study, uncultivated farmlands were also included in this class.
Water bodies	This class includes all surface waters; such as streams, rivers, dam, all pools of water.

Source: Adapted from Laari et al. (2015) and modified (2023)

3.10.3 Images classification

After creating spectral signatures for each class, the photos were classified using the Maximum Likelihood Classification (MLC) technique with the assistance of supervised classification.

3.10.4 Change detection

The process of change detection was performed with the picture differencing technique. According to Laari et al. (2015), it is believed that the digital numbers in the difference photographs conform to a normal distribution because of small variations in pixel values around the average. The technique entails removing corresponding pixels from two aligned raster datasets to detect areas of alteration (Gurgel & Ferreira, 2003; as cited in Tengapoe, Baddianaah & Agyemang, 2023). Therefore, alterations were identified based on Land Use and Land Cover (LULC) maps spanning from 2002 to 2022. A transition matrix was computed for the time span from 2002 to 2022 to illustrate the different changes between classes.

3.10.5 Accuracy Assessment

The accuracy assessment phase is a crucial step in the classification of satellite images, serving to validate the accuracy of the classification (Faqe Ibrahim, Rasul, & Abdullah, 2023). To evaluate the accuracy of classifications made by both users and producers, the confusion matrix was utilized on the latest categorized images from 2022 for the three districts: Wa West, Wa East, and Nadowli-Kaleo. Congalton (1991, as cited in Maxwell et al., 2021) suggested that the confusion matrix is the most reliable method for assessing the accuracy of classified satellite images from both the user and producer perspectives. The assessment involved using 210, 198, and 230 ground truth points for evaluating map accuracy in the Wa West, Wa East, and Nadowli-Kaleo districts, respectively. These points are detailed in Table 1, Table 2, and Table 3. Congalton (1991, as referenced in Maxwell et al., 2023) stated that to effectively assess the accuracy of a classified image for three or more land use and land cover (LULC) classes, a minimum of ten ground truth points per class is necessary.

3.10.5 Spatial Data Processing, Analysis, and Presentation

The accuracy of the classification of each land use and land cover (LULC) map was evaluated by comparing it to the ground truth data. The classification maps for 2002, 2010, and 2022 were then converted to vector format using ArcMap version 10.8. This conversion allows for the identification of percentage changes in LULC after the classification, with a specific focus on the changing areas. The resulting change map was used to quantify the extent of LULC changes in the study areas. The LULC in the study areas was classified into five main categories: water bodies, closed vegetation, open vegetation, built-up areas, and bare lands. The diagrammatic view of the above methodology is shown in figure 3.1 below:

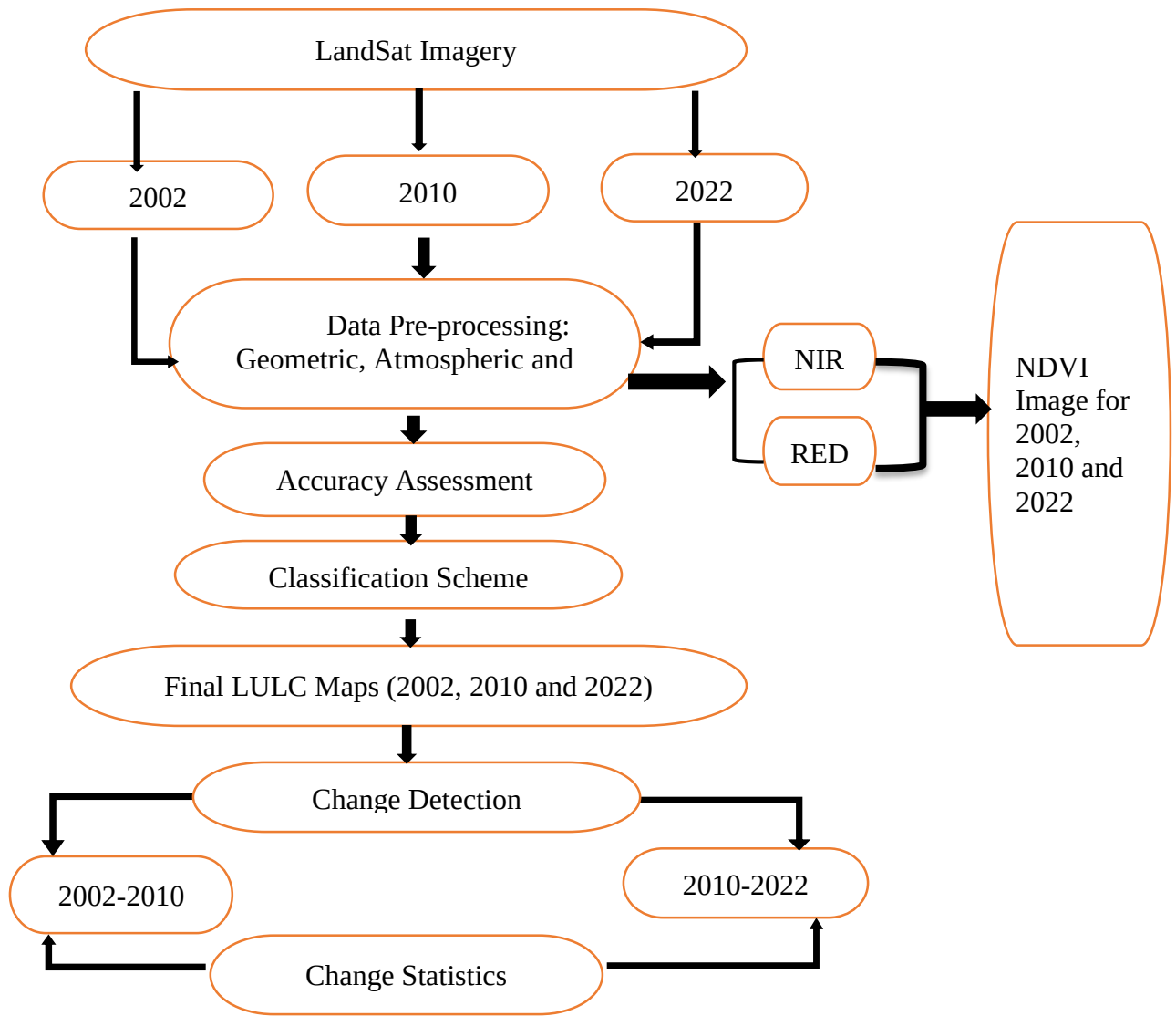


Figure 3.10: Diagrammatic View of LULC Methodology Source: Author's Construct, 2023

3.11.0 Research Ethical Considerations

According to Beauchamp and Childress (2013), as cited by Stolt et al. (2022), research ethics involves with individual beneficence, respect, justice, and community respect. It establishes rules for conducting responsible research. The study addressed the following ethical concerns: informed consent, anonymity, secrecy, and participant harm.

3.11.1 Informed Consent

Informed consent, according to Baloch and Shah (2014), is the agreement to engage in studies after learning about the study, including any risks and benefits. This indicates that those participating must be informed of the details the research includes and how they can benefit from the research.

In instances where participants could not indicate their acceptance by signing a portion was created for such participants to thumbprint. Again, the informed consent form was also translated into the local dialect (Waale or Dagaare) by verbally reading for them to have a better understanding of the study and what is expected of them to do as a respondent. In these instances, respondents were given the opportunity to verbally agree or disagree to take part in the study. The researcher made sure that no participant participates in the study under duress but based on their own volition.

3.11.2 Anonymity

In terms of anonymity, a 'strictly anonymous' study design is one in which data or information cannot be traced back to the research participant from whom it was received (Bryman, 1988; 2012). To address the issue of anonymity, the data gathering instruments in the investigation did not demand the human subjects' actual identities in terms of names, phone number among other personal details. When it comes to key informants, the name/s, code numbers were used for questionnaires were relied on instead of office names. This is done to ensure that the human subjects in the study remain anonymous.

To further ensure, participant anonymity, particularly for sensitive data or insights, the researcher described participants in a more abstract manner hence relying pseudonyms (fictitious names) rather than as real individuals. These behaviors are vital for maintaining participants' anonymity, but they can also impair the researcher's and others' capacity to return to the research context and similar circumstances ethically (Knott et al., 2022). This explains the fact that names used in the data analysis section especially qualitative responses are fictitious and does not in any way refer to any particular individual for purposed of anonymity.

3.11.3 Confidentiality

Cohen et al. (2011) defined confidentiality as the practice of ensuring that information from participants is not disclosed in any manner that could identify or trace the individual. Data was

stored without compromise in order to provide participants with anonymity and confidentiality. For example, the researcher removed names and other superfluous personal details from interview transcripts, password-protected and encrypted files, and labeled and stored all interview data using pseudonyms. "Data can be handled by creating a folder where it can be saved," as asserted Richards and Morse (2013:142). If the data acquired for the research study is saved on a computer and an external hard drive, it will be used as backup storage in case the computer be stolen or destroyed". After data has been acquired for the research project, the tape recorder must be placed and locked in a safe filing cabinet to ensure that it is not accessible to anyone; thus, such action can only be maintained by permanently locking the filing cabinet. The researcher considered how the data was safeguarded against unwanted access.

3.11.4 Voluntary participation

This assures that research participants are able to participate in the research on their own volition, without compulsion or violation being used to urge them to do so. This was made feasible because the researcher took the time to explain the potential benefits and objectives of the research, allowing participants to comprehend and decide whether or not to participate in the study. According to Babbie and Mouton (2001; Lebitso, 2021), voluntary involvement is frequently simple in theory but difficult in practice. As a result, if participants agree to participate in the study, they will be required to sign an informed consent form stating that they completely understand what will be expected of them.

3.11.5 Harm to participants

The balance of safeguarding respondents from damage, abuse, and injury by concealing their identity while also preventing "loss of ownership" is an issue that each researcher must manage on an individual basis with each respondent (Grinyer, 2002). The researcher made certain that individuals were not subjected to any psychological, physical, or emotional harm. The researcher made certain that the participants were given enough information so that they could make educated judgments about whether or not to participate in the study. Another way the researcher protected participants was by keeping data private rather than exposing it to a third party without the participants' prior authorization. The aforementioned was fruitful as a result of the researcher performing an in-depth risk and benefit analysis.

3.12 Community Entry Formalities

Identification of community involvement, authority (formal/informal), stakeholder identification, familiarization building, and needs assessment include community entry (Physical Activity Strategy, 2010). Once permission was granted by the Simon Diedong Dombo University of Business and Integrated Studies' Research Review Board, the research team proceeded into the study area, approached the targeted study participants, and obtained their individual consent when the researcher piloted the study.

The research team gained access to the chosen groups through official interactions with gatekeepers. Researchers must make contact with gatekeepers in order to get entry to a closed community. Individuals or institutions with decision-making authority in any community are known as gatekeepers. However, Gatekeeper has been described as any person who stands between you and the individual you wish to research (Wells, 2013). Our examples in this section may be drawn primarily from public health challenges.

In almost all communities, the assembly members were always the first point of call. The purpose of the study and the benefits of the study to the community were all explained to the assembly members before we were allowed entry into the study communities. In areas where the assembly were workers in Wa (the Capital of Upper West), the unit committee members were those recommended to us for community entry procedures.

After this, assembly members or unit committee members would normally lead us to the chiefs of the community for onward introduction to the community members concerning our purpose of visiting their communities. In most of these cases, the chief would normally invite some of his cabinet members (elders) for further introduction. All these community entry protocols were necessary because of the circumstances surrounding the modus operandi of artisanal small-scale gold mining. Again, this study was contacted at a critical time when the government has already put in place stringent measures aimed at flushing out small-scale miners because of the consequences of their activities, such as pollution of Ghana's major primary water bodies (River Ankobra, River Pra, etc.), depletion of our major economic trees through forest destruction, clearing of farmlands, especially cocoa farms, and contraction of cancer and other skin-related diseases as a result of too much exposure to mercury and other chemicals, just to mention but a few. During these periods, Special Force (Operation Vanguard) made up of both military and police were tasked by the government to either apprehend or shoot to injure illegal small-scale

gold miners. Consequently, these reasons, among others, put illegal (galamseyers) at risk of opening up to respond to questions from all strangers, especially when it has to do with the documentation of their responses regarding mining.

As a solution to making the miners gain the trust of the research team, the communities would normally recommend another opinion leader to take the researcher through the community familiarization tour. In some instances, their cultural or religious occasions, like naming ceremonies and community meetings were always used as a medium to disseminate information about impending academic research to community members. The use of their cultural gathering to create awareness among community members about this study made an immense contribution to this study's community entry, as almost all elders, household heads, heads of clans, and other opinion leaders were always present to further carry the information to different quarters.

Another entry points the researcher relied on for proper community entry procedures included the heads and leaders (committee chairmen) of the various mining groups within the communities. This was the final stage that acted as the straw that broke the camel's back, as people who were into mining activities such as cooks at mining sites, blacksmiths, women's groups crushing stones, machine operators, sponsors, gold buyers, diggers, chiselers, blast men, loco boys, and washers, among others, were further made aware of the research by their leaders.

After these entry procedures, the opinion leaders or gatekeepers were always pre-informed about our date of return for actual data collection. All communities were always given a five-day ultimatum for the research team to return, depending on how ready they were.

3.13.0 Ensuring Accuracy, Validity and Reliability

3.13.1 Validity of the Instrument

Validity is defined as the accuracy and precision of inferences based on the results of research (Mugenda & Mugenda, 2003). Following the piloting stage, the instrument was validated in order to guarantee that the data collecting instruments appeared correct. Pre-testing of research instruments prior to the actual study encourage criteria and validation of constructs of the instruments, in accordance with. Pre-testing the instruments employed for the research established criterion and construct validation. This validates the suitability of the data gathering instruments

The research instruments were provided to my supervisors and certain lecturers in the Department of Environment and Resource Studies, Faculty of Integrated Development Studies for expert assessment in order to improve the study's validity. This ensured that both the content and appearance of relevant evidence was provided to the items, as well as an examination of whether the items connected to the research questions and completely covered the facts of the study.

3.13.2 Reliability of the Instrument

Petters, Asuquo, and Eyo (2015) define reliability as the constancy with which a measuring device provides specific results when the entity being monitored has not changed. A variety of steps were undertaken to ensure the consistency of the instrument. The study utilized the coefficient alpha (Cronbach's alpha) to assess the internal reliability of the study instruments. The coefficient alpha can vary from 0 to 1, indicating the level of reliability. The coefficient alpha serves as a useful estimate of reliability in this regard. Coefficient alpha values above .70 are considered to indicate reliability that is deemed "acceptable." Values above .80 are considered to represent reliability that is classified as "good," while values above .90 are seen as indicating reliability that is considered "excellent."

However, when using short scales (scales with fewer than ten items), it is not uncommon to observe relatively low Cronbach values, such as .50. In this study, pilot investigation was carried out in two (2) mining communities between July 2022 and September 2022 to aid in the testing of the instruments' reliability. The study used the Statistical Package for Social Sciences (SPSS Version 23.0) to compute the Cronbach's reliability analysis, which resulted in an alpha value of 0.7 (acceptable reliability), implying that the questionnaire was reliable for the closed-ended questions utilized to quantify the study results. This helped to address questions, revise queries, and modify the data.

3.14 Limitations of the Research

The research first aroused anticipation among the miners, with many presuming that the researcher had an interest in acquiring minerals or facilitating them access to global markets. However, when realizing that the survey was affiliated with a doctoral research project at Simon Diedong Dombo University of Business and Integrated Development Studies, certain miners exhibited reluctance in their willingness to participate. Doubt and mistrust emerged, encompassing concerns such as accusations of government participation and the researcher being viewed as an undercover officer from the Criminal Investigations Department (CID), seeking to collect information for prospective legal proceedings. The investigation was conducted at the same time as a nationwide initiative to halt illicit mining (known as *galamsey*) because of its harmful impact on water sources, forests, and agricultural areas. This research happened at a time the government of Ghana, Civil Society Organizations (CSOs), Non-Governmental Agencies, media outlets as well as other well-meaning stakeholders were calling for an end to *galamsey*. It was at this same period that the government of Ghana deployed a military task force comprising of both the military and police force known as operation vanguard with the core mandate of clamping down on illegal miners and a possible ban on '*galamsey*' in totality.

To address these concerns, it was necessary to make multiple trips and engage with community gatekeepers, such as assembly members and their unit committee members, traditional leaders and their elders of mining communities, opinion leaders among others. This was done to reassure miners that the research was only for academic objectives. Notwithstanding these endeavors, certain miners persisted in demanding the researcher's student identification card as evidence of genuineness.

Another obstacle was to the physical entry to mining locations, especially during the period of heavy rainfall. Research in remote mining settlements was challenging due to the lack of well-developed roads, particularly in places where main roads were still being built. The presence of muddy and slippery roads presented difficulties for transport, impacting interview timetables and occasionally requiring delays.

In Phase I of the research, obtaining interviews posed difficulties due to the officials' demanding schedules and unexpected disruptions. Several interviewees exhibited a lack of punctuality, resulting in the need to reschedule, and interruptions were frequently encountered during the interviews. There was also the issue of mistrust among the mining regulatory institutions

such as the Minerals Commission, Environmental Protection Agency, district assemblies because of the dicey nature of ‘galamsey’ in Ghana hence their reluctance at releasing certain vital information to me.

While collecting data, further issues arose. Participants residing in the study area, known for having a less knowledgeable community, frequently evaded the researcher upon noticing the presence of paper and pen, despite being previously informed about the study. The respondents' limited educational background resulted in a lack of comprehension of the questions, necessitating the researcher to employ code mixing and code switching to their native language in order to overcome this issue.

Interviews and surveys occasionally excluded information to safeguard mining sites from being shut down, such as the deliberate omission of children's participation in mining, despite evidence suggesting otherwise.

3.15 Chapter Summary

The research in question utilized a case study approach as its research design and adopted a pragmatic philosophical standpoint. It employed the concurrent triangulation method, a type of mixed-methods research, to collect both quantitative and qualitative data simultaneously and analyzed them separately. To achieve its research objectives, the study gathered information from both primary and secondary sources. The selection of research participants involved the use of both probability and non-probability sampling techniques. Probability sampling was carried out using simple random sampling, while non-probability sampling methods included purposive sampling and snowball sampling. The study determined its sample size, which consisted of 320 household, based on the sampling formula provided by Miller and Brewer (2003), drawn from a total of 1,593 households across ten selected communities as per the 2021 population and housing census conducted by the Ghana Statistical Service. Again, the study used the snowball sampling techniques to sample 40 miners due to the illegal nature of their work which made it difficult recruiting a larger number. The study used various data collection methods were employed, including survey questionnaires, observations, key informant interviews, focus group discussions, document reviews, and the interpretation of Land Satellite (Landsat) Imagery. Quantitative data were analyzed using statistical software, with data presented through graphs, figures, tables, and percentages. Qualitative data, on the other hand, were analyzed by directly quoting respondents after transcribing the qualitative information.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Introduction

A research project's critical stage is when the data, discussions, and conclusions are carefully analysed, interpreted, and presented (Dawadi et al., 2021). This section is organized into two primary parts: the presentation of the demographic characteristics of the study respondents and the analysis of data based on the specific research objectives. Each objective is addressed in a separate chapter which include: the mode of operations of ASGM (Artisanal and Small-Scale Gold Mining) in the Upper West Region; the socio-economic implications of ASGM; the effects of ASGM on rural household livelihoods, diversifications, assets, and activities; the effects of ASGM on the physical environment, including mapping the spatio-temporal land use and land cover change trends, and the roles and effectiveness of regulatory institutions, laws, and policies governing ASGM in the Upper West Region.

4.2 Respondents' Demographic Characteristics

Understanding the demographic characteristics of study participants is a fundamental aspect of any research endeavor, as it unveils the socio-economic tapestry within which the study unfolds. In the context of this thesis, the focus narrows onto two distinct groups: artisanal and small-scale gold miners and non-miners. The demographic variables analyzed in this thesis include age, gender, educational attainments, marital status, occupation and household size. These variables collectively shape the identity and context of each participant, influencing their perspectives, experiences, and roles within the artisanal and small-scale gold mining communities.

4.2.1 Gender Distribution of Respondents

From Table 4.2.1, presents results on the gender distribution of respondents where male constitutes 72.5% of the total respondents for miners, while female respondents represent 27.5%. Also shows how non-miners are distributed by gender. As shown by the responses, 59.7% of respondents were men, while 40.3% were women. Drawing from the results, it is clear that male constitutes the majority of the respondents interviewed. The result reflects the fact that artisanal and small-scale mining is a physically demanding activity and is mainly male dominated in the study area. It is clear from the analysis that men constitute the majority of the non-miners same as that of the miners interviewed in the studied communities to have been into farming and other

livelihood alternative aside mining. This also confirms other studies that assert that men constitute the general active agricultural working force and that of the mining sector (Safo-Kantanka et al, 2006; Mumuni et al., 2012).

Table 4.2.1 Gender Distribution of Respondents

Gender	Miners		Non-miners	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Male	19	72.5	191	59.7
Female	11	27.5	129	40.4
Total	40	100	162	100

Source: Field Survey, 2023.

4.2.2 Respondents' Age Distribution

In assessing the level of vulnerability of respondents, gender and age are crucial factors; therefore, the age distribution of respondents was also analyzed. Again, age of respondents', particularly that of miners, is very essential to determine which category of people in terms of age are involved or affected by artisanal mining operations in in the Upper West Region.

The results as shown in figure 1 indicate that out of the 40 miners interviewed nearly two-fifths (37.5%) of miners were between 15-24 years, those within 25-34 years, comprises just over a third (32.5%) of the workforce. The above analysis therefor reveals that majority of the miners were within the youthful age of 15-54 and can therefore be regarded as active, agile and physically disposed to pursue mining activities due to its hazardous nature.

In contrast to miners, the distribution for non-miners shows a different trend. One of the most interesting findings in the age distribution of non-miners is the significant presence of older individuals, particularly those aged 55 and above, who make up 13.4% of this group. This suggests that non-mining sectors offer opportunities that are less physically demanding, making them more accessible to older workers. Additionally, the 25-34 age group emerges as the most engaged working-age category in non-mining, at 26.6%. This contrasts with mining, where younger

workers dominate, indicating that non-mining activities may appeal to individuals seeking more stable and sustainable career paths beyond the physically demanding nature of mining.

According to Uddin (2008) as cited in Nguyen-Nhu- and Phan (2023), age of a person is a crucial determinant of the ability to perform a job and young people can better apply their eagerness, dedication, consciousness and motivation towards achieving a target successfully. So, age structure of the members is very important in the context of their ability to get out of poverty. Results of studies conducted by Iheke (2008; cited in; Nguyen-Nhu- and Phan (2023), indicated that age is negatively related to output, and the negative relationship implies that with advance in age, output decreases due to decline in the ability to do manual work.

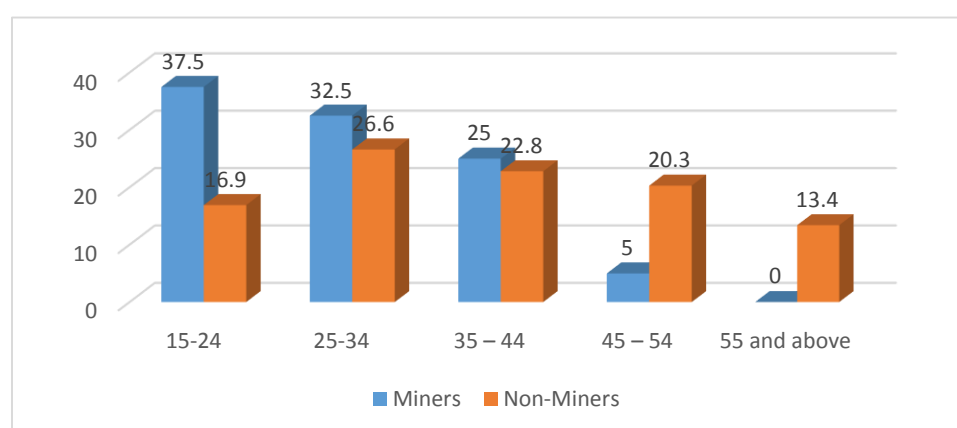


Figure: 4.2.2 Respondents' Age Distribution Source: Field Survey, 2023

4.2.3 Marital Statuses of Respondents

Figure 4.2.3 shows the responses of miners and non-miners in terms of marital status. From the responses, 45.0% of the miners were married, while widowed miners were represented by 7.5%. In terms of the non-miners, the survey revealed in Figure 4.2.3 that majority (50.6%) of them were married, while only 4.7% of them were widowed.

These findings highlight how employment type influences personal and family relationships. While mining offers economic opportunities, its demanding nature appears to impact marital stability more than non-mining occupations, reinforcing the idea that work-life balance plays a crucial role in long-term personal well-being.

Based on the study results of Alhassan (2023), the fact that the majority of non-miners were married shows that couples engaged in cooperative effort in farming activities or operations and farm families use mainly household head, wives, children and relations. Results of a study by

Adebiyi *et al.*, (2009) also indicated that most respondents were married and according to him, the findings imply that there is the possibility of more availability of family labour.

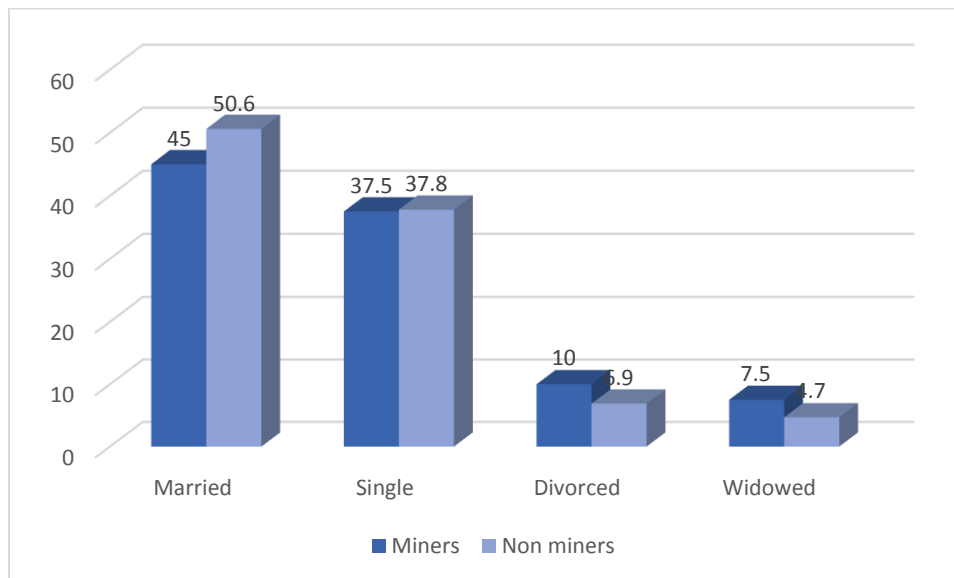


Figure 4.2.3: Respondents' Marital Status (Source: Field Survey, 2023)

4.2.4 Distribution of Respondents by Educational Attainments

Education is the foundation in which human skills are built (Uddin, 2008). The mineral industry requires a steady supply of skilled professionals to enter the work force for efficient operations (; cited in; Mihaye, 2013). The educational statuses were determined in terms of the highest educational level reached by respondents. Table 4.2.4 shows the educational attainments of both miners and non-miners. The result shows stark contrast in educational attainment between miners and non-miners, particularly when comparing those with lower education levels (no formal education and basic school) to those with tertiary education. Among miners, 62.5% have either no formal education or only basic schooling, while only 7.5% have attained tertiary education. Similarly, among non-miners, an even higher 75% fall within the lower education category, while just 7.2% have tertiary qualifications.

This pattern suggests that both mining and non-mining occupations are largely dominated by individuals with lower educational backgrounds, reinforcing the idea that these sectors rely heavily on unskilled or semi-skilled labor. However, the fact that miners have a slightly lower percentage of individuals with minimal education (62.5%) compared to non-miners (75%) hints at

the possibility that mining may require at least some level of technical knowledge or vocational training. It could be implied that the only survival strategy of this class of people is to engage primary economic activities especially mining or farming as a main source of livelihood. This is because the educational attainments of these categories of people may not qualify them to engage in any meaningful educational related occupation such as banking, teaching and nursing (Mihaye, 2013).

Additionally, the study uncovers that the educational deficit among small-scale miners is a contributing factor to the practice of ‘galamsey,’ or unauthorized mining activities, in the Upper West Region.

Table 4.2.4 Distribution of Respondents by Educational Attainments

Educational Attainments	Miners		Non miners	
	Frequency	Percentage (%)	Frequency	Percentage (%)
No Formal Education	15	37.5%	137	42.8%
Basic school	10	25%	103	32.2%
SHS/ Voc/Tec	12	30%	57	17.8%
Tertiary	3	7.5%	23	7.2
Total	40	100%	320	100%

Source: Field Survey, 2023

It is believed that respondents who have higher educational attainments are likely to have a better understanding of the negative health and environmental challenges that confronts the small-scale mining sector in the studied communities. Economic benefits of schooling include the potential to obtain paid employment or to generate income through self-employment using skills learned in school (Charity, Gabriel & Joseph, 2021). In theory, education is expected to improve productivity in all spheres of activities including agriculture (Wongnaa, 2022).

4.2.5 Respondents’ Religious Distribution

Figure 4.2.5 shows the dominance of Islam among both miners (57.5%) and non-miners (63.1%), suggesting that mining and non-mining activities in this region are largely undertaken by

communities with a strong Islamic presence. However, the slightly higher percentage among non-miners might indicate that Islamic communities are slightly more engaged in alternative economic activities beyond mining.

Another notable observation is the higher representation of African Traditional Religion among miners (7.5%) compared to non-miners (2.5%). This suggests that mining may be more deeply rooted in indigenous or traditional belief systems, potentially due to cultural practices or historical connections between local communities and mineral-rich lands. Traditional beliefs may influence miners' engagement in the sector, possibly linked to rituals or practices associated with mining activities. This overall distribution suggests a religiously diverse group, yet with clear majorities and minorities, reflective of broader societal patterns in the study area.

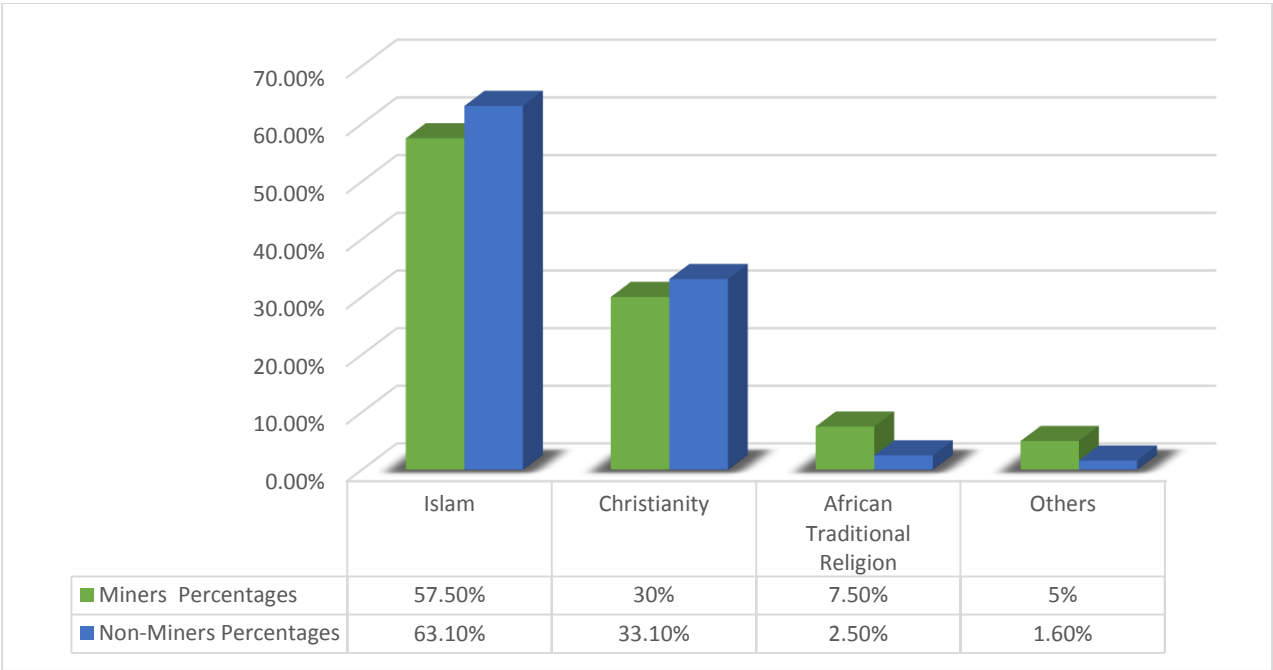


Figure 4.2.5: Respondents’ Religious Distribution **Source: Field Survey, 2023**

In the context of developing countries, religious institutions significantly influence the choice of livelihood activities, as nearly all individuals in the studied areas are affiliated with one religion or another. Contemporary research corroborates earlier study Oyesola and Ademola (2011), highlighting the pivotal role of religious institutions in shaping economic activities in rural settings of developing nations.

4.2.6 Respondents' Household Size

Table 4.2.6 below indicates the number of people found in the households of respondents. The data presents a stark contrast in household sizes between miners and non-miners. A significant 29.4% of non-miners live in households with 13 or more people, compared to just 10% of miners. This suggests that non-miners tend to live in larger, more extended family settings, possibly due to cultural norms or the nature of their occupations, which may allow for more communal living. Miners, on the other hand, may reside in smaller households due to the mobility required for their work or the need to stay closer to mining sites, reducing their ability to live with extended family.

Table 4.2.6 Number of People in the Households of Respondent

House Hold Size	Miners		Non-Miners	
	Frequency	Percentage (%)	Frequency	Percentage (%)
1-4	1	2.5	42	13.1
5-8	17	42.5	102	31.9
9-12	18	45.0	82	25.6
13 and above	4	10.0	94	29.4
Total	40	100	320	100

Source: Field Survey, 2023

Another striking observation is that miners are more concentrated in mid-sized households (9-12 members) at 45%, compared to 25.6% among non-miners. This indicates that while miners do not often live in the largest household category, they still have substantial family responsibilities, possibly reflecting a balance between maintaining extended family ties while adapting to the demanding nature of mining work. Thus, unmonitored mining activities will have adverse effects on vulnerable households that many people depend on the head of household for survival. This is so because many people in the mining communities depend on land that is degraded by artisanal small-scale miners. In this regard, there is undue pressure on household heads for the survival of household members in the studied communities. Overall, the data reveals that miners tend to live in moderately large households, while non-miners are more likely to be part of very large extended families, reflecting possible differences in income stability, lifestyle, and work-related mobility between the two groups.

Inferring from the above analysis the average household size for miners is approximately 8.85, and for non-miners, it's approximately 8.91. These averages suggest that both

groups have similar household sizes, with non-miners having a slightly higher average. With non-miners, the struggle to provide for larger families without the potentially higher incomes from mining can lead to increased economic vulnerability driving them into mining as alternative source of livelihoods aside their unpredictable primary occupation-farming hence exacerbating illegal mining activities leading to detrimental effects on the physical environment.

This result corroborates those of Daudu et al (2022) that a fairly large household size is dominant in rural sub-Saharan Africa. This implies that a fairly large member of household in the study area is likely to have more diversified income sources if all the members are working and contributing to household welfare (Goetz, 2022).

4.2.7 Origin of Artisanal Miners

A greater chunk of respondents representing 64.6% were natives of the various sampled communities while non-natives (Migrants) formed 35.4% of the total respondents of miners. To explain this, Nyame and Grant (2009; Osei-Bagyina, 2012) stated that macro-level models predict that labour will flow from 'labour-abundant' regions or countries to 'labour-scarce' ones in order to secure higher wages on offer. During the development phase when ore has been delineated and ready to be mined at a profit, demand for all forms of labour from skilled to unskilled tends to be high, qualitatively in conformity with the volume and quantum (or diversity) of work required. This phase, therefore, attracts maximum labour of all kinds often equaled only when existing mines undergo massive expansion projects (Nyame and Grant, 2009; cited in Osei-Bagyina, 2012).

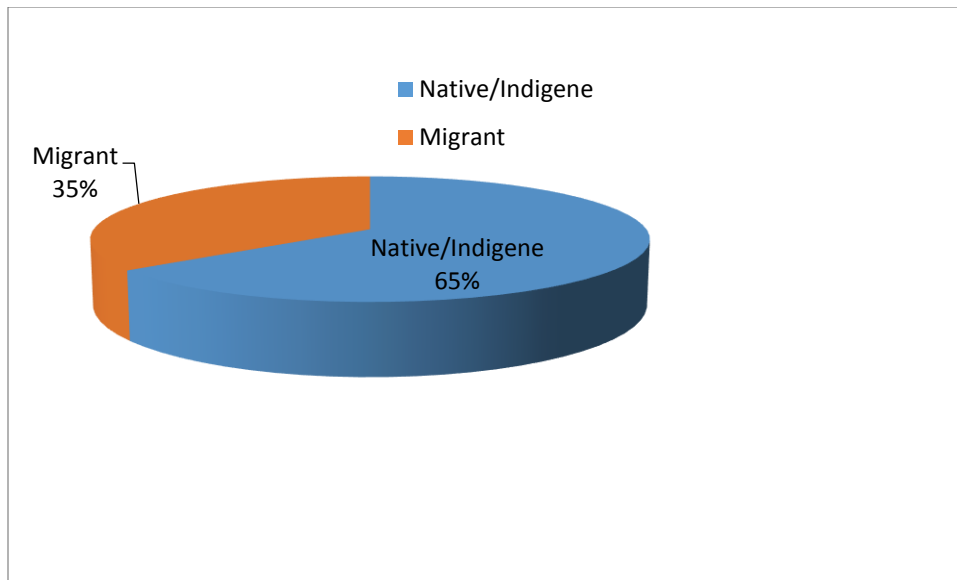


Figure 4.2.7: Origin of Artisanal Miners

Source: Field Survey, 2023

Therefore, the larger number of non-natives in the communities can be explained with the above assertion. These non-natives were from other parts of the upper west region and beyond it. To buttress the above findings a mining sponsor at the Gbegebe mining site at Manwe mentioned that:

“About 80% of miners are not from Goripie. Only 2 out of every 10 miners are residents or indigenes of this community (Manwe). Miners come from across the entire Northern Ghana. We become miners due to lack of sustainable jobs in our various localities. We have carpenters, masons and even farmers in our mist here that travelled from almost all parts of the country just to have something to feed their families”. (KII, Manwe, June 2023)

4.2.8 Nature of Work as Miner

In examining the major occupations of respondents, this thesis aims to delve into the employment landscape that shapes the livelihoods of individuals within a specific demographic. The primary occupations identified in the study area includes agricultural activities such as crop farming, fishing, livestock rearing, shea nut picking and poultry keeping. From the analysis in figure 4.2.8 a greater percentage of the respondents, 57.5%, were full-time miners whilst 17 of them representing 42.5% of the respondents were part-time miners. This indicates that the majority of the surveyed group dedicates most of their time to mining activities. This could be due to the potential profitability, personal commitment, or lack of other employment opportunities driving individuals to engage in mining as their primary source of income.

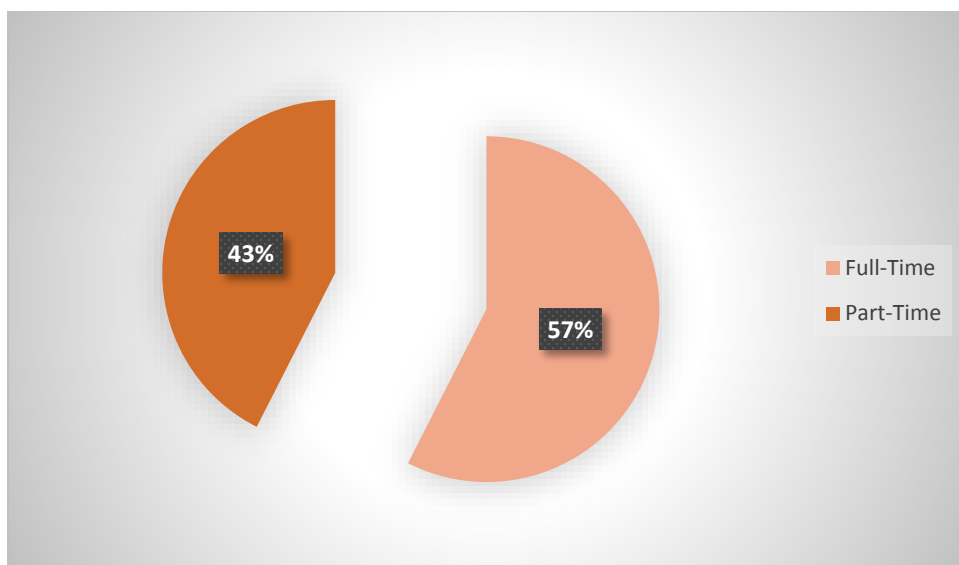


Figure 4.2.8: Nature of Work as Miner

Source: Field Survey, 2023

Part-time miners in the study area indicated that they turn to mining during the dry season, a period when agricultural activities are less demanding. This seasonal shift to mining allows them to augment their earnings, providing essential financial support for their farming needs. This finding is in tandem with those of Huntington and Marple-Cantrell (2022) who asserted that: "In the context of rural Guinea, artisanal and small-scale gold mining (ASGM) serves as a critical economic activity, particularly for part-time miners. These individuals often engage in mining activities during the dry season, a time when agricultural demands are notably reduced. This strategic seasonal shift allows them to supplement their income, thereby providing essential financial support for their farming needs"

4.2.9 Non-Mining Livelihood Pursuits for Seasonal Miners

The data presented in figure 4.2.9 shows the dominance of agriculture in the selected mining communities, with a significant 58.82% of respondents involved in this sector, underscoring its crucial role in providing sustenance and economic stability. Again, trading activities, engaged in by 11.76% of the part-time miners, such as selling provisions, second-hand clothing, and vending food, are essential for goods distribution and meeting the local population's needs.

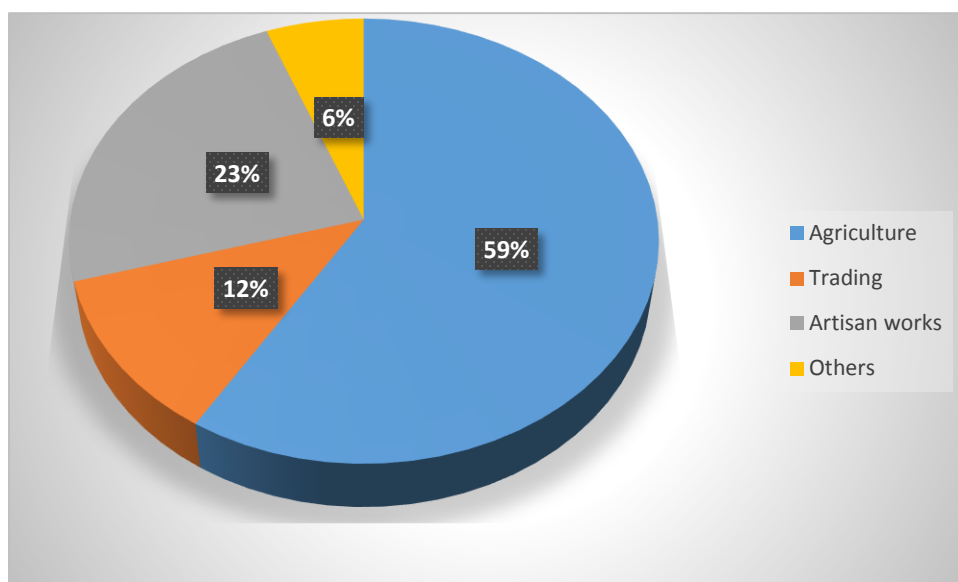


Figure 4.2.9: Non-Mining Livelihood Pursuits for Seasonal Miners

Source: Field Survey, 2023

Those in artisanal jobs, making up 23.53%, 'Others' category, which constitutes 5.88% and includes professions like teaching, underlines the importance of education in fostering community development and resilience.

4.2.10 Primary Occupations of Non-Mining community members

The survey results in table 4.2.10 reveal that a significant majority of the respondents accounting for 62.8% were engaged in agriculture. On the other hand, trading was the second most prevalent occupation, involving 19.06% of respondents. Additionally, artisans, making up 15% individuals of the 320 respondents, reveal weaving, soap making, masonry, carpentry and tiling. Lastly, the 'Others' category, encompassing 3.13% of the respondents, points to teaching, healthcare, or digital services, indicating a spectrum of other essential but less common roles within the community.

Table 4.2.10: Primary Occupations of Non-Mining community members

Occupation	Frequency	Percentages (%)
Agriculture	201	62.81
Trading	61	19.06
Artisan works	48	15.00
Others	10	3.13
Total	320	100%

Source: Field Survey, 2023.

MODE OF OPERATIONS OF ARTISANAL AND SMALL-SCALE GOLD MINING IN THE UPPER WEST REGION

4.3.0 Introduction

This chapter offers a comprehensive look at ASGM, detailing its importance, distinctive traits, and operational approaches. It then differentiates ASGM's features from those of large-scale mining, focusing on its decentralized, informal nature, small scale, and labor-intensive processes. The chapter also considers the factors driving people into ASGM, including elements like poverty, the absence of other job options, and mining traditions, which shape the operational methods of ASM workers. Hence, assessing ASGM's operational methods is essential for developing approaches that encourage ethical mining, reduce negative effects, and improve the long-term viability of ASM ventures as livelihoods.

4.3.1 Methods of Acquiring Land for ASM

A total of 40 miners were asked about how they acquired land for the small-scale mining operations. The figure 4.3.1 below reveals that 32.5% of artisanal miners acquired their land through leasing, 42.5% had their lands through family inheritance, and 20% of them had their mining lands from chiefs while 2% said they acquire lands through other means such as borrowing from individual land owners who need partnership in mining.

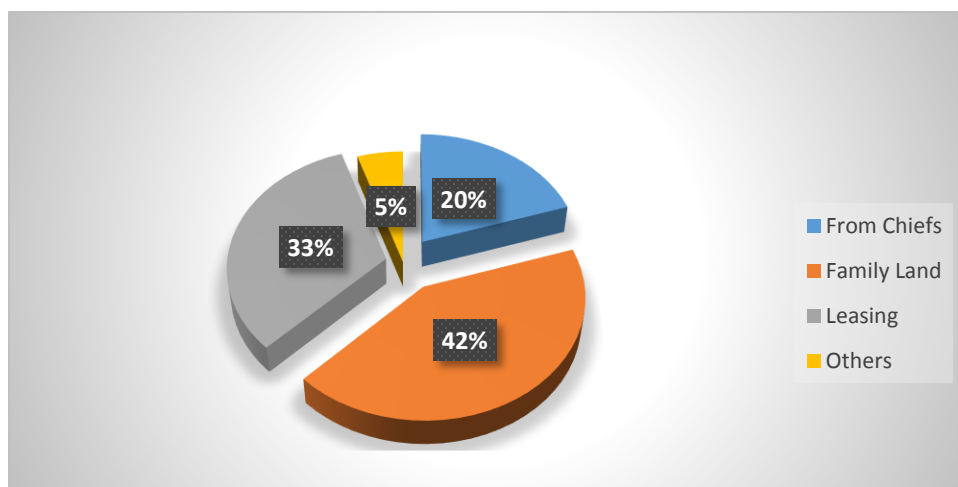


Figure 4.3.1 Methods of Acquiring Land for ASGM

Source: Field Survey, 2023

This finding is confirmed by Nyame and Blocher (2010), when they examined the issue of land tenure and how it influences artisanal and small-scale mining activities in Ghana. Their findings show that, regardless of the fact that mineral resources are by law the property of the state, stool lands in mineral-endowed areas continue to be utilized and, in most cases, frequently traded, according to existing customary laws and this has promoted small-scale mining in Ghana.

In all the studied communities, there was a violation of the principle of justice in land acquisition. The Minerals and Mining Act, 2006 (Act 703) entrusts all mineral in the hands of the government for the people of Ghana. Thus, the national government, in consultation with stakeholders and other institutions are responsible to grant mining leases/licenses in the country (Obara and Heledd, 2006). However, landowners, opinion leaders and some chiefs arrogate power to themselves by granting permission to people to mine in the study area (Anthonio-Apedzi, 2021). To substantiate the above a lead miner at Goripie revealed that:

“We the indigenes inherited the site from our forefathers who discovered the land was endowed with gold and mined it so many years ago. So, we are also continuing until time seizes for our children to equally take over” (KII. Goripie, July 2023)

4.3.2 Training as a Miner

The results from figure 4.3.2 revealed that majority of 35 respondents representing 87.5%, have not received training as small-scale miners. The reasons behind this from the respondents were multifaceted, including a lack of training programs, the illegal nature of artisanal and small-scale miners, perceived irrelevance of training by the miners, or other hindrances such as cost or time constraints.

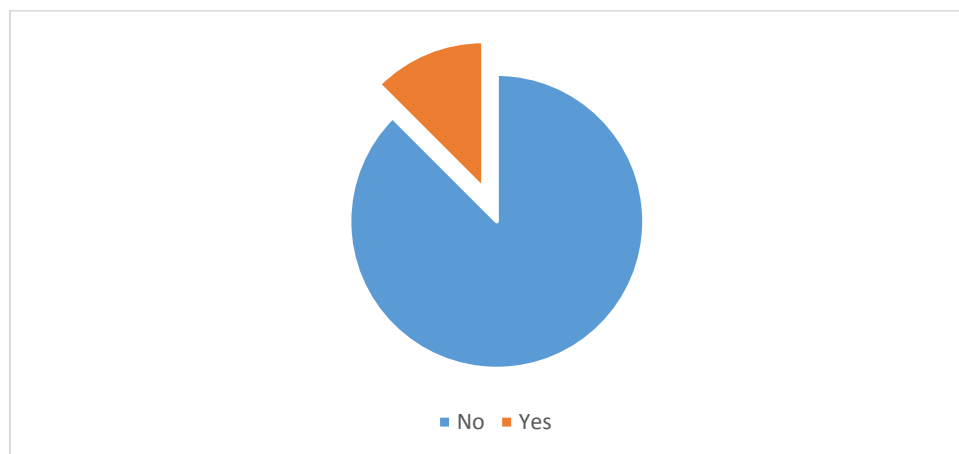


Figure 4.3.2: Training as Miner**Source: Field Survey, 2023**

Conversely, the remaining 5 respondents representing 12.5% of the miners revealed they have undergone training, hinting at the presence of training opportunities that are being leveraged by a few. This disparity in training among small-scale miners could have far-reaching consequences on their safety and the efficiency of their operations. Further field interviews revealed that the 12.5 small scale miners who indicated that they had some forms of training were found out to be old miners who had worked with formal gold companies in the southern part of Ghana. In order to further unearth much information on the aspect of miners who claimed they were trained; I embarked on a key informant interview with a 45-year-old miner who revealed that:

“My son talking about training before mining, I can tell you that I have gained a lot of experience working with AngloGold Ashanti Company limited. At Obuasi, I started when it was still called Goldfields. This is one of the leading mining companies in Ghana. I have worked with them for over 21 years prior to my retrenchment. Before I was recruited as a mine worker I was made to go through training with ‘Nansaarihi’ (Whitman) for half a year until I was given the full opportunity to venture into mining on my own. I started as an unskilled laborer to an experienced miner. The tedious training activities I undertook not only instilled me with the technical skills necessary for safe extraction of gold but also equipped in me a deep respect for the delicate balance between mining activities and environmental. The white men alongside seasoned miners I met at the mining company taught me underground mining, beginning with drilling, blasting, ventilation and water management” (KII, A Male Miner, Goripie, Wa East, June, 2023)

Another miner from Polee shared his perspective on the issue of training as a miner:

“In our line of work practical experience often outweighs any form of training. With years of hands-on involvement in mining activities, I believe that the demands of the job require nothing more than resilience, adaptability, and a willingness to learn on the job. Instead of training, I rely on the guidance passed down from more experienced miners and learn through trial and error. My priority is on our immediate survival as miner than any form

of training. Had I sought training in another profession, I might have considered becoming a tailor or a mechanic who wouldn't fetch me more money'' (KII, 34 years old male miner, Manwe, March, 2023).

The narratives of the few mine workers who asserted they have received some form of training revealed was supported by some group of miners in polee a mining community in the Wa West District. One of them revealed:

“We have undergone some form of training at Tarkwa at the University of Mines and Technology (UmaT). The training took place over a span of four days in December 2018 where we were taking through several mining courses and were awarded certificates. With that certificate we are still been pursued by the District Assembly and the police for mining without license. It was later that we were briefed that those certificates were for the training as a miner and not a mining lease or certificate” (FGD, Male, Polee, April 2023).

This group of miners further revealed that their personal sponsorship of travel and feeding expenditures, they encountered challenges in the field all went into the drain. Notwithstanding the acquisition of certificates, which are believed to serve as validation of their training, the miners in question still had encounters with law enforcement agencies, such as police and military personnel, District Assembly or the Minerals Commission due to the utilization of these credentials in their mining activities.

4.3.3 Methods of Artisanal Small-scale Mining

In small-scale mining operations, there are significant differences between the highly rudimentary, manual methods such as the use of pick and shovel, hand panning and sluicing and the sophisticated methods involving the use of heavy equipment, controlled blasting, processing plants among others in mining operation. In view of this, miners were asked about the mining methods they use in the extraction of minerals in the study area.

Table 4.3.3: A Cross tabulation Comparing Gender and Method of mining

		Mining Methods		Total
		Underground mining	Surface mining	
Gender	Male	7	22	29
	Female	2	9	11
	Total	9	13	40

Note: Pearson Chi-Square=.162, df=1, p=.687**Source: Field Survey, 2023**

The results in table 4.3.3 show the cross tabulation between gender and mining methods. The data shows that males overwhelmingly dominate both underground and surface mining, accounting for 29 out of 40 miners (72.5%), while females make up a significantly smaller proportion at 11 out of 40 (27.5%). This pattern is consistent with global trends in the mining industry, where men are traditionally more engaged in mining due to historical, cultural, and occupational factors (Lahiri, Latif, & Punnett, 2005). The physically demanding nature of mining, coupled with gender-based barriers such as safety concerns, discrimination, and lack of gender-specific protective equipment, has contributed to the lower participation of women in the sector (Benya, 2009).

An interesting observation is that while men are more engaged in both mining methods, their dominance is more pronounced in underground mining, where 7 out of 9 (77.8%) underground miners are male. Underground mining is widely recognized as one of the most hazardous forms of mining, involving exposure to extreme conditions, including confined spaces, toxic gases, and the risk of cave-ins. Studies suggest that occupational health risks and physical labor intensity deter many women from participating in underground mining (Hermanus, 2007). Additionally, social and workplace norms in many mining regions continue to discourage female involvement in underground operations, reinforcing the gender gap in this area (International Labour Organization, 2018).

On the other hand, female miners appear to have a higher representation in surface mining compared to underground mining, where they account for 9 out of 13 (69.2%) of all female miners. This could be attributed to the relatively lower physical demands and health risks associated with surface mining, making it a more accessible option for women in the industry (Sainato, Das, & Karmakar, 2020). Additionally, automation and technological advancements in surface mining have reduced the need for manual labor, potentially opening more opportunities for women (Parker, Jorritsma, & Van den Broeck, 2018). However, despite this shift, systemic barriers such as gender stereotypes, wage gaps, and limited access to leadership roles in mining remain prevalent, limiting women's full participation and career progression in the sector (Perks & Schulz, 2020).

The overall low participation of women in mining highlights the need for gender-inclusive policies that promote equal opportunities, workplace safety, and targeted training programs for women interested in mining careers. Governments and mining companies should implement initiatives to encourage more women to enter the field, including scholarships for women in mining-related studies, gender-sensitive recruitment policies, and investment in mechanization to reduce physical labor barriers. Additionally, strengthening labor rights, improving safety measures, and addressing cultural stigmas will be crucial in ensuring a more balanced gender representation in both underground and surface mining.

Djietror and Catherine (2012), reveals that surface mining operations which is the most common type of mining method engaged in by small scale miners represents the major cause for land use change from cropland to mining land.

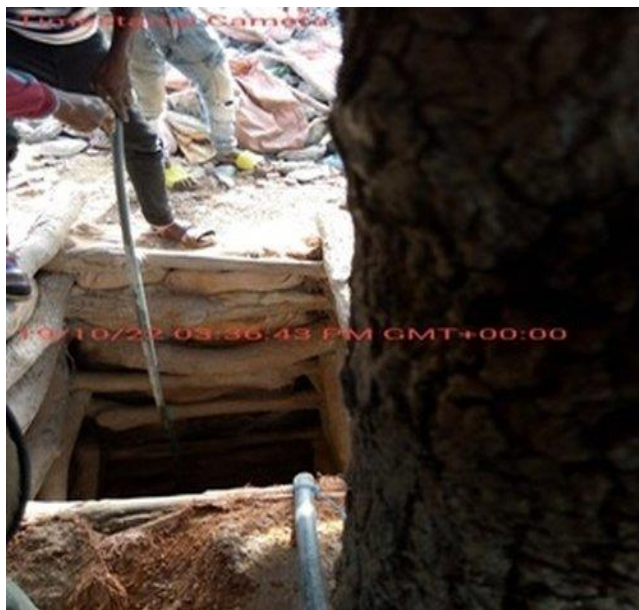


Plate 1: Underground Mining Shaft

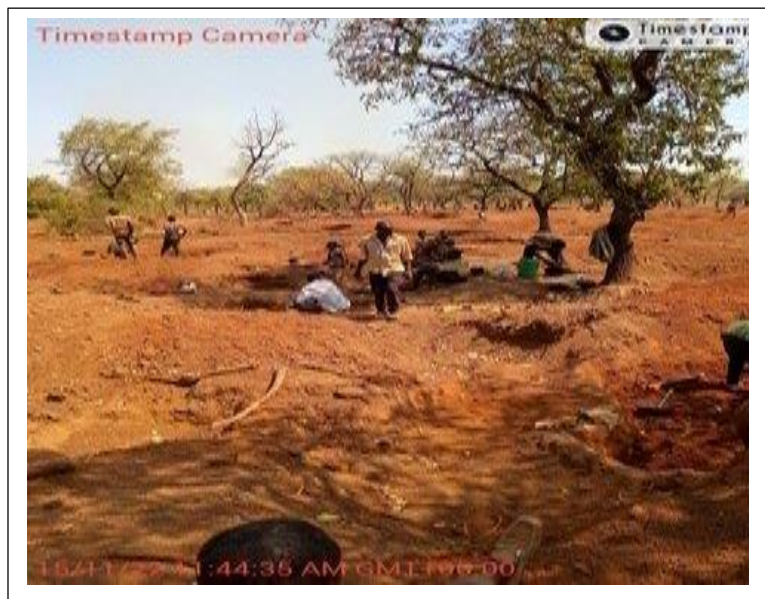


Plate 2: Surface Mining (Dig and Spread)

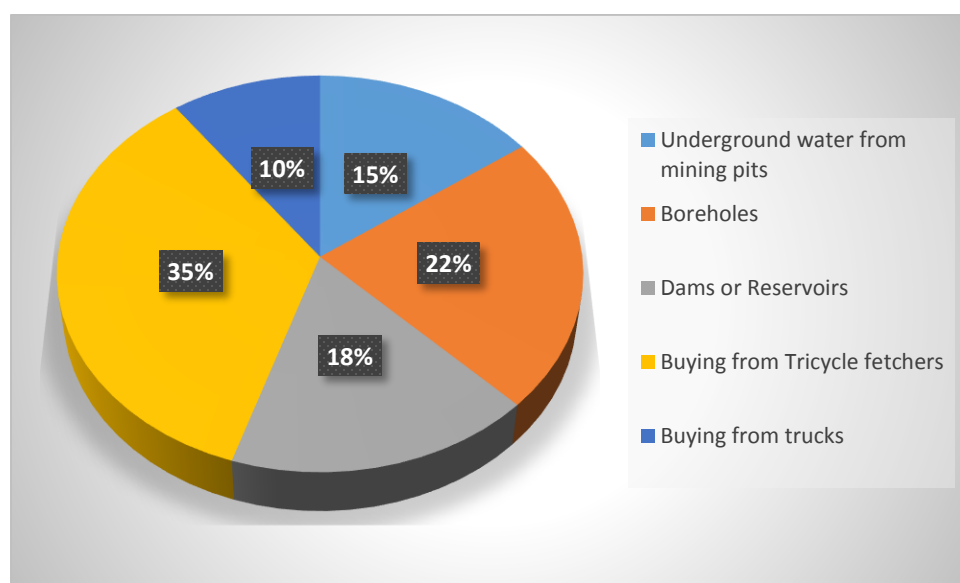


Plate 3: Surface Mining (Dig and Wash)

Source: Field Survey, 2022/2023

4.3.4 Sources of water for ASGM activities

The quest for water is a critical aspect of artisanal and small-scale gold mining in the Upper West Region, where miners' reliance on various sources especially in areas where water is used for washing and separating gold from other materials. This study delves into the various sources employed by 40 artisanal and small-scale gold miners uncovering a complex tapestry of dependence that ranges from tricycle fetchers to boreholes.



4.3.4 Sources of water for ASGM activities

Source: Field Survey, 2023

In reference to the field data from a sample of 40 miners reveals a diverse reliance on water sources, with the majority (35%) purchasing water from tricycle fetchers, indicating a significant dependence on water vendors for their supply. Miners who relied on boreholes were the second most relied upon source, accounting for 22.5% of the usage, suggesting that a considerable number of miners have access to boreholes for mining activities. Dams or reservoirs provide water for 17.5% of the miners, while a smaller group (15%) extracts underground water directly from mining pits. The least utilized source is buying from trucks, used by only 10% of the respondents. This distribution highlights the challenges faced in accessing clean, reliable water and the varying degrees to which miners must go to secure this vital resource.

4.3.5 Chemicals Used for Artisanal Gold Mining

The results in 4.5.5 figure below depicts the types of chemicals used by artisanal miners in the extraction of gold from their tailing or gold ore. Out of the total artisanal gold miners interviewed, 4.5% did indicate that, they do not use any chemical, 80.5% of them responded that they used mercury, while cyanide users represent 10%. However, 5% of the miners use other chemicals to extract gold from tailings.

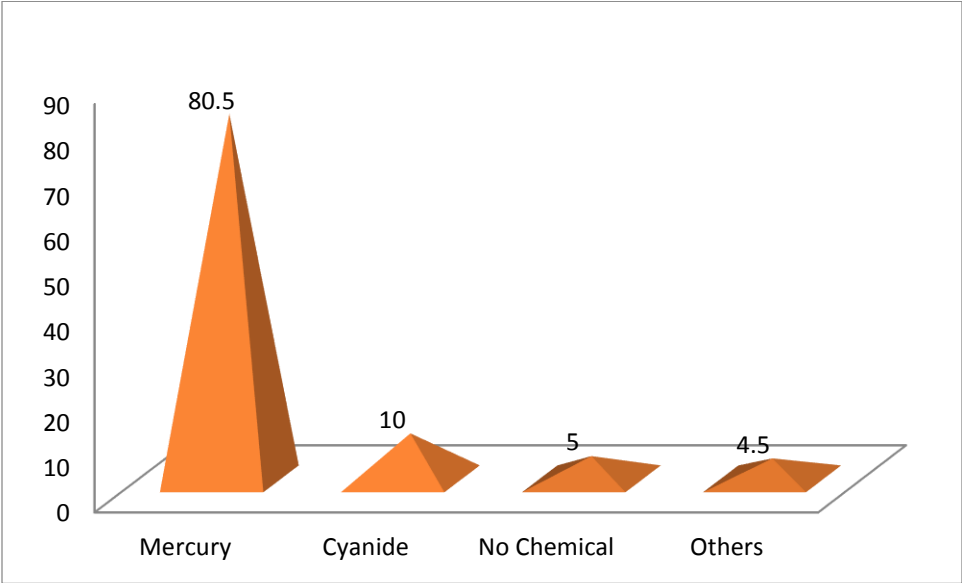


Figure 4.3.5: Chemicals Used for Artisanal Gold Mining Source: Field Survey, 2023

A 32-year miner in Goripie revealed that:

‘I use mercury washing to extract gold because it is the only chemical readily available to me. Although many people have expressed concerns about its dangers, I continue to use it because it is the most accessible method for extracting gold. My primary concern is providing for my family with the money I earn from this process’. (KII, Youth Miner, Goripie, May 2023)

When questioned further about the source of his mining chemicals, he disclosed that:

"My brother, I don't need to share all my mining secrets. In this profession, there are influential individuals known as sponsors who supply us with mercury at no cost in exchange for purchasing the gold we extract. In our business, a sponsor who provides mercury is the one to whom you should sell your gold. The most popular buyers are those who supply mercury to miners for free in exchange for gold. Their motto is that to catch fish, you use meat as bait, and we understand that perfectly." ((KII, Youth Miner, Goripie, May 2023).

4.3.6 Miners Knowledge on the Adverse Effects of Mercury

The crosstabulation between educational status and miners' knowledge on the adverse effects of mercury presents important insights into how education influences awareness of health risks in artisanal and small-scale mining.

A striking observation is that miners with no formal education are less likely to be aware of the adverse effects of mercury, as seen in the distribution where only 5 out of 15 (33.3%) acknowledged awareness, while 10 out of 15 (66.7%) lacked knowledge. This suggests that a lack of formal education may contribute to a limited understanding of environmental and occupational hazards associated with mining activities. This aligns with research findings indicating that lower literacy levels in artisanal mining communities correlate with reduced awareness of occupational health risks, increasing the likelihood of unsafe practices such as the uncontrolled use of mercury in gold extraction (Eisler, 2003).

Among miners with senior high school, vocational, or technical education (SHS/VOC/TEC), the awareness of mercury's adverse effects is 100%, with all 5 miners acknowledging the risks. This trend continues among miners with tertiary education, where the single respondent in this category also reported awareness. The sharp increase in awareness at higher educational levels suggests that formal education significantly improves the understanding of occupational hazards and environmental sustainability. Studies have shown that miners with higher educational attainment are more likely to adopt safer mining practices, use protective equipment, and seek alternative mercury-free gold processing methods (Hilson & Pardie, 2006).

Overall, the analysis reveals those higher levels of education correlate with greater awareness of the adverse effects of mercury in mining operations. This underscores the importance of integrating educational programs and health awareness campaigns into artisanal and small-scale mining communities. Governments and non-governmental organizations (NGOs) should invest in adult education, training workshops, and visual-based learning approaches to improve knowledge dissemination, particularly among miners with little or no formal education. Additionally, regulatory bodies should consider policies that require mandatory health and safety training before granting mining licenses.

Table: 4.3.6: A Cross tabulation Comparing Educational Status and Miners' knowledge on the adverse effects of mercury

		Miners' knowledge on the adverse effects of mercury		Total
		Yes	No	
Educational Status	No Education	5	10	15
	Basic Education	11	5	16
	SHS/Voc/Tech	3	0	3
	Tertiary	1	0	1
	Others	2	1	3
Total		24	16	40

Note: Pearson Chi-Square=4.705, df=4, p=.319

Source: Field Survey, 2023

A 43-year-old miner was asked to share his thoughts on the negative impacts of mercury in his operations with regards to his personal health as an experienced miner, he opined that:

Working with mercury is something we can't really avoid here, and it's had a real toll on many of us. Personally, I've seen quite a few health issues that I never dealt with before getting into mining. The most noticeable for me has been the skin rashes. They started appearing a few years back, and it took me a while to connect the dots back to mercury exposure. These rashes can get pretty severe, and sometimes they're just unbearable. It's not just an irritation; it feels like your skin is constantly burning (A 43-year-old miner, male, Dayoukuraa, February, 2023)

Another miner who had worked for more than 20 years as a small-scale miner had this to say about the negative consequences of mercury on their health:

The issue about mercury been detrimental to our health has always been over exaggerated else It's not just me; a lot of the guys talk about similar strange symptoms. The exaggeration is from the issue of mercury causing women to give birth to children without legs, limbs among other deformities. I know it's from the mercury that I always feel dizzy and incessant headaches because it's one of the common things among those of us who handle it directly. Beyond the skin issues, there are guys complaining about other problems like headaches and dizziness. It makes you worry about the long-term effects, you know? We're trying to make a living, but at what cost to our health? (A 51year old miner, male, Duu, February, 2023)

The above narrations point to the results that a greater chunk of artisanal miners used chemicals in their mining activities despite its harmful effects on the environment and even on their own health when these chemicals are deposited on farmlands or discharged into water bodies. This finding corroborates with the finding that mercury contaminates rivers and other water sources that supply drinking water to nearby communities has been suggested (Obiri et al., 2010; Ssenku et al., 2023). In artisanal and small-scale gold mining, hazardous chemicals seep into the ground and water, disrupting local fauna by contaminating their food and water sources (Abdulgafar & Ishola 2014).

Again, the above findings were supported by study of Alhassan et al. (2019) who investigated the environmental fate of mercury and revealed that for every gramme of gold recovered by ASM, two grammes of mercury were lost. Their results showed that 39% of the mercury was released into the air when the amalgam was roasted, whereas 61% was lost in water and ended up on the ground. On the facilities, workers were found to be handling mercury without protective gloves and storing it in eye-drop vials for amalgamation purposes which have negative consequences on their health.

Despite the enactment of Mercury law 1933 banning Ghana gold miners from using this chemical (Hg) in their operations, the practice continued until the Mercury law 1989(PNDL 217) was passed granting permission to certain individuals and companies to transact in mercury (Hilson, 2001; 2002) till its legalization in May 1989 by the Provisional National Defense Council Law 218, (PNDC Law 218).

4.3.7 Daily work duration of mine workers

The results on the number of working hours of artisanal and small-scale gold miners in the study area highlights some critical insights into labor conditions within this sector, particularly when compared to the standard 8-hour workday expected for workers in Ghana.

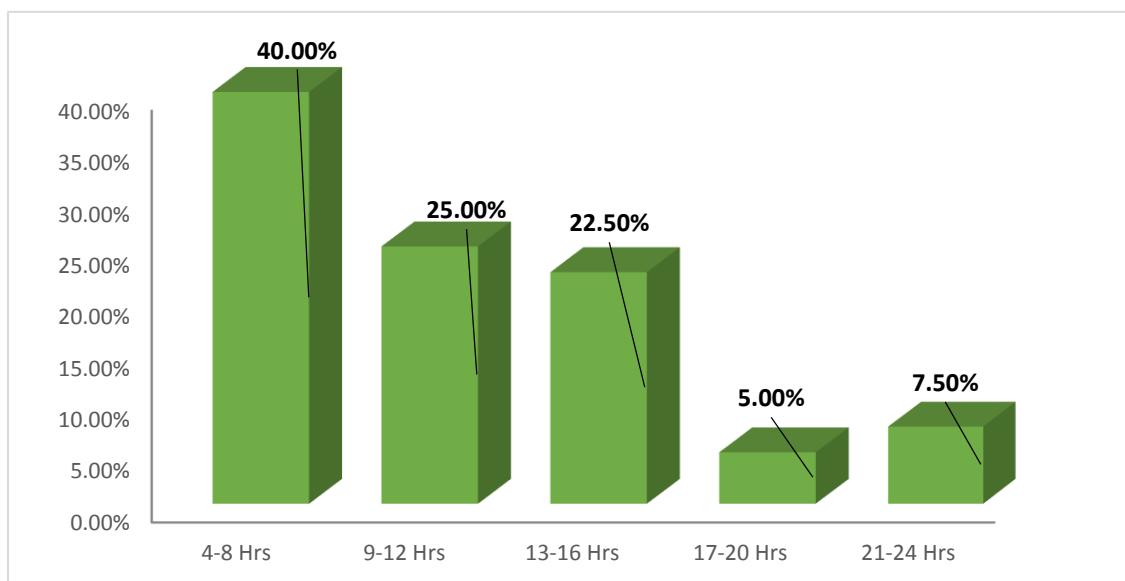


Figure 4.3.7: Daily Work Duration of Mine Workers Source: Field Survey, 2023

The result from figure 4.8 above indicates that only 40% of the miners adhere to or work less than the typical 8-hour workday. The remaining 60% of the miners revealed to be working more than 8 hours a day with others working the whole day including night.

The above analysis shows that majority of the artisanal and small-scale miners' work above the required eight normal working hours. The adverse effects maybe those miners would become too exhaustive as a result of working overtime. This may have an adverse impact on their health in term of accumulative fatigue and consequently weakening them early as miners. When a miner in Manwe was asked a question concerning the number of hours they work he recounted that:

“As miners we don't have the specific number of hours we work. We sometimes work 24 hours at times when we have to go underground of several feet deep. We only break on Wednesdays which is known as 'Breaking Day' evening at 6:00pm every week and share our loads on Thursday. Fridays are off-days for all Galamseyers at Begebe owing to the community being predominantly Muslim and also the belief that the spirit that guards the gold prohibits mining on that day” (KII, Gbegebe mining site, June, 2023)

4.3.8 Category of Gold Buyers in the Study Area

The distribution of buyers for gold mined by ASGM operators in the study area reveals a significant reliance on internal and external networks for selling gold. The results from figure 4.3.8 reveals that miners who sell their gold sponsor-buyers representing were the majority representing 52.5%, while 37.5% of them sell their gold to foreigners. Lastly, 10% of them sell their gold to jewelers who travelled from other parts of the country to the study area.

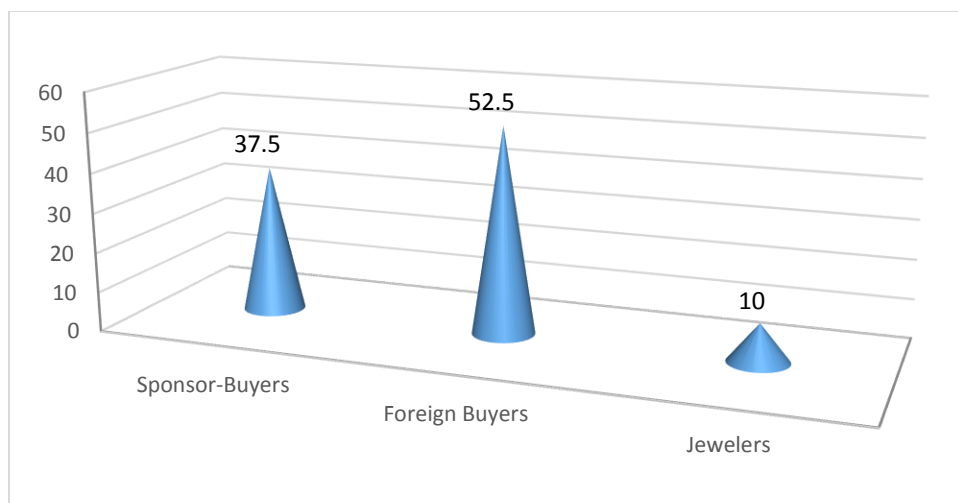


Figure 4.3.8: Category of Gold buyers in the Study Area

Source: Field Survey, 2023

To buttress the above quantitative data a miner revealed that:

“We sell our gold to traders known as "moshies" who come from neighbouring countries like Burkina Faso and Ivory Coast to settle in our community due to the gold trade. Although their prices can be unstable, I prefer selling to them because they offer better rates compared to our local sponsors who also buy gold. Our main challenge is the language barrier, as we don't understand their language. However, we manage to communicate effectively when it comes to gold transactions”. (KII, Manwe, April, 2023)

This dominance of foreign buyers in the marketplace underscores the significant role that international markets play in the gold trade from the Upper West Region. The preference for foreign buyers could be attributed to their willingness to offer competitive prices for gold, reflecting the global demand’s impact on local mining operations. The influx of foreign capital has the potential to positively impact the local mining community but also poses challenges related to economic dependency and the equitable distribution of benefits.

An important aspect to consider in this analysis is that none of the buyer groups were licensed by the Precious Minerals Marketing Corporation (PMMC) act 1989 of P.N.D.C.L 219, the body mandated by law to grant buying and selling rights to individuals and companies. The PMMC is mandated by the same act to buy and sell minerals, grade, assay, and process precious minerals. This lack of licensing raises concerns regarding the legality and regulation of these transactions. It suggests a significant portion of gold trading occurs outside the formal regulatory

frameworks intended to ensure fairness, legality, and safety in the trade of precious minerals. The absence of PMMC licensing could imply potential issues such as underreporting of income, loss of government revenue, exploitation of miners, and a lack of accountability in environmental and ethical standards.

To confirm the above information a gold buyer was interviewed regarding the possession of valid buying license from PMMC, he commented that:

“My friend, I don't even know the name you're mentioning. For me, my license is the money that keeps me in business for a long time. Maybe the people I sell to have a buying license, but I don't” (KII, Manwe, April 2023).

4.3.9 Knowledge of Gold Price

The results of the survey of 40 miners as displayed in table 5.6 reveals that 40% of respondents indicated they are aware of the current market prices of gold, while 60% admitted they do not have knowledge of these prices. This disparity suggests that a significant portion of the miners were operating at a disadvantage in the market due to a lack of information, which can impact their ability to negotiate fair prices or make informed decisions about when to sell.

Table 4.3.9: Knowledge of Gold Price

Response	Frequency	Percentage
Yes	16	40%
No	24	60%
Total	40	100%

Source: Field Survey, 2023

A youth miner opined that:

“The price of gold does not stay at one place. It is possible to sell gold at five different prices during the span of one month. Recently, I sold a single unit of gold for GH ₵420.00. However, the buyer notified me yesterday that the price had decreased to GH₵380.00 owing to fluctuations in their selling market. Due to my inability to sustain myself solely on the gold, I was compelled to sell it at a reduced price, despite my perception of the transaction as unjust. Currently, I am unable to provide you with the precise price of a blade of gold” (KII, 34-year-old Miner, Manwe April 2023).

To support the miner's claim, my conversation through key informant interview with a gold buyer revealed that:

“The price of gold in mining communities is heavily influenced by the exchange rate between the dollar and the cedi. The dollar's fluctuation affects not only gold prices but also various other commodities and services. Explaining to miners why they receive different offers at different times can be quite challenging”. (KII, Manwe, April 2023

It is abundantly convincing that gold prices according to the above field narrative are unstable and unpredictable. This unpredictability makes it difficult for miners to plan financially or to expect consistent earnings from their gold sales. According to miners they feel pressured to accept lower prices because holding onto the gold doesn't provide immediate sustenance or financial relief. As a result, miners often feel at the mercy of buyers, whom they suspect of manipulating prices to their disadvantage.

Buyers, on the other hand, understand the price of gold as being closely linked to broader economic factors, particularly the exchange rate between the dollar and the cedi. According to a foreign buyer, the price they can offer miners is largely dictated by the prevailing dollar rate. This linkage is crucial because the value of gold is globally benchmarked in dollars. Consequently, any fluctuation in the dollar rate directly impacts the local gold prices in cedi terms.

4.3.10 Motivations for ASGM

Numerous researches on ASM have advanced a wide range of motivations for participation. While in many parts of sub-Saharan Africa, these reasons are primarily related to rural livelihood diversification, the narrative surrounding this sector has been dominated by two ideas: one describes ASGM as an activity that is primarily driven by poverty, while the other characterises the sector as being dominated by rogue entrepreneurs looking to get rich quick (Traoré, Hilson & Hilson, 2024). Such narratives, according to Hilson and Garforth (2013), only apply to particular situations and fall short of explaining why farm families have resorted to the non-farm sector in order to make ends meet. Against this backdrop and drawing from the insights of Hilson and Garforth by shedding light on the reasons why rural residents of Ghana's Upper West Region are motivated to participate in ASGM. The results are shown in table 4.7 below:

Table 4.3.10 Motivations for ASGM

Motivational Factor	Responses	Percent (%)	Ranking
Born to a mining family	23	9.2	7 th
Limited Access to Formal Education	25	10	6 th
Livelihood diversification	30	12	4 th
Agricultural Vulnerability to Climate Variability	38	15.2	1 st
Declining Agricultural Productivity	35	14	2 nd
Get rich quick	28	11.2	5 th
Unemployment	33	13.2	3 rd
Challenges in Agricultural Market Access	18	7.2	9 th
Ease entry into ASGM Mining	20	8	8 th
Total	250	100%	

Source: Field Survey, 2023**Note: Multiple****Responses**

The potential for quick and significant financial returns, despite the inherent risks, motivates many to engage in ASGM. Additionally, cultural and social factors play a role, as mining communities often share traditions and collective knowledge that make ASGM a familiar and accessible means of subsistence. Moreover, the allure of gold, with its enduring value and demand, provides a strong incentive for individuals to enter this sector, despite the challenges and uncertainties involved.

Agricultural Vulnerability to Climate Variability

The results from table 4.3.10 reveals that most of the miners entered into mining as a result of agricultural vulnerability to climate variability has the most significant influence, with 95% of the respondents indicating it as a critical issue. The instability caused by climate variability pushes individuals to seek more stable and potentially lucrative alternatives like artisanal and small-scale gold mining (ASGM). The high response rate for this factor indicates that climate change is not just an environmental issue but a socio-economic one, driving communities to diversify their livelihoods to mitigate the adverse effects on their primary source of income. This finding aligns with Persaud et al (2017), who asserted that the mining industry has helped supplement the income of Senegalese farmers who are hit with vagaries of climate change.

Declining Agricultural Productivity

The second highest-ranked factor mentioned by respondents was declining agricultural productivity with an 87.5% response rate, highlights a major concern among the communities. This reveals that traditional agricultural practices have become less viable due to factors such as soil degradation, overuse of resources, and perhaps inadequate agricultural support services. ASGM becomes a viable option due to the immediate financial returns it offers compared to the increasingly unreliable agricultural sector.

Unemployment

Unemployment was ranked third, with 82.5% of respondents identifying it as a key motivator for engaging in ASGM. This high percentage indicates a significant lack of education for formal employment opportunities and the unviability of the agricultural sector due to mining and other natural factors like climate change. To buttress the above narration a youth miner at Manwe opined that:

“My brother, unemployment is the only motivation behind my involvement in ‘Galamsey’. I have a first degree in Computer Science from the university. After my national service I realized life was not easy so I engaged in fraud activities down south until I heard my ancestors have discovered Gold so I decided to come back home from Kumasi to the ‘Gbegebe’ mining site. I came here not more than a year now but i have been able to to put up 3 rooms up to a lintel level and bought a ‘tear-rubber’ Akoba motorbike. I will always praise God for blessing my hometown with gold else I would have still been wallowing in abject poverty.” (KII Miner, Manwe, June 2023)

The above findings resonate the idea of Laari (2018) who found in his study that illicit small-scale mining cannot be abolished until the miners are given alternate means of subsistence based on the claims that unemployment forces people to engage in galamsey. As a result of economic hardship, many rural Sierra Leoneans have turned to illicit gold and diamond mining as a means of subsistence (Carier & Burge, 2011).

Livelihood Diversification

Ranked fourth, livelihood diversification was recognized by 75% of respondents as an important factor. This motivation reflects a strategic response by individuals seeking to mitigate risks associated with depending solely on one income source, particularly agriculture. A miner replied to a probe concerning why he ventured into ASGM by saying that:

“I am a farmer. I just came to the mining site. I was away during the rainy season to farm. We have harvested, so I am here now. I pay school fees with the mining proceeds. I have two children at the Senior high school level. I also need the mining proceeds to support my farming activities. I am a maize farmer and I buy inputs such as fertilizer and also finance plowing with my mining proceeds. Both mining and farming gives me subsistence security. Mining is the more lucrative venture compared to farming” (KII, Polee, June 2023).

Born to a mining family

Budo (Pseudo) a 25-year-old miner in Goripie stated that:

“I started absenting myself from school frequenting the mine at the age of seven because all the members of my immediate family members were miners. I started by keeping them company and watching over few mining items at the site. At age ten my parents started assigning me to crushing of stones, washing (panning), selling of gold to buyers. So any time I needed quick cash, I would offer my labor to other mining gangs (group of ASGM Miners). As I grew older, I noticed that the strong and influential boys were all involved in mining. Even those who weren't miners were considered as lazy and unproductive to their families. So, mining is as essential to me as farming. Now, at 25 years, I've acquired enough skills and knowledge to consistently earn an average of GHS 2,000.00 per month. Can you tell me how many government workers in the country earn such an income? If I were to switch to any other occupation, it would require me to earn roughly the same amount as I do in Galamsey.” (KII, Male, Goripie, August, 2023)

Ease entry into ASGM Mining

The most common motivation that resonates across the area is the ease with which people could become miners. This was evidenced when a youth miner in Polee stated that:

‘All you need is to know somebody who is already a miner to lead you to a mining site. No one is asking you of the school you attended or the certificate you acquire once you have the ability to work physically then you are a miner like that. Sometimes the tools you use are even borrowed from friends then after few weeks when luck comes your way and you earn some money you are able to buy your own tools. Mining is not like a provision shop where you need a lot of capital to venture into it...The only people who need huge capital to start mining is the sponsors’’. (KII, Polee, May 2023)

This finding agrees with the study Olawumi (2011) and Lebitso (2021) who revealed in their study that of Illegal mining activities pose a threat to mining industries and communities worldwide, but another major concern is the ease of access to mines. They stated that the mining industry struggles with the oversight and regulation of easy access to both operational and decommissioned mines.

4.3.11 Chapter Summary

This chapter explores the operational dynamics of Artisanal and Small-Scale Gold Mining (ASGM) in the Upper West Region, focusing on various aspects including land acquisition, training, mining methods, water sources, chemical use, work duration, gold buyers, and motivations for engaging in ASGM. It was found that land for mining is commonly acquired through leasing, family inheritance, and transactions with local chiefs. Training among miners is notably scarce, with most miners lacking formal training and relying on experience or informal methods to learn the trade. Surface mining is the predominant method, particularly the "dig and wash" technique, while water for mining activities is often sourced from tricycle fetchers and boreholes.

Generally, mercury use was widespread among miners despite its health risks. The motivations for engaging in ASGM are varied and include factors such as the vulnerability of agriculture to climate variability, declining agricultural productivity, and unemployment. Additionally, the potential for quick financial gains and the relative ease of entry into the mining sector also attract individuals to this industry. This examination of ASGM operations in the Upper West Region highlights the economic and social complexities driving this informal sector, emphasizing the need for targeted interventions to promote sustainable and ethical mining practices.

CHAPTER FIVE

SOCIO-ECONOMIC IMPLICATIONS OF ARTISANAL AND SMALL-SCALE GOLD MINING

5.0 Introduction

Artisanal and small-scale gold mining (ASGM) is a crucial livelihood activity for millions of people worldwide, particularly in developing countries. It serves as a source of employment and income for local communities but also presents a complex array of socio-economic implications. While ASGM contributes significantly to economic growth, it also introduces profound social and environmental challenges that affect individuals, families, and entire communities. Understanding the distinction between social and economic implications is essential in assessing the broader impact of this mining practice.

The economic implications of ASGM refer to the financial aspects of the industry, including employment, income generation, market dynamics, government revenues, and local business development. ASGM often provides direct employment to thousands of individuals, offering income opportunities in regions where formal job markets are scarce. It also stimulates local economies by increasing trade, creating business opportunities, and contributing to national revenues through taxes and royalties. However, economic challenges such as price volatility, lack of access to formal financial systems, and the informal nature of ASGM often hinder long-term financial sustainability. Additionally, the environmental degradation caused by ASGM can reduce land productivity, leading to economic losses in agriculture and other sectors.

On the other hand, the social implications of ASGM encompass the broader societal effects of mining on communities, including health, education, gender dynamics, and social stability. The industry often exposes miners and surrounding populations to hazardous working conditions, mercury poisoning, and respiratory diseases due to inadequate safety measures. Additionally, child labor, forced labor, and gender inequality are prevalent in some ASGM communities, exacerbating social injustices. Mining-related conflicts, including disputes over land ownership and resource control, can also contribute to social unrest and displacement. Despite these challenges, ASGM can foster social cohesion by providing shared economic opportunities, supporting community networks, and financing local infrastructure such as schools and healthcare facilities.

While ASGM has the potential to drive economic development and improve livelihoods, its negative social consequences often undermine long-term sustainability. A balanced approach that addresses both economic opportunities and social risks is necessary to ensure that ASGM benefits communities without exacerbating poverty, inequality, and environmental degradation. The following sections will explore the socio-economic implications of ASGM in greater detail, examining both the positive contributions and the critical challenges associated with this mining practice.

5.1. Knowledge of socio-economic effects of mining

The results in figure 5.7 presented compares the knowledge of the socio-economic implications of artisanal and small-scale mining (ASGM) between miners and non-miners in the study area. Among the miners surveyed, 72.5% (29 out of 40) responded affirmatively, indicating they were aware of the socio-economic implications, whereas 27.5% (11 out of 40) indicated a lack of such knowledge.

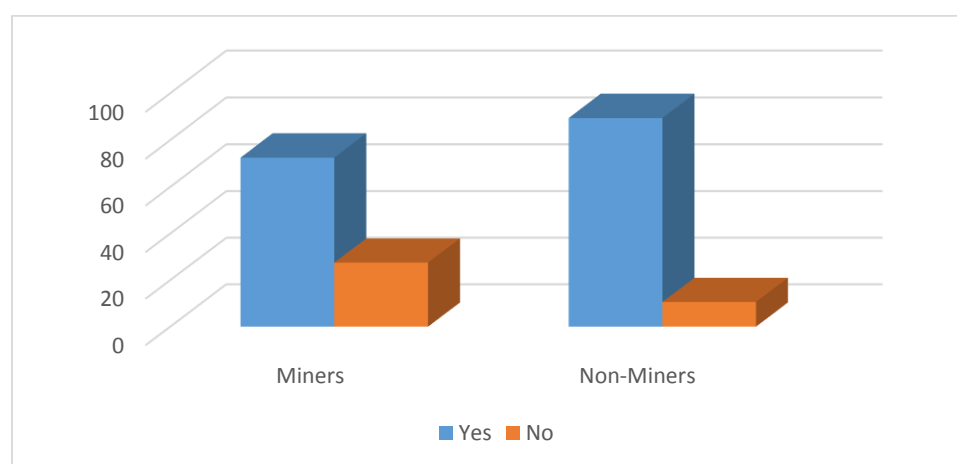


Figure 5.1: Knowledge of socio-economic effects of mining Source: Field Survey, 2023

A further analysis was made by using a bivariate correlation analysis to investigate the associations between the awareness of socio-economic impacts and various demographic factors of the respondents. The findings from this analysis are detailed in correlation matrices, which can be found in Tables 5.1 and 5.2

The Spearman's correlation matrix provided assesses relationships between Age, Educational Background, and knowledge of the Socio-economic effects of Artisanal Small-Scale Gold Mining (ASGM). In the matrix, the correlation between Age and Educational Background was reported as -0.115, indicating statistical significance at the 0.05 level. This weak negative correlation suggests that older individuals tend to have slightly lower educational levels, a result that is statistically significant even though the effect size is small. The significance indicates that the probability of observing such a correlation by chance (if there were no actual association in the population) is less than 5%, supporting a genuine inverse relationship between these variables.

Conversely, the correlation between Age and knowledge of the Socio-economic effects of ASGM, though positive at 0.064, does not meet the threshold for statistical significance, as it lacks any marking for significance. This indicates a very weak positive relationship that is not statistically reliable; the p-value in this case would be 0.05 or higher, suggesting insufficient evidence to conclude that age influences knowledge about the socio-economic impacts of mining.

Similarly, the correlation between Educational Background and knowledge of the Socio-economic effects of ASGM is -0.080, also unmarked and therefore not significant. This very weak negative correlation suggests that higher educational levels do not correlate strongly with greater awareness of the socio-economic impacts, with a p-value again likely at or above the 0.05 level, indicating that this observation could well be due to random variation within the sample.

Overall, only the correlation between Age and Educational Background shows statistical significance, pointing out a slight but consistent pattern where older community members may have slightly lower educational attainments. The other correlations, however, do not provide strong evidence of a relationship with knowledge of the socio-economic impacts of ASGM, suggesting that further investigation with potentially more variables or a larger sample might be needed to uncover more substantial relationships.

Table 5.1: Spearman's Correlation Matrix Examining Relationships between Non-Miners Demographics and Awareness of Mining's Socio-Economic Effects

	Age	Educational Background	Socio-economic effects ASGM
Age	1.000		
Educational Background	-.115*	1.000	
Socio-economic effects of ASGM	.064	-.080	1.000

Correlation is significant at the 0.05 level (2-tailed).

Table 5.2: Spearman's Correlation Matrix Examining Relationships between Miners Demographics and Awareness of Mining's Socio-Economic Effects

	Age	Educational Status	Socio-Economic effects of ASGM
Age	1		
Educational Status	-.146	1	
Socio- economic effects of ASGM	.250	-.224	1

Correlation is significant at the 0.05 level (2-tailed).

This Spearman's correlation matrix examines the relationships among Age, Educational Status, and knowledge of the Socio-Economic effects of Artisanal Small-Scale Gold Mining (ASGM) among miners. The correlation coefficients provided are interpreted based on an assumed significance level of $p < 0.05$, though no explicit markers such as asterisks are given to denote significance.

The matrix reveals a weak negative correlation of -0.146 between Age and Educational Status, suggesting that as miner's age, there is a slight tendency for their educational status to decrease. The statistical significance of this correlation would imply a p-value less than 0.05, indicating a statistically significant finding if marked as significant. Otherwise, a p-value of 0.05 or greater would suggest that the finding might not be reliable for generalization.

In contrast, there is a moderate positive correlation of 0.250 between Age and the Socio-economic effects of ASGM, indicating that older miners might have a better understanding or awareness of the socio-economic effects of ASGM. If this correlation is significant, it would reflect a p-value less than 0.05, supporting a statistically significant association where older age groups

are more knowledgeable of the effects of ASGM. If not significant, then a p-value of 0.05 or greater would mean the observed correlation might be due to chance.

Overall, these correlations suggest potential trends, especially with age showing a positive correlation with knowledge of socio-economic effects, indicating that older miners might possess more experience or exposure to the impacts of ASGM.

5.2 Economic Benefits of ASGM

Beyond the immediate financial benefits obtained from gold mining, 245 community members, constituting 76.5%, noted that Artisanal and Small-Scale Gold Mining (ASGM) activities offer various socio-economic advantages. They highlighted that ASGM helps to curb rural-urban migration, provides employment opportunities, fosters local community development, enhances income generation, and offers alternative livelihoods

The analysis of the community perception regarding the socio-economic benefits derived from Artisanal and Small-scale Gold Mining (ASGM) reveals a significant impact on providing alternative livelihoods, with about 24.08% of non-miners identifying it as a key benefit. This suggests that ASGM serves as a critical alternative to traditional employment, particularly in communities where other lucrative job opportunities may be scarce. The creation of jobs, noted by 18.37% of respondents, complements this view, indicating that ASGM is a substantial employment generator, crucial for sustaining local economies and reducing dependency on single-industry economies.

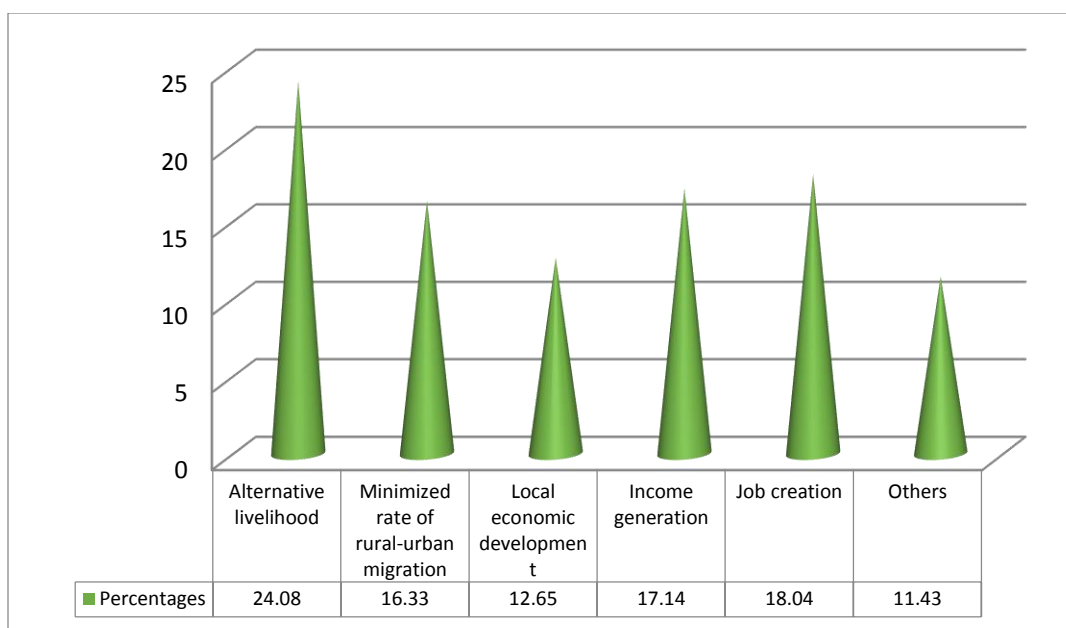


Figure 5.2: Economic benefits of ASGM Source: Field Survey, 2023

Alternative livelihoods as positive socio-economic impact of ASGM

Residents of the study area have noted that despite the negative consequences of ASGM, such as the destruction of some livelihoods, it has also created significant opportunities for alternative livelihoods within mining communities. They further highlighted that these activities have enabled them to diversify their income sources, thereby reducing their reliance on traditional, often unstable sectors like agriculture. A farmer shared his perspective on the positive impact of ASGM on his livelihood, stating:

“ASGM has had a profound impact on our community. For many of us, especially those who struggled with farming due to unpredictable weather and poor soil, mining has become a vital alternative. It offers a source of income that is more reliable than agriculture. I've seen families who couldn't make ends meet through farming alone now able to provide for their needs and even save a little for the future thanks to the earnings from mining”. (FGD, Male, Kende, May, 2023)

The Effects of ASGM on Minimize rate of rural-urban migration

Personal interviews with respondents revealed that before the advent of ASGM, many of their able-bodied youth, both men and women, were constantly migrating to the southern regions in search of better opportunities. In many rural areas, limited employment opportunities and the decline of traditional livelihoods like agriculture have historically driven residents to seek better prospects in urban centres. To support the above claim a youth chief narrated in a focus group discussing that:

“ASGM has had a significant impact on keeping our people here. Before the mining activities, many of our young people were leaving for the cities, searching for work and better opportunities. This was causing a lot of problems, as the elderly were left behind, and our community was slowly diminishing. But since ASGM started, there are more jobs available right here in our village. People no longer feel the need to migrate because they can earn a good living from mining. This has helped us maintain our population and keep our community vibrant”. (FGD, Male, Manwe, June 2023)

The effects of ASGM on Local Economic Development

According to respondents of the study, ASGM has had a profound impact on local economic development in their communities. The influx of income from mining activities has stimulated the growth of local businesses, such as food vendors, equipment and tools suppliers, and creating a diverse array of job opportunities and enhancing overall economic activity. This financial boost has enabled families to invest in education, healthcare, and infrastructure. Respondents noted that the presence of ASGM has thus transformed many communities, promoted economic resilience and reduced poverty. A key informant interview with a community assembly member revealed that:

“The influx of money from mining has led to the growth of local businesses. People have started small enterprises, like food stalls, equipment rentals, and transport services, to cater to the miners. This has created more jobs and business opportunities in the community. It's not just about the mining itself; the whole local economy has been boosted.

This kind of economic activity was hard to imagine before ASGM became prominent here. ’’
(KII, Polee, June 2023)

The Effects of ASGM on Income Generation

Members in the study area have noted that artisanal and small-scale gold mining (ASGM) has greatly increased income creation in their communities. They observed that ASGM has facilitated the improvement of financial stability for numerous individuals and families by offering direct employment possibilities and additional sources of income. Respondents have been able to allocate funds towards vital necessities like education, healthcare, and housing, thanks to the revenue generated from mining activities. When a community member was asked in a focus group discussion about how mining has impacted his income level, he explained that:

‘‘ASGM has had a tremendous impact on our community's income. Before the mining activities started, many families were barely getting by. Now, with the opportunities provided by ASGM, people have steady jobs and can earn a good income. Honestly, the income from mining is much higher than any other venture, especially farming. It used to take months of hard work on the farm to earn what we can now make in a few weeks of mining. This has allowed us to better support our families and improve our standard of living. ’’ (FGD, Eggu, July 2023)

This finding aligns with IGF, (2018; World Bank, 2013) who mentioned that Artisanal and small-scale mining (ASGM) is widely acknowledged as a vital source of income for millions of individuals in around 80 countries globally.

The Effects of ASGM on Creation of Jobs in the study area

Artisanal and small-scale gold mining (ASGM) has been a significant catalyst for job creation for many in the study area, providing employment opportunities where few alternatives exist. As asserted by respondents the study area has limited industrial development and high unemployment rates, hence ASGM offers an accessible means of livelihood. This sector absorbs a substantial portion of the labour force, including those who may not have the education or skills required for more formal employment.

Moreover, some respondents through personal interviews alluded that the ripple effect of ASGM extends beyond their communities in terms of job creation. To substantiate this, they highlighted that high demand for certain goods and services to support mining operations has led to the establishment of numerous auxiliary businesses. These include food vendors, equipment suppliers, repair services, mining tools and water vending and transportation providers. To buttress the above assertion a food vendor through focus group discussing disclosed that:

“ASGM has actually been quite beneficial for my business. Before the mining activities increased, I was running a small food stall that barely made enough to get by. But as more miners started coming into the area, the demand for meals skyrocketed. I expanded my stall into a small canteen, and now I’m serving dozens of customers every day. I’ve been able to hire a few people from the community to help with cooking and serving, which means more jobs for locals. The money flowing from ASGM has really boosted the local economy, and many of us business owners are seeing the benefits. It’s allowed me to support my family better and reinvest in my business to keep growing”. (FGD, Female, Goripie, April, 2023)

Loayza and Rigolini (2016) argue that the mineral and oil extraction business has not only resulted in increased employment, population growth, and per capita income, but has also enhanced infrastructure quality.

5.3 Insecurity Concerns Identified by both Miners and Non-Miners

The data collected from field provides a clear picture of the perceived insecurity issues among both miners and non-miners in mining area of the Upper West Region. With 31 miners and 279 non-miners acknowledging negative impacts due to mining activities, the survey highlights the substantial concerns regarding community and personal security.

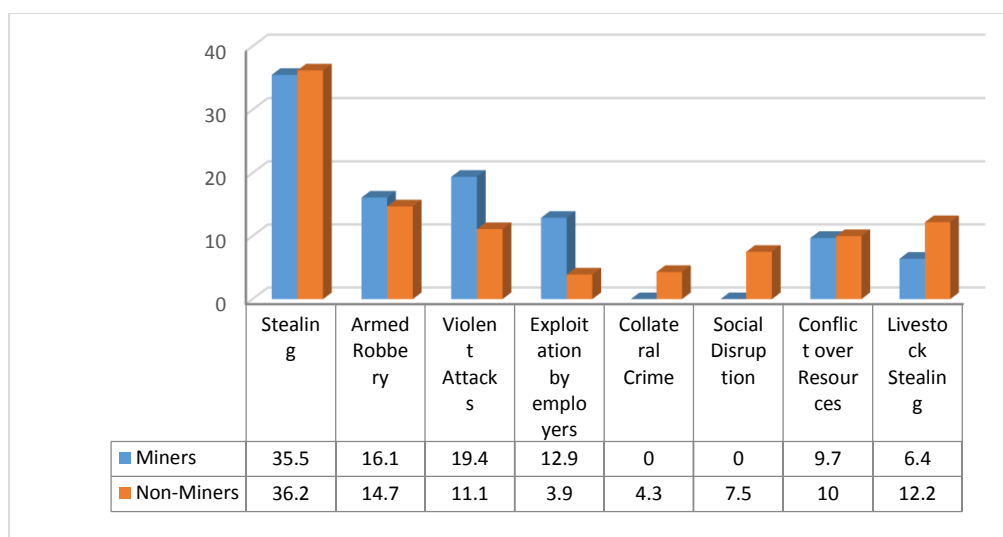


Figure 5.3: Insecurity Concerns Identified by both Miners and Non-Miners
Source: Field Survey, 2023

The results from figure 5.3 reveal that approximately 35.5% of miners and 36.2% of non-miners, suggesting that theft is a pervasive issue across mining communities. Armed robbery was also identified as a pronounced, reported by 16.1% of miners and 14.7% of non-miners, indicating the violent risks associated with mining, as criminals may target miners for cash or valuable ore.

Violent attacks are more frequently reported by miners (19.4%) compared to non-miners (11.1%). Exploitation by employers is another significant issue but more so for miners (12.9%) than non-miners (3.9%), highlighting poor working conditions and potentially abusive labor practices within the mining sector.

Interestingly, collateral crime does not concern miners but affects 4.3% of non-miners, suggesting increased criminal activity in surrounding areas that impacts the broader community. Non-miners also experience more social disruption (7.5%), likely due to the influx of miners and associated transient populations, which can disrupt social norms and community structures. Besides pockets of conflicts over resources was similarly concerning for both groups, with nearly 10% of each group noting it as an issue, reflecting competition for essential local resources like water and land that are strained by mining operations.

ASGM and Armed Robbery

The study sought to probe further concerning the implications of ASGM on armed robbery in the study area and had a community elder who opined that:

‘‘We have encountered two instances of robbery. In one case, a miner was shot in the left leg by armed robbers and left in a pool of blood. The issue of armed robbery emerged as a consequence of mining activities. Additionally, motorcycles, motorized tricycles, and John Mahama Camboos are frequently stolen. Shops and storage facilities are being broken into by robbers. This surge in criminal activities is attributed to the influx of strangers into the community due to mining, coupled with the handling of physical cash without banking it’’. (KII, Eggu, April, 2023)

Additionally, localized instances of hostility can be linked to the procurement and administration of land, resources, and gold (Crawford & Botchwey, 2016). The main forms of conflict typically occur between LSM (Large-Scale Mining) and ASM (Artisanal and Small-Scale Mining). These disputes usually arise from lengthy periods of tension and mistrust, as well as unmet obligations that can be ascribed to inefficient communication and the transfer of corporate social responsibility from one generation to another (Saenz, 2024).

In Ghana, the occurrence of artisanal and small-scale mining (ASM) operations, which are sometimes short-term, has led to disputes over land among artisanal miners, mining corporations, local populations, and the government. This phenomenon arises when informal miners trespass onto the territories of established mining corporations or the territories of indigenous populations without getting prior consent (Nyame and Grant, 2014).

5.4 Perception on the Negative Consequences of ASGM on Socio-Cultural Practices

Despite the economic benefits of ASGM, the impact on socio-cultural norms among both miners and non-miners has raised considerable concerns, particularly as these changes threaten long-standing community values and behaviors. The result depicting the above scenario is shown in table 5.4 below:

Table 5.4: Negative Consequences of ASGM on Socio-Cultural Practices

Response	Miners		Non-Miners	
	Frequency	Percentage	Frequency	Percentage
Yes	27	67.5%	231	72.2%
No	12	32.5%	89	27.8%
Total	40	100	320	100

Source: Field Survey, 2023

The results shows that majority of miners 27 (67.5%) responded ‘‘Yes’’, indicating they believe that mining has had negative impacts on socio-cultural practices whiles the remaining 12 (32.5%) responded in the opposite. In contrast, the non-miners' group, which was significantly larger with 320 respondents, had 231 (72.2%) responding ‘‘Yes’’ and 89 (27.8%) responding ‘‘No’’. This shows a majority in both groups perceives negative consequences due to mining, but non-miners perceive these impacts slightly more strongly than miners.

5.5 Forms of Negative Consequences of ASGM on Socio-Cultural Practices

The results as depicted in figure 5.5 unearthed that both miners and non-miners considers substance abuse as of the lead negative effect of ASGM and was represented by 55.5% and 64.5% respectively. Again, a significant portion of both miners and non-miners reported that teenage pregnancy is one of the negative of the socio-cultural practices that affects mining communities with a higher percentage among miners at 33.33% compared to 25.11% among non-miners. This result is as show below in figure 5.5 below:

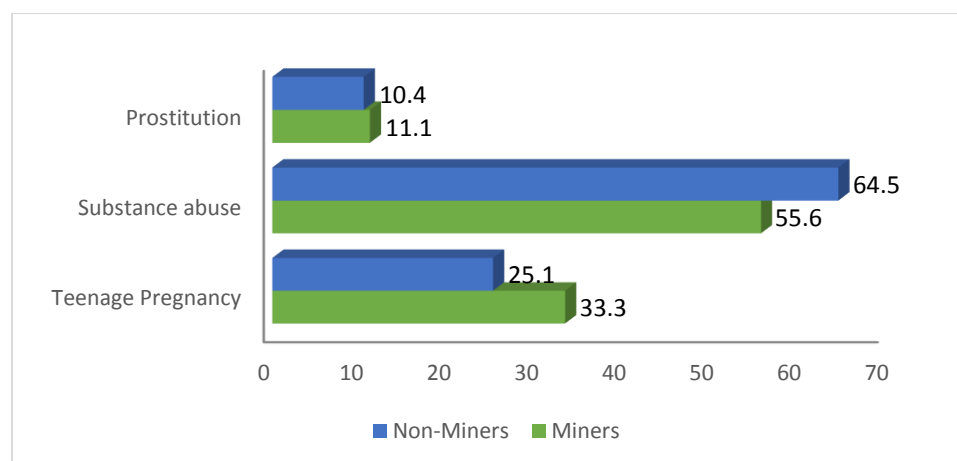


Figure 5.5: Forms of Negative Consequences of ASGM on Socio-Cultural Practices
Source: Field Survey, 2023

Effects of ASGM on Prostitution and Family Dynamics

Artisanal and small-scale gold mining (ASGM) has significantly impacted social dynamics within mining communities, particularly in terms of prostitution and family stability. The influx of miners, the availability of cash, and the challenging working conditions have created an environment ripe for the exploitation and erosion of traditional social values. The mining

environment, characterized by transient workers and substantial cash flow, has led to an increase in prostitution. Women, including those who are married, are often lured into providing sexual favors in exchange for money. The financial allure of the mines can be particularly enticing for women facing economic hardships. A lead miner shared his perspective during a field interview, illustrating this troubling dynamic:

"Being here at the mines, I've seen how money changes everything. Even married women sometimes find it hard to resist when they're offered cash for sexual favors. It's not just about the money; it's about survival. I've witnessed young girls, barely out of their teens, being approached by miners with pockets full of cash. They see the money and think about what it can do for their families. It's heartbreaking but it's the reality we live in." (KII, Danyuokuraa, June 2023).

Again, young girls at mining sites were found to be particularly vulnerable to sexual advances from miners. The money circulating in the mines acts as a powerful lure, drawing them into risky situations. The miners, often transient and with few ties to the local community, take advantage of the financial disparity. The same lead community elder elaborated on this issue:

"Every day, I see young girls around here, and it's clear they're targets for the miners. These girls see the money and think it's an easy way to get out of poverty. Some miners, knowing this, exploit the situation. They offer gifts, money, anything to win the girls over. It's a dangerous cycle because once these girls get a taste of the money; it's hard to turn back." (KII, Duu, June 2023)

This testimony underscores the harsh reality faced by women in mining communities. The promise of quick financial gain can overshadow moral and social norms, leading many into situations they would otherwise avoid.

Besides, prolonged stay of married men at mining sites has also led to a rise in family instability and divorce. The separation from their families, coupled with the presence of women at the mining sites, creates an environment ripe for infidelity. Many men find themselves drawn into relationships with women at the mines, leading to the breakdown of their marriages back home. This issue was highlighted by a miner in Polee:

"I've seen many of my colleagues leave their wives and kids behind, only to start something new here. The women at the mines can be very persuasive, and with the money we make, it's easy to get caught up. Some men just stop going home altogether, and eventually, they divorce their wives. It's sad because it destroys families that were once strong and happy."
(KII, Polee May 2023)

The disintegration of these families not only affects the immediate parties involved but also has broader social repercussions. Children from these broken homes often suffer the most, losing the stability and support of a unified family structure.

Prostitution, often seen as a direct consequence of the influx of workers and the resultant economic disparities, has been reported to increase significantly in mining areas. This practice not only challenges the moral and social fabric of the communities but may also contribute to the spread of sexually transmitted infections (STIs) and other health complications.

Ghana is presently grappling with notable social issues, specifically substance dependency and commercial sex work. Health professionals have determined through consultations that artisanal gold mining communities, sometimes referred to as 'galamsey', pose a significant risk for HIV/AIDS transmission (Bansah et al., 2018). Prostitution is observed in the Eastern parts of the Democratic Republic of Congo, namely in the proximity to artisanal mining operations. This phenomenon predominantly encompasses adolescent females, including a subset who has assumed the role of motherhood. It is associated with poverty and is thus seen as a method of economic sustenance (Kelly et al., 2014).

In addition, galamsey worsens social issues in the mining areas (Adu-Gyamfi, Brenya, & Abakah, 2016). The arrival of people from diverse backgrounds with different values in mining towns frequently leads to the growth of social vices, such as prostitution and child labor.

The effects of ASGM on Substance abuse area

Substance abuse emerges as the most prevalent issue, affecting a greater percentage of non-miners (64.50%) than miners (55.56%). This indicates that the social and economic stresses associated with mining activities extend beyond those directly engaged in mining, impacting the wider community. This high prevalence highlights the need for effective community support and intervention programs to address substance abuse. A community member lamented that:

‘Drug use in the community has become as common as drinking water in public. Young miners frequently turn to drugs to boost their energy or alleviate pain. This is a troubling issue because the youth are imitating their behavior, often being asked to purchase drugs from peddlers for the miners. Tramadol, in particular, has become as prevalent as paracetamol in the community’. (KII, Manwe, May 2023)

To further validate the assertion of drug use in the mining community, a miner shared his experience with drug use in mining activities and his views on its potential impact on the social fabric, particularly concerning the youngsters who live in the community with them. He says:

‘I used drugs as a source of energy because working in the mines is incredibly tough and exhausting. The hours spent in the mines are long, and the physical labor is intense pushing us to resort to drugs to cope with the demands. Personally, I started using tramadol and sometimes weed to keep going. Tramadol helps with the pain and keeps me awake and focused, especially during those times that I have to go ‘down’ (a mining shaft/pit). Drug use is almost like eating any normal food here. Plus, drugs are easy to get from peddlers around the mines. The sad thing is that younger guys see us using drugs and think it is normal. It is not as it has side effects of making you feel weak and dizzy without consuming it. Even Some guys get really addicted and it messes up their lives’ (KII, Kende, June 2023).

The above study finding corroborates that of Agbesinyale (2023) who states that the existence of a galamsey activity in the Tarkwa region has resulted in a rise in the indigenous population. This is due to a significant influx of residents relocating to the mining villages within the area in search of employment opportunities. Consequently, the expanding population leads to conflicting norms and customs, thereby contributing to the development of social vices like drug abuse and prostitution, resulting in an upsurge in sexually transmitted illnesses.

The effects of ASGM on teenage pregnancy in the study area

To buttress the above finding, a key informant interview with an elder revealed that:

Teenage pregnancy is now something we are battling with as a result of the influx of ‘galalmsey’ (ASGM) boys from other towns and villages. Almost all our girls of school

going ages are now becoming mothers with some already pregnant. ‘Nbidau, wala kabie meng na Dogi Bie? Ajaa Salema Bihi’ ...Respondents in Waale language (To wit my son, how can a child give birth to a child? This is all because of ‘galamsey’ boys. This problem has become an albatross on our neck for some time now. The most painful thing is that most these men who impregnate these girls normally refuse to accept responsibility but rather run away from our community to a different community to continue his ‘galamsey’ activities. Just go around the community you will see a lot of teenagers’ girls either backing or breastfeeding their babies when they were supposed to be in school’’. (KII, Goripie, Male, May 2023).

5.6 Types of Drugs Used at ASGM Sites

The table 5.6 presented reflects the results of a survey conducted with 40 miners who were allowed to choose multiple options regarding the types and combinations of substances they use. The total number of responses (229) compared to the number of respondents indicates a high response rate, suggesting that miners are selecting multiple substances. This indicates a complex pattern of substance use among the group, possibly highlighting the prevalence of polydrug use.

Table 5.6: Type of substances abused by miners in the study area

Substance	Responses	Percentages	Percentage per case	Rank
Alcohol	15	5.02%	37.5%	8 th
Gebedol	22	7.36%	55%	7 th
Cigarette	31	10.37%	77.5%	4 th
Tramadol	35	11.71%	87.5%	2 nd
Tramadol mixed with Energy drink	30	10.03%	75%	5 th
Energy drinks	32	10.7%	80%	3 rd
Marijuana (Weed)	37	12.37%	92.5%	1 st
Marijuana (Weed) mixed with tea	27	9.03%	67.5%	6 th
Total	299	100%	572.5%	

Source: Field Survey, 2023

Note: Multiple Responses

The field results as shown in 5.6 indicates that marijuana was the most commonly used substance, with 37 response and accounting for 92.5% of responses, making it the first ranked drug and the most popular or accessible substance among the miners. With 35 responses, tramadol was ranked second representing 87.5% responses per case the.

Besides, energy drinks were also highly used, with 32 responses and roughly representing 80% of the responses per case and hence was ranked third most used substance. Cigarettes were ranked fourth drug use by miners to abuse themselves with 31 mentions representing 77.5% of responses per case. The combination of Tramadol with energy drinks, having 30 responses and 13.1% of the total, points to a concerning trend of substance mixing to enhance effects, potentially increasing health risks. Marijuana mixed with tea, noted 27 times and making up 11.8% of responses, indicates a community-specific method of consumption, possibly to moderate effects or enhances the experience.

Finally, alcohol, despite being a common substance, was ranked eight as the least used substance abuse with only 15 responses representing 37.5% of the total, suggesting a preference for other substances over alcohol among the miners.

The reasons why miners resort to drugs was indicated as pain relief, energy boost, the scare of fear to venture into dangerous places in search of gold. A miner who was interviewed with regards to the reasons behind the consumption of drugs revealed that:

‘My brother, it is the drugs that make us ‘high’ so that we get extra energy to work at the mines. The drugs have become like the tools we use in working so anyway we cannot come to the mining site without supporting ourselves with drugs in order to work normally. As you can see am holding my two rolls of ‘wee’ and my 5-Star drink which can sustain me underground from morning till evening. The drugs serve as food until we late in the night when we have to now find some solid food to eat’. (KII, Manwe, May 2023)

Overall, the results demonstrate a diverse range of substance use among miners, with significant overlap in types used. The preference for both stimulants (like tramadol and energy drinks) and depressants (like alcohol and marijuana) suggests that miners might be using these substances to cope with the physical and mental demands of their work.

5.7 The State of Sanitation in the Mining Communities

The survey results as shown in table 5.7 highlights different perceptions of sanitation conditions within mining the study area as expressed by miners and non-miners. Notably, a greater proportion of both groups rates the sanitation as "poor," with 42.5% of miners and 52.81% of non-miners holding this view.

Miners, being closer to the operational sites, might experience direct consequences of inadequate sanitation practices more acutely. Their higher "Very Poor" rating (20.0%) compared to non-miners (8.44%) might reflect closer proximity to the mines, which are often burdened with environmental pollutants and lesser sanitation infrastructure.

Table 5.7a: The State of Sanitation in the Mining Communities

Sanitation Situation	Miners		Non-Miners	
	F	%	F	%
Good	10	25.0%	78	24.38%
Very Good	5	12.5%	46	14.38%
Poor	17	42.5%	169	52.81%
Very Poor	8	20.0%	27	8.44%
Total	40	100%	320	100%

Source: Field, survey, 2023

Table 5.7b: Crosstabulation between age group of respondents and Sanitation Condition in Mining Communities

		Sanitation Condition				Total
		Very Good	Good	Bad	Very Bad	
Age Group	18-24	0	8	16	30	54
	25-31	11	6	36	32	85
	32 – 38	25	11	32	5	73
	39 – 45	26	6	28	5	65
	46 – 52	6	5	32	0	43
Total		68	36	144	72	320

Note: Pearson Chi-Square=105.155, df=12, p=.000

Source: Field Survey, 2023

The data in table 5.8 the youngest age group (18-24 years) perceives sanitation as the worst compared to other groups. Within this age range, 30 individuals (over half of the group) rated sanitation as Very Bad, while 16 rated it as Bad, meaning that 46 out of 54 individuals (85%) in this age group view sanitation negatively. Notably, none of the respondents in this age group rated sanitation as Very Good. This suggests that younger individuals are either more exposed to poor sanitation conditions or more critical in their assessment of sanitation standards.

The 46-52 age group presents another interesting trend, as none of the respondents in this group rated sanitation as Very Bad. However, 32 out of 43 respondents still rated sanitation as Bad, suggesting that while individuals in this group acknowledge poor sanitation conditions, they do not perceive them as severely as younger groups do. This could indicate differences in expectations regarding sanitation across age groups, with older individuals possibly having a higher tolerance for substandard conditions.

The perceptions of sanitation may be influenced by generational differences in expectations and standards. Younger individuals, particularly those in the 18-24 and 25-31 age groups, might have higher expectations regarding sanitation due to greater exposure to modern sanitation facilities, health awareness campaigns, or education on hygiene standards. As a result, they may be more critical of substandard sanitation conditions, leading to a higher number of negative ratings in these groups.

Suffice it to say, younger individuals tend to perceive sanitation conditions more negatively, while older individuals are more likely to rate sanitation as good or very good. The high number of negative ratings across all age groups, however, suggests a widespread concern about sanitation, indicating an urgent need for improvements in hygiene and sanitation infrastructure. Understanding these age-based perceptions is crucial for designing targeted interventions that address the concerns of those most affected by poor sanitation conditions.

5.8 ASGM as a cause of Poor Sanitation

The data presented in figure 5.8a shows the percentages of miners and non-miners who attribute the poor sanitation situation in mining areas to the activities of small-scale gold mining. 72.5% of miners and a higher percentage of non-miners, at 82.18%, agree that small-scale gold mining activities contribute to poor sanitation. This significant majority in both groups indicates a

prevalent belief that mining activities are a central cause of sanitation issues, reinforcing the need for targeted environmental and health interventions within the study communities.

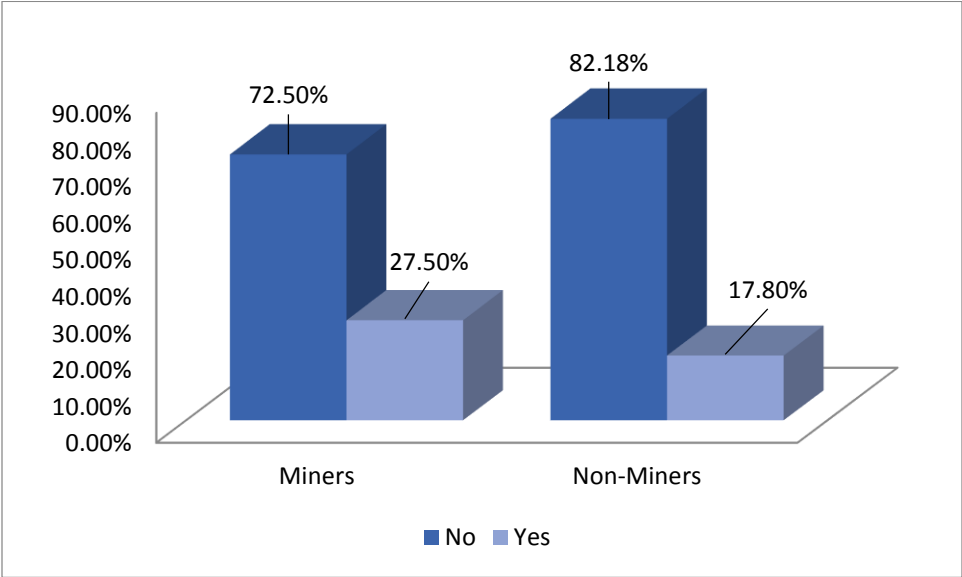


Figure 5.8a: Poor Sanitation Caused by ASGM Activities **Source: Field Survey, 2023**

The higher agreement among non-miners compared to miners suggests that those not directly involved in mining operations might either experience the negative impacts more broadly or be more critical of the environmental degradation caused by these activities.

Conversely, the fact that 27.5% of miners and 17.8% of non-miners do not believe that their industry's activities are the cause of poor sanitation could indicate a variety of perspectives, including a defensive stance by miners who feel their livelihoods are threatened by negative perceptions, or a genuine belief that other factors, such as inadequate government infrastructure and services or natural conditions, are more to blame.

Table 5.8b: Crosstabulation of Educational Background and Sanitation Problems Caused by ASGM (Galamsey)

		Sanitation Problem Caused by Galamsey Activities		Total
		Yes	No	
Educational Background	No Formal Education	59	78	137
	J.H.S/Middle School	68	35	103
	SHS/VOC/TEC	45	12	57
	Tertiary	23	0	23
	Total	195	125	320

Note: Pearson Chi-Square=19.809, df=3, p=.000

Source: Field Survey, 2023

The results from table 5.8b reveal that individuals with no formal education are the only group where more respondents believe ASGM does not cause sanitation problems (78) than those who do (59). This trend suggests a disconnect between environmental degradation caused by galamsey and the perception of sanitation problems among less-educated individuals. It is possible that many of these respondents reside in mining-dependent communities, where their livelihoods are closely tied to ASGM activities, making them less inclined to acknowledge its negative effects. Additionally, limited formal education may restrict access to environmental awareness campaigns, resulting in a lack of understanding of the long-term consequences of illegal mining on water pollution, waste management, and public health.

In contrast, the senior high school group displays the highest agreement with the statement that ASGM causes sanitation problems, with 45 respondents supporting this view compared to only 12 who disagree. This finding indicates that as education levels increase, so does the recognition of the link between illegal mining and poor sanitation. Individuals in this group may have been exposed to more structured environmental education or have access to information that highlights how mining waste, mercury contamination, and soil erosion contribute to sanitation challenges.

An even more pronounced trend appears among tertiary-educated respondents, where all 23 individuals unanimously agree that ASGM contributes to sanitation problems. This is the only

educational category with no disagreement, strongly suggesting that higher education enhances environmental literacy.

The linkage between education level and the perception of ASGM as a cause of sanitation problems is evident in the data. Higher education correlates with a greater awareness of environmental issues, while lower education levels are associated with a reduced acknowledgment of the negative effects of galamsey on sanitation. Those with no formal education may have limited access to scientific explanations of the environmental consequences of mining or may prioritize economic survival over concerns about sanitation. On the other hand, individuals with tertiary education are likely exposed to research, policy discussions, and media reports that reinforce the connection between ASGM and sanitation challenges.

How the Activities of ASGM Is Causing Poor Sanitation

A majority of miners (31 out of 40, or 77.5%) acknowledged that their activities inevitably generate various types of waste, which significantly impacts the local environment. The miners noted that solid waste often includes empty sacks (commonly known as Loko Sacks), polythene bags, plastics, and mining tailings.

In the study area, residents have articulated how the disregard for environmental protocols in mining areas precipitates significant environmental pollution. The local populace attributes this degradation largely to the rise of artisanal and small-scale gold mining (ASGM) activities. To substantiate the above assertion, a community member of Manwe remarked in focus group discussing that:

"As a long-time resident of Manwe, I've seen firsthand the devastating impact of mining on our local environment and community health," the 45-year-old community member lamented. "Everywhere you look, the landscape is littered with plastics, waste sacks like those common Loko sacks, and discarded polythene bags. But it's not just the visible trash that's troubling; the mining tailings, rich with heavy metals and chemicals, are always left littered on our surroundings. If it's true about what we hear every day on the television concerning mining waste then we are not safe my son. Oh yes, myself among others contribute to this menace. We have no convenient place to dump our waste so we litter everywhere we see. This relentless pollution is more than an eyesore. Our children are

inheriting a toxic environment, and their future is at stake. It feels as though our entire community is being sacrificed for the sake of profit, and it's heartbreaking to witness'' (FGD, Male, Manwe, April, 2023)

To add the above a male miner from Polee, for example, tries to draw a link between ASGM activities and poor sanitation in the mining community. He says:

"Working as a miner in Polee, you see firsthand the impact of poor sanitation on our community. With no proper toilets around the mining areas, a lot of folks resort to open defecation. It's not just undignified; it's unhealthy. Diseases spread faster, and with kids and families around, it's a serious risk. Every time the rains come, it just washes everything into our water sources, making them unsafe. We really need better facilities here to keep our environment clean and prevent these health hazards." (FGD, Male, Eggu, April, 2023)

Artisanal and Small-Scale Mining (ASM) is a prevalent and perilous practice that presents substantial difficulties in maintaining cleanliness and hygiene. These enterprises often suffer from a lack of official infrastructure and control. The unstable living and working conditions in ASM communities give rise to a range of health and environmental problems, as emphasised by Basu et al (2015).

5.9 ASGM as the cause of some diseases in the study area

The results as displayed in figure 5.7 shows the responses from non-miners and miners regarding the perception of the effects of artisanal and small-scale gold mining (ASGM) on diseases in the study community. The data indicates that a higher percentage of non-miners (73.1%) believe that ASGM contributes to the spread of diseases compared to miners (52.5%). Conversely, a larger proportion of miners (47.5%) do not perceive ASGM as a significant factor in disease spread, compared to 26.9% of non-miners.

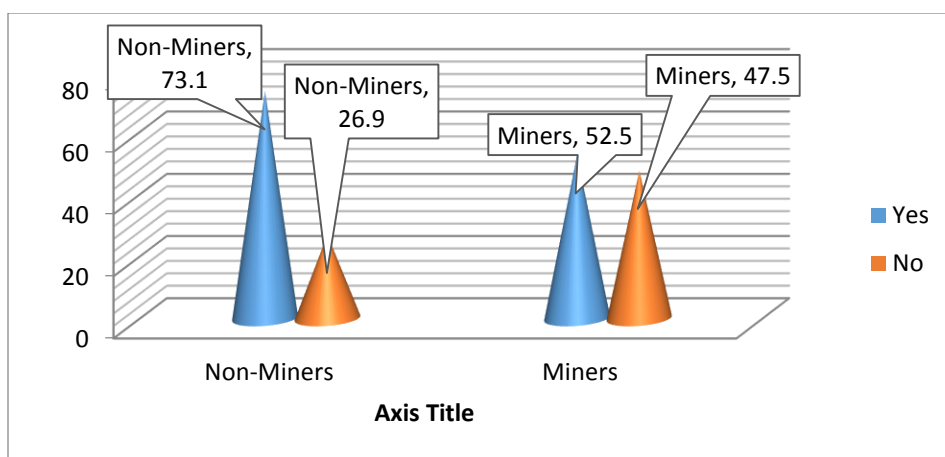


Figure 5.9a: ASGM as the cause of some diseases in the community
Source: Field Survey, 2023

Respondents who alluded that ASGM activities was the cause of some diseases in the study area cited direct impacts such as poor air and water quality, physical injuries, and exposure to harmful chemicals primarily mercury as the cause of diseases like respiratory infections, skin conditions, and other health problems. This perspective underscores a public awareness and concern about the environmental and health safety standards in mining areas, suggesting a call for stricter regulations and better enforcement of existing laws to mitigate these effects.

The lack of proper sanitation and hygiene practices in ASGM communities can lead to the issue of contaminated drinking water, posing a risk to public health. The presence of toxic substances, such as mercury, lead, cyanide, arsenic, cadmium, and cobalt, in the water sources used by miners and neighboring residents, poses significant health hazards. Exposure to these substances can result in waterborne infections, as demonstrated by the research undertaken by Lynas (2018).

Table 5.9b Crosstabulation of Educational Background and ASGM as Cause of Diseases

		ASM as Cause of Diseases		Total
		Yes	No	
Educational Background	No Formal Education	69	68	137
	JHS/Middle School	95	18	103
	SHS/VOC/TEC	49	8	57
	Tertiary	23	0	23
Total		236	94	320

Note: Pearson Chi-Square=.479, df=3, p=.923

Source: Field Survey, 2023

The data presents a cross-tabulation of perceptions regarding artisanal and small-scale gold mining (ASM) as a cause of diseases, categorized by educational background. Out of 320 respondents, a significant majority (236 individuals) believe that ASGM contributes to disease occurrence, while 94 individuals do not share this view. The distribution of responses across educational levels reveals key trends in awareness and perception of health risks associated with ASM.

A particularly striking observation is found among individuals with no formal education, where responses are almost evenly split. 69 respondents acknowledge ASGM as a cause of diseases, while 68 do not, making this the only educational group where opinions are nearly balanced. This suggests that those with little or no formal education may have limited awareness of the health risks associated with ASM. The lack of consensus in this group might be due to a combination of factors, including limited access to health information, dependence on ASM for livelihood, or misinformation about disease causes. Individuals in this group may not recognize the long-term health effects of ASM-related pollution, such as mercury poisoning, respiratory issues, and waterborne diseases, due to low environmental literacy and reliance on informal knowledge sources.

In contrast, the SHS/Vocational/Technical group further reinforces this trend, with 49 respondents acknowledging ASM as a disease-causing factor and only 8 disagreeing. The high level of awareness in this category suggests that higher secondary education, particularly in vocational and technical fields, equips individuals with a more informed perspective on occupational and environmental health hazards.

A particularly noteworthy trend emerges in the tertiary education category, where all 23 respondents unanimously agree that ASM contributes to disease occurrence. This is the only group with zero disagreement, highlighting that higher education significantly enhances awareness and understanding of the health impacts of ASM. Individuals in this category are more likely to have access to scientific research, health reports, and media coverage on the effects of ASM, leading them to strongly associate illegal mining activities with disease outbreaks.

The link between educational background and perceptions of ASM as a health risk is evident in the data. Those with higher education levels are far more likely to acknowledge ASM

as a cause of diseases, while those with lower or no formal education remain divided on the issue. This suggests that public health awareness and environmental education are essential in bridging the knowledge gap, especially for those with limited formal schooling. The findings indicate that lack of awareness, dependence on ASM for livelihood, or misinformation could be contributing to the reluctance of some individuals especially in the no-formal-education group—to associate ASM with disease occurrence.

5.10 Dominant Diseases caused by ASGM in the Study Area

Table 5.10: Dominant Diseases caused by ASGM in the Study Area

Disease	Frequency	Percentages
Malaria	210	65.62
Cholera	17	5.31
Skin disease	23	7.19
Asthma	14	4.38
Acute Respiratory Infection (RTI)	20	6.25
Tuberculosis	15	4.69
Musculoskeletal Disorders	12	3.75
Others (Specify)	9	2.81
Total	320	100%

Source: Field Survey, 2023

The results displayed in table 5.10 above indicate that Malaria is the most dominant health issue among the miners, with an overwhelming 65.62% of the cases. Skin diseases, which account for 7.19% of the cases, and Acute Respiratory Infections (RTI) at 6.25%, highlight occupational hazards related to mining. Cholera and Tuberculosis, although less prevalent with 5.31% and 4.69% respectively, still signify serious public health concerns. Again, (3.75%) of the respondents indicated that musculoskeletal disorders while other less common ailments were represented was represented by 2.81%.

The research also uncovered that some of the youth in the mining-affected communities attribute the high prevalence of malaria not solely to the environmental degradation caused by mining activities but also to the indiscriminate disposal of wastewater from domestic chores. To buttress the above assertion a male youth of Eggu commented that:

"In our community, it's not just the mining that's causing malaria; it's how we handle our household waste water. You see, when people wash dishes, bathe, or do laundry, that water just sits around because we don't really have anywhere proper to dispose of it. It ends up

creating stagnant pools right where we live. The example is not far from the compound that I live. Almost all the waste water generated from my family are not disposed well but rather poured indiscriminately with notion that it will dry very soon. These pools become perfect breeding grounds for mosquitoes. It's these everyday activities, without proper drainage, that are contributing to our malaria problem as much as any mining". (KII, 25 years old youth, Male, Eggu, March, 2023)

Prevalence of Diseases as a Result of ASGM

Besides, the study delved deeper into the investigation to gather firsthand information about the association between poor sanitation related to mining activities and the prevalence of acute respiratory infections through in-depth interview. A retired miner, with years of experience in the field, provided insightful observations on the matter. His viewpoint was expressed, stating that:

"Mining hasn't just damaged our sanitation; it's hitting our health hard, too. Just last month, one of our guys, Mike (Pseudonym), came down with a severe case of pneumonia, an acute respiratory infection that can be devastating. We think it's from all the dust from the mines and the generally bad air quality here, but it's also because we don't have proper sanitation facilities. It's a tough way to live; knowing that just breathing the air or stepping outside could make you seriously ill. We're all constantly worried about our health. It's not just pneumonia; respiratory infections of all kinds are more common here because of these conditions. It really shows how interconnected our sanitation and health issues are." (KII, Retired Male Miner, 64 years, Manwe, March 2023)

A miner substantiated the claim his senior who has retired from the ASGM activities and hence noted that:

"Yes, I have to admit that our mining activities are contributing to some health problems. For instance, there's been an increase in malaria cases among us. The stagnant water from our mining pits and pods is a breeding ground for mosquitoes. Many of my colleagues, including myself, have suffered from malaria multiple times this year. We need to address these issues and find ways to manage the water to reduce the mosquito population."

A Community Elder in a key informant interview added his voice that:

"I have spent all my life in this community, and I have noticed a rise in respiratory problems and coughing among the people here. The dust and chemicals released from the mining activities are affecting our air quality. There is always dust hovering in the community from the grinding mills crushing stones. Many residents, especially the children and elderly, are experiencing severe coughing and other respiratory issues. (KII, Manwe, April, 2023)

Nba Kalbajanoor (Pseudonym) another elder opined in a focus group discussion that:

"One of my sons was recently diagnosed with lung damage at the Wa Municipal Hospital. He had been finding it difficult to breathe, and the doctor attributed this to constant exposure to dust and the inadequate access to oxygen beneath the mining pits. The doctor specifically mentioned that these issues were a result of the mining activities and advised him to stop working in the mines to prevent further deterioration of his health." (FGD, Eggu, June, 2023).

The In-charge of the CHIPs clinic in Manwe contributed to the discussion on the negative relationship between ASGM and diseases. He emphasized that the influx of mining activities has led to a noticeable increase in health issues among the community members. He says:

"The diseases we sometimes record in the clinic are always scary. We've recorded a number of coughing, respiratory infections, tuberculosis, and skin infections among community members. I must confess that the commonest ailment among them has always been malaria. Most of the diagnoses we make often point to mining work as the cause. Their constant exposure to dust and chemicals, along with the physical strain of the work, is leading to serious health issues that we have to manage on a daily basis. The worst affected group is the men, who spend most of their lives at the mines, putting their health at significant risk. Sometimes, the cases are so severe that we have to refer many of them to the municipal or regional hospital for more specialized treatment". (KII, Medical Practitioner, Manwe, June 2023)

When asked whether the health institution provides any form of sensitization to the miners, he revealed that:

“Miners usually prefer not to be informed about their medical conditions because they perceive it as criticism of their livelihood. Whenever we attempt to invite them for sessions to educate them about precautionary measures, they blatantly refuse, often citing flimsy excuses about being busy. Even when we try to reach them through their sponsors, our efforts have proven unsuccessful. Consequently, safety precautions are the last thing these small-scale miner’s practice.” (KII, Medical Practitioner, Manwe, June 2023).

The narratives above highlight a consensus among miners, community members, opinion leaders, and health experts that mining activities have led to a proliferation of diseases in the study area. Respondents frequently suffer from respiratory issues, tuberculosis, and skin infections due to their prolonged exposure to dust and harmful chemicals at the mining sites. Community members, especially those living near mining operations, also experience these health problems, exacerbating the local healthcare burden.

This study finding therefore aligns with Hermanus (2007) who in his study highlighted significant health hazards associated with mining, including respiratory illnesses, skin diseases, and malaria. Again, the work of Dias (2014), also found that significant number of mineworkers are experiencing musculoskeletal disorders, a condition that affects the nerves, joints, blood vessels, and overall body structure due to frequent lifting of heavy objects, squatting or taking abnormal positions in uneven, rough, and muddy areas in the process of extracting gold.

5.11 Forms of Occupational Accidents

The results in table 5.11 shows result of accidents gathered from 40 artisanal and small-scale gold mining operations in the study area. It was revealed that the most type of accident involved accidents from using tools and equipment, which accounted accounting for nearly a fifth (19.9%) of all incidents which was raked first.

The slip and fall type of accidents represent the second highest percentage of incidents, with 17.9%. The third and fourth ranks belong to "Injury from falling rocks" and "Injury from falling-bagged gold ore," with 15.8% and 14.8% respectively. The least ranked type of accident was collapse or Cave-Ins with 3.1%. Although less frequent, the serious nature of these incidents, particularly cave-ins, underscores the importance of strict monitoring and maintenance of mining structures and electrical systems to prevent potentially fatal outcomes.

Table 5.11: Latest Self-Reported Occupational Accidents Experienced by Miners

Form	Responses	Percentages	Percentage Cases	Rank
Accidents from using tools and equipment	39	19.9%	97.50%	1 st
Accidents from falling-bagged gold ore	29	14.8%	72.50%	4 th
Accidents from falling rocks	31	15.8%	77.50%	3 rd
Accidents from pit collapse or Cave-Ins	6	3.1%	15.00%	9 th
Accidents from Split of rock particles during crushing	23	11.7%	57.50%	5 th
Accidents from Explosions and Fires	10	5.1%	25.00%	7 th
Electrical Shocks	8	4.1%	20.00%	8 th
Slip and Fall	35	17.9%	87.50%	2 nd
Falling into uncovered mine pits	15	7.7%	37.50%	6 th
Total	196	100%	490.00	

Source: Field Survey, 2023**Note: Multiple Responses**

When a young miner was asked to share his views on the types of injuries miners in his community experience, he revealed that:

“Sure, injuries are common here. Many of us have scars from past accidents. Just look at my hands – these scars are from times when the hammer slipped and missed the chisel, hitting my hand instead. It's something that happens often because we don't use proper protective gloves. Some of the guys are even working with fresh wounds that haven't healed yet. They get cut or bruised, but they have to keep working to make a living. It's tough, but that's the reality we face”. (KII, Polee, March 2023)

This analysis reveals that while the most common accidents are related to everyday activities and interactions with the physical mining environment, there is a crucial necessity for comprehensive safety training and enforcement of safety standards.

5.12 Types of Mining injuries

The results in table 5.12 reveals lacerations topmost injury sustained by miner represented by 31.9% of the reported injuries, indicating that cuts or tears are the most common accidents. These often occur due to mishandling of tools or accidental contact with sharp, jagged rocks and other materials found in mining environments.

Table 5.: Types of Mining Injuries

Types of Mining injuries	Responses	Percentages	Rank
Fractures,	13	11.4%	4 th
Lacerations	37	31.9%	1 st
Amputations	4	3.4%	7 th
Loss Fingers (Limbs)	6	5.2%	5 th
Dislocation of joints	19	16.4%	3 rd
Eye Problems	6	5.2%	6 th
Abrasions or contusion	31	26.7%	2 nd
Total	116	100%	

Source: Field Survey, 2023

Note: Multiple Responses

The results from table 5.12 indicate that 31% of majority of respondents sustained laceration injuries making it the most common injuries sustained in mining and hence was ranked first. This was followed by Abrasions or contusions are the second most common type of injury, accounting for 26.7% of incidents.

Besides, dislocation of joints, representing 16.4% of the injuries and ranking third, suggests that miners frequently experience joint injuries due to falls, heavy lifting, or other motions that place excessive force on joints. Fractures, which were fourth at 11.4%, highlight the serious impact of falls and high-force impacts.

Mining is a hazardous occupation, and miners frequently sustain a variety of injuries due to the demanding and dangerous nature of their work. Field key informant interviews with respondents reveal the following common types of injuries:

A youth miner lamented that:

‘I remember one time I was using a chisel and hammer, and the hammer slipped, slicing my hand open. Have a look at the finger on my left hand, the cut was deep and I was stitched before I got healed. Many of us have scars from similar accidents. We work with sharp tools and rocks all day, so it’s easy to get cut.

Unfortunately, not everyone has access to proper first aid, so these injuries can take a long time to heal''. (KII, Gbegebe mining site, Manwe, May 2023)

A lead miner added his voice to mining injuries by reiterating that:

‘‘Just last month, one of my workers had his leg fractured when a heavy rock fell on it. We had to carry him out of the mine and rush him to the nearest clinic for first aid and were referred. We then decided seek for the services of an herbalist at Bihee (A born setting Village in the Upper West Region). It took him 6 months before he was fully recovered and was out of work. It's a big risk because we don't have the best equipment to protect us from these kinds of accidents. (KII, Goripie, May 2023)

The cumulative effect of these injuries on the mining community is substantial and far-reaching. Each injury impacts not only the health and productivity of the individual miner but also has significant consequences for their families and the broader community.

When a miner sustains an injury such as a fracture, laceration, or dislocation, like amputations or the loss of fingers and limbs it often results in an immediate cessation of work, leading to a loss of income. Families' dependent on the miner's earnings may struggle to meet basic needs such as food, shelter, and education for their children. This economic strain can lead to increased poverty and social instability within the community.

The findings align with the results of Jennings (1999; Siabi et al, 2022) who mentioned that miners in the ASGM sector are more likely to be injured than those in the LSM, according to statistics from an International Labour Organisation (ILO) survey. Because of this, the death rate among miners, particularly in ASGM, is ninety times higher than that of LSM in wealthy countries (Cossa et al., 2021; Jennings 1999).

5.13 Causes of Mining Site Accidents

From the table 5.13, lack of job training emerged as the leading cause, highlighted by 20.33% of the responses. This indicates a significant gap in the necessary skills and knowledge required to safely conduct mining operations. Poor maintenance of equipment and tools, accounting for 17.03% of the responses, also poses a major risk.

Working without PPEs, noted by 14.84% of participants, reflects a disregard or lack of availability of essential safety gear. Inappropriate use of explosives, which was mentioned in 12.64% of the responses, involves risks associated with blasting operations used to break rock.

Table 5.13: Causes of Mining Site Accidents

Cause of Mining Accidents	Responses	Percentages	Percentages cases	Rank
Lack of job training	37	20.33	92.50%	1 st
Poor maintenance of equipment/Tools	31	17.03	77.50%	2 nd
Working without PPEs	27	14.84	67.50%	3 rd
Inappropriate use of explosives	23	12.64	57.50%	4 th
Environmental Factors	21	11.54	52.50%	5 th
Inappropriate handling of chemicals	18	9.89	45.00%	6 th
Carelessness	15	8.24	37.50%	7 th
Nature of mining land	10	5.49	25.00%	8 th
Total	182	100	455%	

Source: Field Survey, 2023

Note: Multiple Responses

To support the above claims, the following narratives were solicited from respondents to substantiate the causes of accidents and injuries at the mining site. These personal accounts highlight the real-life challenges and risks faced by miners, adding depth and context to the statistical findings. Against this backdrop, a miner at Kende expressed in a focus group discussion that:

“Many new workers come into the mines without proper training. They don’t know how to handle the equipment safely or what to do in an emergency. Many miners, driven by the allure of quick cash, often skip any form of training. When I first started, I was essentially thrown into the job with minimal instruction. This is extremely dangerous because you have to learn on the job, and mistakes can be fatal. For instance, I sustained a cut on my left ankle because I didn't know how to handle a 'loko' sack and tools while descending a mining shaft. Both of my hands slipped off the cage, and I fell into the pit. It was a terrifying situation, but thankfully, my life was saved.” (FGD, Male, Kende May 2023).

A lead miner added his voice that:

“Poor maintenance is a big problem. We rely on our tools and machinery to be in good working order, but if they’re not regularly checked, they can fail at any moment. I’ve had a drill malfunction while I was using it, and it was terrifying accident because I nearly got my hand amputated. The maintenance team is often short-staffed or doesn’t have the resources to do their job properly.” (KII, Tapko, April 2023)

The data highlights that the most significant cause of accidents in Artisanal and Small-

Scale Gold Mining (ASGM) in the study area is the lack of job training. This overwhelming majority indicates that inadequate training is a critical issue in the ASGM sector, leading to a high incidence of accidents. The absence of proper training means that miners are not well-versed in safe mining practices, equipment handling, and emergency response, which significantly increases the risk of accidents.

The high rate of accidents and injuries among miners in the ASGM, however, has been linked in low- and middle-income nations like Ghana to a lack of OSH policies, education, working infrastructure and equipment, law enforcement, and training (Bansah et al., 2017; as cited in Siabi et al., 2022).

Health seeking behaviors in the mining communities

The study results indicate that 77.5% of miners and 80% of non-miners, who acknowledged the presence of health facilities within the mining communities, specifically highlighted a variety of healthcare options, including clinics, Community-Based Health Planning and Services Facility (CHPS compound), drug stores, pharmacies, and herbal centers but these were considered inadequate and not up to standard based on the kinds of critically mining related diseases that community members often contract

The differences in health-seeking behaviours between miners and non-miners can be interpreted in several ways. Miners according to interview prefer drug stores due to their remote working locations and the immediate need for medical supplies without the formalities of visiting a clinic or CHPS facility. The lower utilization of CHPS facilities and clinics by miners indicate barriers such as distance and time constraints provided. Additionally, the high reliance on drug stores and low utilization of pharmacy services indicates that miners are resorting to self-

medication more frequently, potentially due to a lack of awareness or access to comprehensive healthcare services. To substantiate the above, miner revealed that:

"For me, when I'm sick, I do not go to the hospital because they require laboratory tests and other formalities that delay getting treatment. Recently, I had to leave the community clinic because the nurse insisted on seeing the lab test results for my ailment, which I was supposed to get done in Wa. Instead, I took the lab prescription form and went straight to the drug store to buy Gebedol and that was sufficient for me". (KII, Polee, April 2023)

Again, findings from focus group discussions reveal that in response to emergencies or severe health issues, such as mining accidents and other critical ailments, both miners and community members predominantly rely on major healthcare facilities. These include the Wa Municipal Hospital, Upper West Regional Hospitals, Wa West District Hospital and the Nadowli District Hospital which are all located faraway from mining sites and communities. An assembly member through a key informant interview argued that:

"The last time my brother was injured in an accident at Kende Mines, where blasting caused rock particles to injure his stomach and other parts of his body, we had to rush him to Bulenga Clinic. He received first aid there and was then referred to Wa Regional Hospital for further treatment. Unfortunately, by the time we arrived, it was too late, and he passed away. If there had been a well-equipped hospital in our district, we might have been able to save him. His untimely death has left his two wives and five children as a responsibility for our family to bear." (KII, Male, Duu April 2023)

A nurse practitioner also added that:

"The absence of adequately equipped hospitals in our district not only endangers lives during emergencies but also hampers our ability to provide timely and effective medical care. This deficiency significantly increases the risk of preventable deaths and places an immense burden on families who lose their loved ones." (KII, Nurse, Manwe, April 2023).

5.14 Summary of Chapter

This chapter examined both the negative and positive socio-economic consequences of Artisanal and Small-Scale Gold Mining (ASGM). On the negative side, ASGM was found to have

been associated with various forms of insecurity, including armed robbery, violent attacks, and conflicts over the ownership and management of natural resources, particularly gold and land. These issues often lead to theft and social disruption. Additionally, ASGM has contributed to the erosion of societal values, evidenced by increased school dropouts, teenage pregnancies, and substance abuse. Conversely, ASGM has had positive socio-economic impacts, such as generating employment opportunities and fostering local economic development through direct and indirect activities related to mining. It also helps to mitigate rural-urban migration by providing local job opportunities. However, the chapter highlights a prevalent belief among both miners and non-miners that mining activities are a significant cause of sanitation problems.

Furthermore, the chapter notes that malaria is the most common health issue in the study area, with skin diseases and acute respiratory infections also prevalent. These health issues are exacerbated by occupational hazards associated with mining. There is a strong concern among community members, opinion leaders, and health personnel regarding the substandard nature of local health facilities, including Community Health Posts (CHPs), clinics, and drug stores. The inadequacy of these facilities, due to a lack of proper equipment and staff, makes it difficult to address critical health conditions effectively in mining areas.

CHAPTER SIX

ASSESSING THE IMPLICATIONS OF ASGM ON RURAL HOUSEHOLD LIVELIHOOD DIVERSIFICATION, ASSETS, ECONOMIC ACTIVITIES IN MINING AREAS

6.0 Introduction

This chapter uses the Sustainable Livelihood Framework (SLF) to examine how ASGM affects rural household livelihood diversification, assets, and activities in the mining landscape amongst the ten selected mining communities in the Upper West Region of Ghana. In many poor nations, including Ghana, rural communities rely on artisanal and small-scale gold mining (Adranyi, Stringer & Altink 2023). ASGM activities have grown in the Upper West Region of Ghana, offering local populations economic opportunities and challenges.

Livelihood diversification helps rural people manage risk and build resilience. Alternative income sources like ASGM can assist people manage with agricultural uncertainties like climatic unpredictability, pest infestations, and market changes (Makponse, 2023). ASGM may help households earn more, invest in productive assets, and live better. To comprehend these dynamics, this study utilized the Sustainable Livelihood Framework to examine how households cope with the adverse effects of mining on their livelihoods. This framework helps to understand the strategies and resources households employ to mitigate the negative impacts of mining activities and sustain their livelihoods amidst these challenges.

6.1 Has ASGM Negatively Influenced your Livelihood?

The study revealed that community members in the ten mining communities under study engage in a variety of livelihoods including crop farming, livestock rearing, trade shea nut picking, and fuel wood fetching, hunting, and fishing. It was revealed that the majority of miner (77.5%) responded affirmatively by agreeing that their livelihoods have been affected by ASGM. This high percentage suggests that while mining is a primary occupation, miners are also significantly involved in other forms of livelihood to sustain their households. Conversely, only 22.5% of miners responded negatively, indicating that a small proportion of miners responded in the negative indicating that ASGM has not affected their livelihoods.

The results suggest that while both miners and non-miners rely heavily on various forms of traditional livelihood, non-miners were more dependent on these non-mining activities. This

could be due to the fact that non-miners do not have the supplementary income that mining might provide and thus must rely more extensively on agriculture and other forms of subsistence.

Table 6.1: ASGM Negative Influence on Livelihoods

Response	Miners		Non-Miners	
	Frequency	Percentage	Frequency	Percentage
Yes	31	77.5%	289	90.3%
No	9	22.5%	31	9.7%
Total	40	100%	320	100%

Source: Field Survey, 2023

From the results displayed in table 6.1, it was revealed that more than 77% of miners and 90.3% of non-miners admitted that artisanal and small-scale gold mining (ASGM) has a negative impact on their livelihoods. This significant majority indicates a widespread perception of adverse effects associated with ASGM activities among community members, regardless of their direct involvement in mining. The various livelihoods affected by ASGM, as reported by both miners and non-miners, include crop farming, livestock rearing, shea nut picking, trading, fuel wood fetching, hunting, and fishing.

6.2 Livelihoods Destroyed Due to the Advent of ASGM

Table 6.2: Cross tabulation of Name of District and Livelihood Negatively Affected by Galamsey

		Livelihoods Negatively Affected by Galamsey									Total
		C	LR	PR	SNP	FWF	CP	F	H	PB	
Name of District	Nadowli-Kaleo	9	3	3	3	0	4	2	0	5	29
	Wa West	54	6	4	10	1	11	8	2	2	98
	Wa East	111	14	13	13	6	13	3	20	0	193
Total		174	23	20	26	7	28	13	22	7	320

Note: Pearson Chi-Square=61.6, df=16, p=0.00

Source: Field Survey, 2023

CF = Crop Farming, **LR** = Livestock Rearing, **PR** = Poultry Rearing, **SNP** = Shea Nut Picking, **FWF** = Fuel Wood Fetching, **CP** = Charcoal Production, **F** = Fishing, **H** = Hunting, **PB** = Pito Brewing

The data in table 6.2 presents a cross-tabulation of livelihoods negatively affected by illegal mining (*galamsey*) across three districts: Nadowli-Kaleo, Wa West, and Wa East. One of the most striking observations is that Wa East is the most severely affected district, with a total of 193 individuals impacted, compared to 98 in Wa West and 29 in Nadowli-Kaleo. This indicates that *galamsey* activities are more prevalent in Wa East, where their effects on livelihoods are particularly pronounced. Notably, Wa East has the highest number of individuals affected in almost every category, especially in crop farming (111) and hunting (20). This suggests that the district relies heavily on agriculture and natural resource-based activities, which have been significantly disrupted by illegal mining operations.

Across all districts, crop farming is the most negatively affected livelihood, reinforcing the idea that *galamsey* has a profound impact on agricultural activities. Wa East records the highest number of affected crop farmers, followed by Wa West and then Nadowli-Kaleo. This pattern suggests that agricultural communities in Wa East are experiencing a greater loss of fertile land and water resources due to mining activities. Additionally, hunting is disproportionately affected in Wa East, with 20 individuals impacted, compared to only two in Wa West and none in Nadowli-Kaleo. This suggests that deforestation and habitat destruction caused by illegal mining have made hunting increasingly unviable in Wa East, while the other districts appear to be less reliant on hunting as a means of livelihood.

Conversely, poultry rearing appears to be one of the least affected livelihoods across the three districts. The numbers remain relatively low, with Wa East recording 13 affected individuals, Wa West 4, and Nadowli-Kaleo 3. This may indicate that poultry farming is more resilient to environmental disruptions caused by *galamsey*, as it does not rely heavily on land and water resources. Similarly, fuel wood fetching is the least affected livelihood overall, with only seven individuals impacted across all three districts. This suggests that, despite illegal mining, people can still access firewood, possibly due to the availability of alternative sources.

A notable distinction is observed in *pito* brewing, which is only reported in Wa West (2 affected individuals) and Nadowli-Kaleo (5 affected individuals), while there is no reported impact on *pito* brewing in Wa East. This suggests that *pito* brewing is not a common livelihood in Wa East or that it has remained largely unaffected by *galamsey* activities. Additionally, charcoal production is affected across all three districts, with Wa East and Wa West experiencing the

greatest disruptions. This indicates that galamsey may be limiting access to trees and wood resources, further affecting those engaged in charcoal production as a source of income.

Despite the differences among the districts, some commonalities exist in the pattern of livelihood disruptions. Crop farming remains the most affected livelihood across all three districts, while poultry rearing and fuel wood fetching are relatively less affected. The severity of impact varies, however, with Wa East experiencing the greatest overall disruption. The significant differences in the number of affected individuals suggest that galamsey activities are more intense in Wa East compared to Wa West and Nadowli-Kaleo.

6.3 Ways by which ASGM Enhances Livelihood of Community Members

Table 6.3: Ways by which ASGM enhances livelihood of community members

Way of Enhancement	Miners		Non-Miners	
	Frequency	Percentage	Frequency	Percentage
Source of Income	13	32.5	78	24.38
Improved Well being	9	22.5	59	18.44
Reduce Vulnerability	5	12.5	44	13.75
Acquisition of Assets	6	15	38	11.88
Alternative Livelihood	7	17.5	101	31.56
Total	40	32.5	320	24.38

Source: Field Survey, 2023

ASGM as Source of Income

The data provided offers insights into how artisanal and small-scale gold mining (ASGM) has enhanced household livelihoods, focusing on both miners and non-miners. One of the most significant benefits reported is the source of income provided by ASGM. For miners, 32.5% identified income generation as a primary benefit, while 24.38% of non-miners shared this view. This steady source of income allows households to meet their daily needs and invest in their future. For instance, one respondent from a focus group discussion disclosed that:

“The income from ASGM enabled us to send our children to school and buy necessary supplies, which would have been impossible without the mining activities. Before this, we struggled to afford even the basic necessities. Now, we can provide them with a proper education and hope for a better future. It's made a huge difference in our daily lives and given us a sense of security we never had before.” (KII, Eggu, May 2023)

Simultaneously, there is growing proof that ASM promotes educational possibilities and attendance at schools (Potter & Lupilya, 2016). As an illustration, mine earnings are frequently used by parents to pay for their children's tuition (Stylo et al., 2020; Zolnikov, 2020).

Improved well-being

Improved well-being was another important benefit, with 22.5% of miners and 18.44% of non-miners recognizing this advantage. The economic stability provided by ASGM allows families to access better healthcare, nutrition, and living conditions. One miner shared in an interview their family's overall wellbeing has improved significantly since they started working in the mining sector. We can now afford for some common medical expenses and also afford to buy food for the family

ASGM as A Means to Reducing Vulnerability

The results also indicate that ASGM helps in reducing vulnerability, as noted by 12.5% of miners and 13.75% of non-miners. By providing a reliable source of income, ASGM reduces the economic insecurity that many households face. For example, a farmer in a focus group discussion highlighted that:

"ASGM income helped us build a financial cushion, which was crucial during times of unexpected expenses, such as medical emergencies or crop failures."(KII, Polee, April, 2023

Acquisition of assets

Another crucial benefit is the acquisition of assets, which 15% of miners and 11.88% of non-miners acknowledged. Earnings from ASGM enable families to purchase land, build homes, and buy essential equipment, contributing to long-term financial stability. One miner recounted:

"I have been able to put a building of my own last 3 years through the income I made from mining activities. This was something I couldn't do working as a farmer for the past 15years. I have even acquired another land and hoping to start developing it as and when I'm blessed with money from the mining site." (KII, Goripie, May, 2023)

Another miner revealed that:

"While I am at the mining site, I have sent some money to my younger brother to arrange tractor services for this year's farming season. Where else would I generate the money

from if not through mining activities? Even when it's time to buy fertilizer, I send money home for buying of hoes, cutlasses for farming. This is what I do every year during the farming season, and it helps me a lot because I no longer need to send large amounts of money home for food, except in critical situations like health issues, school expenses, or funerals. For me, mining supports my ability to farm at the same time. '' (KII, Duu, April 2023)

ASGM as an Alternative Livelihood

Lastly, the data points to ASGM providing an alternative livelihood for many, with 17.5% of miners and a high response of 31.56% from non-miners, indicating multiple responses. This diversification of income sources is vital for economic resilience. For example, a respondent from a field interview explained:

"In addition to farming, the income from ASGM allowed us to start helps me to reduce our dependence on a single source of income and spreading our economic risk." (KII, Takpo, May 2023)

In all, the data reveals that ASGM significantly enhances household livelihoods by providing a reliable source of income, improving well-being, reducing vulnerability, enabling asset acquisition, and offering alternative livelihoods. These benefits are crucial for the economic and social well-being of mining communities, as evidenced by the real-life examples and scenarios shared by respondents in interviews and focus group discussions.

ASGM operators are seen as people with imprecise livelihood choices; as a result, they are seen as a means of enhancing or even reorienting rural livelihoods toward agrarian pursuits. Galamsey gives rural residents the chance to select a particular livelihood plan or to supplement their income by alternating between farming and mining (Osumanu, 2020; Baddianaah et al., 2023).

6.4 System of Farming Practiced in the Study Area

The analysis as displayed in figure 6.4 on farming systems within the community provides valuable insights into the extent of agricultural commercialization. The data indicates that majority of respondents, 229 out of 320, or 71.56%, engage in subsistence farming. This high percentage highlights that most community members rely on small-scale agriculture primarily for their own consumption rather than for commercial purposes. This reliance on subsistence farming suggests

that food security and self-sufficiency are paramount concerns for the majority of households, who aim to meet their immediate nutritional needs through their farming activities. Based on respondents' views, the primary reasons for most people practicing subsistence farming were identified as a lack of capital to extend farmlands and insufficient funds to purchase essential farm inputs such as fertilizer and insecticides. Many of these farmlands that have been used for agricultural purposes for over fifty years according many respondents, and without fertilizer, they cannot produce enough yields for commercial purposes.

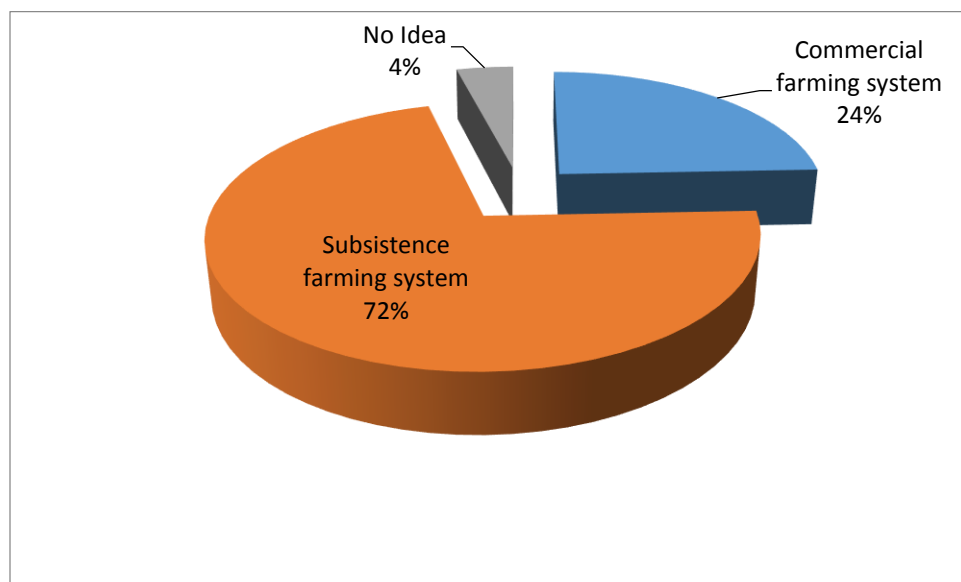


Figure 6.4: System of Farming Practiced in the Study Area **Source: Field Survey, 2023**

To further illustrate these sentiments, during a key informant interview, a community elder was asked why he continued to practice subsistence farming instead of shifting to a commercial system that could potentially bring in more income. He explained that:

“In our community, we continue farming not out of contentment but because we lack the financial means to buy fertilizers, pesticides, pay for tractor service. The lands we inherited from our forefathers are no longer fertile without these inputs. Additionally, hiring labor has become very difficult because most of the youth have moved into mining, which offers higher incomes than farming. This shift is pushing many farmers into mining, leading to a further decline in agricultural activities. As a result, when we harvest our crops, the yield

is insufficient to sustain our families until the next farming season due to the unproductive nature of our current agricultural practices’’ (KII, Polee, April 2023).

In contrast, a smaller proportion of respondents, 78 out of 320, or 24.38%, are involved in commercial farming. The presence of commercial farming within the community, albeit limited, indicates some level of market integration and potential for income generation from agricultural activities.

A small fraction of respondents, 13 out of 320, or 4.06%, indicated that they have no idea about the type of farming system they are engaged in. This response may reflect a lack of awareness or understanding of agricultural classifications among some community members, potentially pointing to gaps in agricultural education or extension services.

Crop farming is considered the main occupation of rural dwellers particularly in Sub-Saharan Africa (Funoh, 2014; Baddianaah, Gordon, & Baatuuwie, 2021). The present state of the mining communities in the Upper West Region follows this trend, with a predominant dependence on subsistence agriculture. Nevertheless, the agricultural sector in the three mining districts has recently encountered a multitude of obstacles that have greatly reduced the profitability of farming. Furthermore, the lack of proper infrastructure, including substandard road networks and inadequate storage facilities, exacerbates the challenges faced by farmers in effectively marketing their produce (Dimopoulos et al., 2023). These issues hinder agricultural productivity and profitability, making it increasingly arduous for farmers to maintain their livelihoods and invest in their farming operations hence their venture into small scale mining to diversify their livelihood (Huntington & Marple-Cantrell, 2022).

Mining has now become the most sought-after job in local communities (Mapuva & Dube, 2016; Baddianaah et al., 2021). As a result, discussions on streamlining artisanal and small-scale mining must take into account the views of local miners and traditional rulers (Osei-Kojo & Andrews, 2016). The livelihood trajectory of artisanal mining must first be assessed towards developing and implementing programmes that would not alienate local communities of their livelihood in mining. The results further suggest that the majority of the study respondents are subsistence farmers who may consider ASM as a supplementary income source. This finding

corroborates that of Mapuva & Dube (2016) who maintained that income accrued from artisanal and small-scale mining play an instrumental role in reducing poverty in rural areas.

6.5 Perceived ASGM Effects on crop farming

The results 6.7 show that majority of the respondents identified takeover of farmlands by ASGM, with 302 responses, accounting for 25.97% of the total responses. This indicates that the encroachment of mining activities on agricultural land is a primary concern among the community members, leading to a substantial reduction in available farmland for agricultural use.

The second most cited factor is the removal of topsoil and land degradation, with 278 responses, representing 23.90% of the total. This highlights the environmental impact of mining activities, where the stripping of topsoil not only reduces land fertility but also leads to long-term degradation, making it unsuitable for future agricultural use. This degradation directly affects the agricultural productivity and sustainability of the land.

Uncovered mined pits were reported by 180 respondents, making up 15.48% of the responses. These pits pose a significant hazard, contributing to the dangerous landscape left behind after mining operations. This not only poses physical dangers to the community but also represents a loss of arable land, further exacerbating the competition for land access.

Reduction in farm land size was noted by 125 respondents (10.75%), reflecting the shrinking availability of land for farming due to expanding mining operations.

Table 6.5: Artisanal Gold Mining Effect on Farmlands

Causal Factor	Responses(N=320)	Percentage	Percentage of cases	Rank
Removal of top soil	278	23.90%	86.88%	2nd
Uncovered mine pits	180	15.48%	56.25%	3rd
Abandonment of farms	98	8.43%	30.63%	6th
Pollution of Water bodies	79	6.79%	24.69%	7th
Farmlands taken over by ASGM	302	25.97%	94.38%	1st
Reduction in Farm Land Size	125	10.75%	39.06%	4th
Inaccessible roads to farmlands	101	8.68%	31.56%	5th
Total	1163	100%	363.45	

Source: Field Survey, 2023.

Note: Multiple Responses

The destruction of farmlands by artisanal miners was as result of lack of technical know-how with regards to how and where to locate a mineral. This they do by, moving from one land area to another using their indigenous knowledge rather than the scientific methods employed by

large scale miners to such for gold hence the destruction of farmlands. In a key informant interview an affected farmer said:

“My farmland has been encroached on by ‘galamseyers’ miners and any time I confront them they told me I don’t need farming to be rich but mining, so my farm is now a mining farm” (KII, Nanga, April, 2023).

The problem of water pollution and availability by mining activities poses a great challenge as far as the availability of water for agricultural purpose was concern. Artisanal miners carry their bags of gold ore to the riversides and other water bodies for washing thereby polluting them (water bodies). Farmers who responded with this reason enumerated the following: massive use of water by miners, siltation of water bodies and chemical pollution.

It is worth pointing out that though farming is rain-fed, farmers depend on water sources during dry seasons to irrigate their crops. Though there might be some distance between mining concessions and farms, water pollution transcends borders. Aragon and Rud (2012) assert that the negative spillover of air and water pollution can extend to a broader population, beyond the boundaries of mining licenses. Akabzaa (2000) posits that the main concern of communities in the case of Tarkwa in Western Region has been potential cyanide pollution of surface and ground water resources by large-scale surface mining operations. Artisanal and small-scale miners make use of mercury in sifting minerals from their ores. This leads to blatant pollution of water bodies that serve as a significant source of irrigation for smallholder farmers. With farming purely rain-fed, food crop farmers have of late depended much on the available rivers and streams to irrigate their crops. The pollution of these water resources as such reduces the capacity of farmers to increase production causing low yields in most of these mining communities.

A classic example is the Black Volta River where most artisanal miners’ uses. In a key informant interview with an agricultural extension officer revealed that said:

“The negative impacts of mining on agriculture in the district are; destruction of farmlands pollution of the water in the Black Volta and reduced labor hence food crops for previous years when we were not having mining activities in our district were better in terms of yields than current times when small scale mining activities are dotted all over.”(KII, Nanga, April, 2023)

A few farmers’ points to the loss in soil fertility as a causative factor of low crop yield as a result of mining activities. This they said was as a result of the felling of trees by artisanal miners

and as a way of clearing land for their mining activities. This therefore makes the soil susceptible to erosion culminating into the washing away of the top soil containing essential nutrients for plant growth.

Abandonment of Farmland

The discovery of mineral deposits and the perceived income opportunities they represent can also lead to the (Hentschel et al., 2002). As people move towards mining for better income prospects, agricultural activities can decline. Farmland may be abandoned because farmers and laborers are drawn to the more lucrative opportunities in the mining sector. This shift can lead to a reduction in local agricultural production, affecting food security and the livelihood of those who depend on farming.



Plate 4: Mining Activities on a Farmland

Source: Field Survey, 2022/2023

The Effects of ASGM on Animal Rearing

The results in table 6.6 present a comparative analysis of the adverse effects of Artisanal and Small-Scale Gold Mining (ASGM) on livestock and animal rearing in mining versus non-mining communities. Insights are drawn from respondents' interviews to support the interpretation of each variable.

Table 6.6: Perception of Effects of ASGM on Animal Rearing

Effects of ASGM on Animal rearing	Mining		Non-Mining	
Theft	10	25	101	31.56
Diseases	6	15	58	18.12
Death	8	20	72	22.5
Accidents	5	12.5	33	10.31
Abandonment of livestock rearing for ASGM	4	10	46	14.37
No Effect	7	17.5	10	3.12
Total	40	100%	320	100%

Source: Field Survey, 2023

Theft of livestock is a prevalent issue in both mining and non-mining areas, with 25.0% of respondents from mining communities and 31.56% from non-mining communities reporting instances of theft. Respondents from non-mining communities reported higher instances of theft, indicating a greater vulnerability. These differences in opinion might be attributed to less organized security in non-mining areas. However, the significant percentage in mining areas suggests that the lucrative nature of ASGM might attract criminal activities, impacting livestock rearing. A retired miner revealed that:

“Because there are a lot of people now living within the community, we are not able to tell who is a thief and who is a miner. Some of them pretend to be miners but secretly stealing our fowls and goats. Is only because of the thieves that I stopped rearing else I use to have a separate structure where I rear both goats and sheep but all of a sudden, they started disappearing. I cannot be wasting my hard-earned money for other people to be enjoying”
(KII, Polee, March 2023)

Crime has always been reported as one of the social costs of artisanal and small-scale gold mining areas. Respondents accused miners of being prime suspects when it comes to the disappearance of livestock or poultry, which often wander into mining sites or get trapped in uncovered mining pits.

Disease incidence is slightly higher in non-mining areas, with 15.0% of respondents from mining communities and 18.12% from non-mining communities reporting diseases in livestock. Respondents attributed animal diseases in mining areas to water contamination and indiscriminate disposal of chemical-infested waters. Furthermore, the indiscriminate disposal of mercury polluted

water from mines indiscriminately deposited on grass grown lands contaminates animals when they go to graze on such lands.

Accidents are more frequent in mining areas, with 12.5% of respondents from mining communities and 10.31% from non-mining communities reporting livestock accidents. Respondents argued that uncovered mining pits pose significant hazards, as animals grazing nearby can fall into these pits, resulting in injuries such as fractures, dislocations, and bruises.

It is clear from the previously mentioned information that in all three areas, agriculture is the most negatively impacted source of income. The findings of Hayes (2008; Ontoin & Agyemang, 2014) in other areas where ASGM is being operated are reflected in the destruction of agricultural activities through livestock death and theft, the rendering of agricultural land unproductive, and the reduction of agricultural activities through the loss of farm labor. These earlier studies also point out that livestock grazing, crop cultivation, and aquatic and livestock life have all been ruined by small-scale miners' pollution of land and water bodies and destruction of flora. Nevertheless, research that lower labor turnout for agricultural activities is caused by greater incomes from mining as opposed to cattle rearing and crop farming could also in part explain the reason there is little participation for agricultural activities in the three communities (Ayana et al., 2021).



Plate 5: Abandoned Mine pit covered with leaves Plate 6: Abandoned Mine pit
(Uncovered mine pits serving as death traps for both livestock and human beings)
(Source: Field Survey, 2022/2023).

6.7 Use of ASGM Income to Finance Agricultural Activities

Artisanal and Small-Scale Gold Mining (ASGM) can positively impact agriculture through the use of income generated from mining to fund agricultural activities (Goetz, 2022). The financial gains from ASGM provide miners with additional capital that can be reinvested into their farming operations. This influx of funds enables farmers to purchase high-quality seeds, fertilizers, and modern farming equipment, which can significantly enhance crop yields and farming efficiency (Adranyi et al., 2023). Divergent opinions have been expressed in empirical research regarding the impact of artisanal mining on agriculture. Onoka et al., (2021) asserts that artisanal mining leads to the degradation of farmland.

In light of this, study seeks to determine whether the people living in artisanal and small-scale gold mining (ASGM) communities are using the money they make from mining to support their agricultural endeavours. Considering the substantial revenue potential that small-scale mining offers, it is critical to ascertain whether and how these profits are being reinvested in agricultural endeavours, which continue to be an essential component of rural livelihoods. Figure 6.7 below provides an illustration of the investigation's findings.

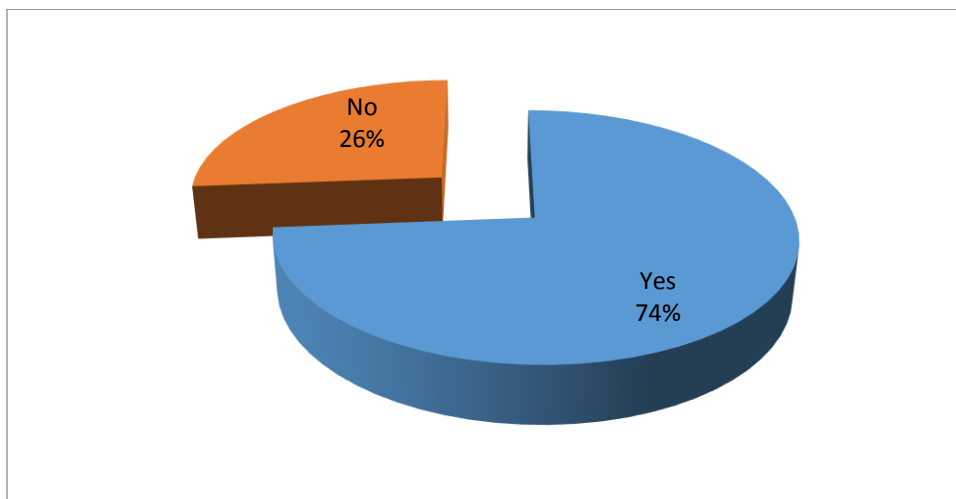


Figure 6.7: Use of ASGM Income to Finance Agricultural Activities

Source Field Survey, 2023

The results provided indicates that a significant majority of the respondents, 236 out of 320 (73.8%), acknowledge using proceeds from artisanal and small-scale gold mining (ASGM) to fund their agricultural activities whiles a smaller proportion of respondents, 84 out of 320 (26.25%),

reported not using mining proceeds to fund agricultural activities. This substantial percentage underscores the important role that income from ASGM plays in supporting and sustaining agricultural operations within mining communities in the Upper West Region. The use of mining proceeds to finance farming activities suggests a symbiotic relationship where the economic benefits derived from mining are reinvested into agriculture, potentially enhancing productivity, improving food security, and promoting the diversification of livelihoods. To buttress the above assertion a farmer opined that:

“I have always depended on mining work for the past 5 years to support my farming activities since my land is no longer fertile for farming. Last year I took 3 weeks off my farming activities and joined a mining gang and went down for some days and was able to buy five bags of fertilizer for my maize farm. I also paid for the services of a tractor to plough my farmland back home. So which activity would have afforded me this quick money within this short period if not mining?” (KII, Polee, April 2023)

A youth 45-year miner at Polee added his voiced that:

“Although mining is not my primary occupation, I engaged in it to generate additional income to support my livestock business, particularly cattle rearing. Before entering the mining work, I owned about 13 cattle and 5 sheep. Today, my cattle alone number over 50 plus. The secret is behind is that, every time I earn money from mining, I ensure that I buy a cow or two to expand my herd. I have a cattle kraal in Gbantala, a community in the Wa East District, where a Fulani man takes care of the livestock. The income from mining allows me to cover the costs of feeding the animals, paying the Fulani man and his family, and ensuring regular veterinary services for vaccinations against diseases and pests. This supplementary income has significantly boosted my livestock business”. (FGD, Polee, Male, April 2023).

The findings of this study align with the research of Maconachie (2011) and Hilson and Garforth (2013), which demonstrated that income generated from ASGM operations can be reinvested in agricultural activities. These studies highlight how the financial benefits of small-scale mining can provide essential capital for farming, enhancing productivity and sustainability.

By supporting agricultural ventures, mining income helps diversify rural economies, reduces vulnerability to agricultural risks, and improves overall community resilience.

Once more, research conducted in Ghana's Wa East District by Baddianaah et al. (2021) shows different ways in which some farmers reinvested the money they received from mining in their farms including the buying of tractors. According to Macconachie and Hilson's (2011) study, women employed in ASGM in Sierra Leone are rerouting their mining revenues into the agricultural industry. This finding reinforces the evidently favorable correlation between mining and rural areas.

This therefore calls for the pressing need to improve upon the methods used in extracting gold in the study area. The current extraction methods have detrimental consequences on arable lands and water sources and pose significant negative impacts on health. By enhancing the extraction techniques, it would be possible to mitigate the environmental and health risks while ensuring that the economic benefits of ASGM can continue to support agricultural and community development sustainably.

6.8 Livelihood strategies to Mitigate ASGM's Negative Effects Livelihoods

In the context of ASGM and agriculture, vulnerability refers to the susceptibility of agricultural systems and communities to the detrimental impacts of ASGM activities. These activities often lead to land degradation, water pollution, and loss of agricultural productivity, loss of arable lands, diseases infection and death of livestock and poultry thereby threatening food security and the livelihoods of farmers (Wawire, 2023).

Based on this trajectory, the research aimed to determine whether respondents were adopting coping mechanisms to mitigate the negative consequences of Artisanal and Small-scale Gold Mining (ASGM) on agriculture, in terms of vulnerability. The results are illustrated in figure 6.8, which highlights the various strategies employed by respondents and their effectiveness in addressing the challenges posed by ASGM.

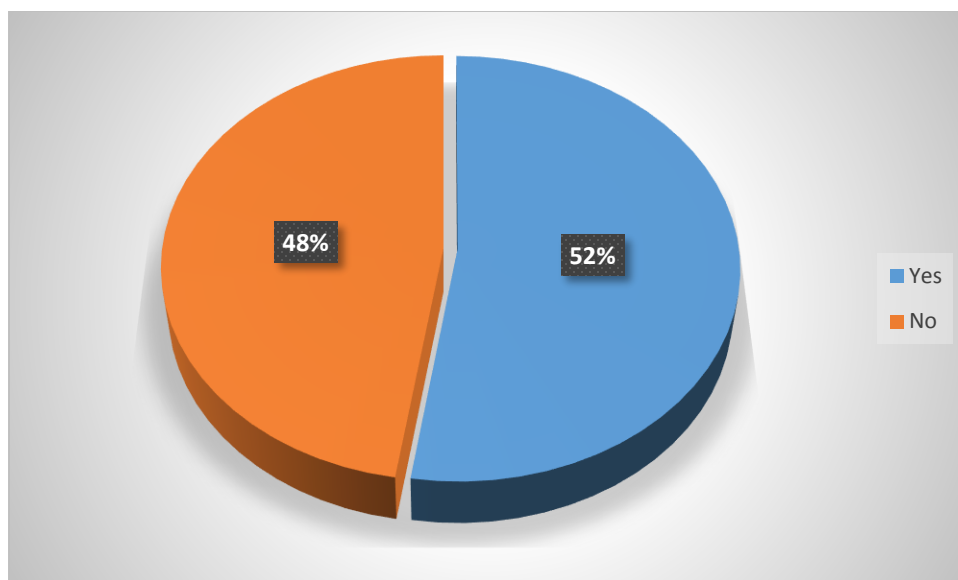


Figure 6.8: Livelihood strategies to Mitigate ASGM's Negative Effects Livelihoods
Source: Field Data, 2023

The results figure 6.8 shows that respondents have different views almost equally when it comes to adopting coping methods to deal with the adverse impacts of ASGM on agriculture. Among all the responses, 168 participants (52.5%) said that they had used coping strategies, while 152 participants (47.5%) did not. The data indicates that slightly more than half of the surveyed population acknowledges the importance of adopting measures to reduce the negative effects of ASGM.

The fact that 47.5% of respondents have not adopted any coping mechanisms raises concerns about the long-term sustainability of agriculture in areas affected by ASGM. This group is potentially more vulnerable to the negative impacts of mining activities, such as soil erosion, arable land conversion to ASGM and water pollution, which can lead to reduced crop yields and increased food insecurity and livelihood. The lack of coping mechanisms among these respondents was attributed to a variety of factors, including a lack of resources, information, or support from relevant authorities (Mousa, 2023).

6.9 Types of livelihood Strategies to mitigate ASGM's Negative Effects on Agriculture

Artisanal and Small-scale Gold Mining (ASGM) has had significant adverse effects on agriculture, particularly in the Upper West Region's mining communities. This has necessitated the adoption of various coping mechanisms by local farmers and households to manage and mitigate these negative impacts.

The research focused on understanding these coping strategies, drawing from the experiences of the 168 respondents constituting (52%) specifically reported adopting various measures to counteract the detrimental effects of ASGM on their agricultural activities. The diverse coping mechanisms adopted reflect the community's resilience and adaptive capacity in the face of environmental and economic stressors.

Respondents indicated a range of strategies, including intensive farming on marginal lands, backyard gardening, and the improvised filling of post-mine pits. These efforts are aimed at maintaining agricultural productivity and securing livelihoods despite the challenges posed by mining activities. The study highlights the importance of these adaptive measures in sustaining agriculture and reducing vulnerability within these communities. Figure 6.9 provides a detailed overview of the types of coping mechanisms adopted and their perceived effectiveness.

Table 6.9: Types of Copying Mechanisms

Types of Copying Mechanisms	Responses	%	% of cases	Rank
Venture into ASGM	138	17.6	82.14	1
Dependence on Remittance	101	12.9	60.12	2
Improvised filling of post-mine Pits	95	12.1	56.55	3
Practice of Intensive rearing system	89	11.4	52.98	4
Intensive farming on marginal lands	86	11	51.19	5
Sharecropping	80	10.2	47.62	6
Relocating onto new farmlands	74	9.4	44.05	7
Backyard gardening	62	7.9	36.9	8
Forced Migration	59	7.5	35.12	9
Total	784	100	466.67%	

Source: Field Survey, 2023

Multiple Response

Venture into ASGM

Results from table 6.9 shows those respondents who diversify into artisanal and small-scale gold mining (ASGM) were the most common coping mechanism, with 138 responses (17.6% 82.14%). This suggests that many individuals diversify their livelihoods by engaging in ASGM,

likely due to the potential for significant financial returns despite the inherent risks. A key informant interview with one assembly member reveals that:

"After my crops failed for the third consecutive year, I decided to join the local gold mining group. It's risky, but the money I make from mining is significantly more than what I earned from farming. The work is tough and often dangerous, but it has allowed me to provide better for my family. I can now afford to send my children to school and pay for medical expenses. I'm now looking for a way to see if I can acquire a new parcel of land and acquire the services of a tractor to start farming again so I can blend the two livelihoods together to fend for my family."(KII, Tapko, May 2023)

Dependence on Remittance from ASGM

Furthermore, dependence on remittance, with 101 responses (12.9%), is the second most common coping mechanism. The study reveals that many households rely on remittances sent by family members working elsewhere. To buttress the above quantitative information an interaction with study participants through focus group discussion an elderly woman commented that:

Our farmland was significantly affected by the activities of artisanal and small-scale gold mining (ASGM), which caused our primary source of livelihood to cease. Because of that my husband who works in a different mining town, hundreds of miles away from our region. He sends money back home almost every month, which we rely on for all our expenses. When my son needed money for his examination fee, I had to call his father to send us the money. Although it's hard not having him around as the breadwinner of the family, his remittances have made a big difference, especially for food, medical expenses, and school costs. Now we have enough to eat and can even save a little for emergencies. (FGD, Female, Polee, April 2023)

A 43-year-old Nba Faaganda is a migrant miner who sends earnings back to his parents, as demonstrated below:

"I always utilize a different mining friend who knows my family well. However, I always make sure to pay the guy in exchange for his kind gesture before I part with the money. To

safeguard the money I'm sending home, for example, if I'm giving Gh₵1000.00 to the sender, I make sure to send Gh₵300.00 to the recipient. In addition, I make sure that the sender's close relatives are known in case something unforeseen happens'' (KII, Duu, May 2023)

Mining remitters often rely on informal mechanisms to send money, using relatives at the mining site, trusted friends, and lorry drivers who frequently travel the mining routes. The remitter compensates these carriers to ensure the safe delivery of the funds to their family members and loved ones, preventing any diversion of the remittances. This practice is based on reciprocity and lacks the standardization of banks or formal institutions.

The aforementioned finding confirms research conducted in Lesotho by Crush et al. (2010), who discovered that a larger portion of the families surveyed in rural Lesotho, particularly those headed by Basotho men, relied on remittances to make ends meet during a boom in the mining industry in South Africa. The further stated that vulnerable households were those without somebody to pay them remittances.

Improvised Ways of Land Reclamation

Other respondents' improvised ways of filling post-mine pits in a form of land reclamation were represented by 95 responses (12.1%). This implies a considerable effort by individuals to mitigate environmental degradation and repurpose mined land for other uses. A 47-year-old community leader, recounted in a focus group discussion:

Once the mining operations ceased, my land was left with numerous hazardous, uncovered pits. With no alternative land available for farming, I decided to fill them in and convert the area for agricultural use. The land's agricultural potential has significantly declined compared to its state before the mining activities began in our community. Filling the pits was a collective effort from my family, with everyone pitching in. We used available resources such as leaves, grasses, sand left beside the pits, and sometimes logs from the trees that the miners had felled. Thanks to our hard work, we are now able to grow maize. However, without the excessive use of fertilizer, we wouldn't even have a half bag of maize to feed the family. (FGD, Male, Takpo, July 2023).

The Practice of Intensive Rearing Systems

The practice of intensive rearing systems, with 89 responses (11.4%), is notable. A significant number of respondents have turned to intensive livestock rearing to sustain their livelihoods, largely due to declining land quality and other agricultural challenges exacerbated by mining activities.

However, respondents encounter numerous difficulties with the intensive livestock rearing system. The cost of feeding the animals is substantial, as many have to hire people to venture deep into the bush to cut leaves and grasses. Additionally, some respondents must wait for their children to return from school to shepherd the animals into the bush, preventing theft and loss of livestock. This situation not only places a heavy burden on the children but also interferes with their education and jeopardizes their future prospects.

Compared to the former open-range system, where animals grazed freely and required less direct management, the intensive system demands much more time and effort. During the dry season, caring for the animals becomes even more challenging due to scarce food and water resources. Respondents emphasize that while intensive livestock rearing is necessary given the current agricultural constraints, it poses significant logistical and financial challenges that were not as pronounced in the open-range system. A 33-year-old livestock farmer, explained in a key informant interview:

“My brother, it's not easy keeping animals at home and feeding them. The cost involved in building multiple coops and investing in better feed is too much for me. Using the tethering method can also be expensive, as I have to buy different ropes for each animal. However, it's better now because my animals no longer wander to mining sites, where they risk accidents, getting lost, or drinking mercury-contaminated water and getting sick.” (FGD, DanyuoKuraa, May 2023)

Compared to the former open-range system, where animals grazed freely and required less direct management, the intensive system demands much more time and effort. During the dry season, caring for the animals becomes even more challenging due to scarce food and water resources. Respondents emphasize that while intensive livestock rearing is necessary given the

current agricultural constraints, it poses significant logistical and financial challenges that were not as pronounced in the open-range system

Intensive Farming on Marginal Lands

Intensive farming on marginal lands, as reported by 86 respondents (11%), indicates a strategic shift toward making more intensive use of less fertile lands. According to respondents in the study area, this shift is driven by land scarcity and the degradation of more fertile areas due to the adverse effects ASGM. This mitigation strategy showcases the resilience and adaptability of the farming communities in the face of environmental degradation. Farmers affected by ASGM acknowledge that intensive farming on marginal lands comes with its own challenges, such as lower soil fertility and higher input requirements. However, they emphasize that this approach offers a viable alternative for maintaining agricultural productivity. Through this method, many farmers have continued to support their livelihoods and contribute to food security, despite the detrimental effects of ASGM on their primary farmlands. A 50-year-old farmer, revealed in a key informant interview remarked that:

"My ancestral land has now reduced in size from 20 acres to only 7 acres. Ask yourself where the other acres went. You might wonder where the other acres went. If you're not asking, I'll tell you—they were taken over and destroyed by small-scale miners. Just look behind you at what those miners are doing to the land, forcing me to farm more intensively on the remaining marginal areas. I used to farm only maize, but now I alternate it with beans season by season. To support my crops, I apply cow dung and other animal droppings, which I gather from nearby herders. Sometimes, instead of applying it raw, I mix it with dry leaves and grasses to decompose before using it on the farm. All these efforts are to ensure I can produce enough food to feed my family." (FGD, Male, Eggu, April 2023)

Farmers affected by ASGM acknowledge that intensive farming on marginal lands comes with its own challenges, such as lower soil fertility and higher input requirements. However, they emphasize that this approach offers a viable alternative for maintaining agricultural productivity

Sharecropping

Sharecropping, with 80 responses (10.2%), remains a significant coping strategy for people living in the mining communities, underscoring their reliance on traditional agricultural practices and mutual cooperation among farmers. Although this livelihood strategy provides essential food and supports the well-being of many farming families in these communities, it does not guarantee a substantial income. According to some farmers, disputes frequently arise during the division of farm produce after harvest. Landowners often demand a larger share than initially agreed upon, leaving those who cultivate the land feeling exploited. This situation can make the sharecroppers feel like unpaid laborers on someone else's farm, despite their families' hopes for a bountiful harvest. A 45-year-old sharecropper lamented that:

"I don't own any land at the moment, so I work on my neighbor's farm as a farmer. We usually split the harvest, which gives me some food and a bit of income. It's something I've been doing for the past eight years. It works for me, but it hasn't been sustainable for me and my family. I keep doing it because we don't have access to our own farmland anymore, and we don't have any animals to rely on, not even a single chicken." (KII, Duu, May 2023)

Although respondents in my study found it difficult to adjust to share cropping as a copying strategy, Botchway's (2018) study, which discovered that 83.3% of farmers in the mining villages of Kwabeng in the Atiwa District adopted it as a copying strategy, supports the conclusions of this study. The above response depicts the broader issues of land access and ownership within the community, particularly in the context of small-scale mining activities that may have displaced many farmers from their ancestral lands. The absence of even basic livestock, such as chickens, further illustrates the precariousness of the rural livelihoods.

Relocation to New Farmlands

Relocating to new farmlands, as indicated by 9.4% of respondents (74 out of 784 responses), reflects the efforts of some individuals to find better farming opportunities by moving to different areas ameliorate their vulnerability statuses. This shift is often driven by the need to replace lands lost to Artisanal and Small-Scale Gold Mining (ASGM). Respondents who adopted this strategy revealed that their new farmlands were often located far from their residential

communities. As a result, they built farm settlements on these new lands, only returning to their home communities for urgent matters, such as funerals or other pressing needs.

Again, according to farmers who adopt this livelihood strategy shift to remote farming locations comes with several challenges. The distance from their primary communities means that farmers must invest additional time and resources into establishing and maintaining these new settlements. Building shelters and ensuring a sustainable water supply for both personal and agricultural use become critical concerns. Moreover, the isolation from their home communities can lead to a sense of disconnection and difficulty in accessing communal support systems. Despite these challenges, the pursuit of fertile land and favorable farming conditions drives many to adopt this strategy, underscoring the resilience and adaptability of farming families in mining-impacted regions. Michael, a 38-year-old farmer, recounted in a focus group discussion,

"After my farmland located at Duu became unproductive due to illegal mining activities, I relocated to a new farmland owned by my mother's family. It was a difficult decision, but essential for my family's survival. We had to start from scratch—building a new home, establishing our farm, and finding new sources of water for drinking and agriculture. I only returned home because one of my sons was getting married, and I wanted to give my blessings and attend the celebration. The first few years were challenging, but now we have a stable source of food and income."(FGD, Male, Duu, April 2023)

Relocating to new farmland has proven to be a challenging livelihood strategy for many farmers, reason it received least responses. Scarcity of land and financial incapability to purchase new lands are significant barriers. Additionally, the competition of land uses between mining and farming, disputes over land ownership and usage further complicate the situation. Farmers also face high costs associated with traveling to new farms, searching for water, and building new farm structures, making the transition burdensome.

Moreover, the available lands have often lost their fertility due to overuse or environmental degradation, and cultivating these lands without scientific fertilizers is prohibitively expensive. These factors collectively make it difficult for many farmers to adopt this strategy, despite its potential for providing stability and a sustainable source of food and income. The financial and logistical burdens, along with the deteriorated condition of accessible lands, underscore the significant challenges faced by farmers in their efforts to secure productive farmland.

Backyard or Home Gardening

In addition to the strategies mentioned, agricultural activities through backyard or home gardening received 62 responses (7.9%) from the respondents during field interviews. This highlights the significance of small-scale, personal food production, especially in supplementing household nutrition and income to counteract the adverse effects of ASGM on agriculture. Respondents shared that backyard gardening allows their families to grow a variety of fruits and vegetables, providing fresh produce that enhances dietary diversity and reduces dependency on market purchases. They also mentioned that it serves as a reliable source of income, as surplus produce can be sold locally.

The respondents noted that this practice helps maximize the use of available space and resources, promoting sustainability and resilience in communities affected by mining activities. By integrating home gardening into their livelihood strategies, households reported being better able to withstand the challenges posed by reduced agricultural productivity due to ASGM. This approach has provided them with a practical means to enhance food security and economic stability amidst the disruptions caused by mining activities. To support the above assertion from respondents through a key informant interview, a 56-year-old farmer commented that:

"With the rising cost of living and the unavailability of farmland to cultivate crops due to mining activities, I decided to use a part of our family land behind our house to make a small garden for the family. I planted okra, cabbage, pepper, and tomatoes. I wanted to add maize, but the land is too small for that. Even with what I've planted, the stray domestic animals don't give me any peace. The garden is fenced, but sometimes the goats still manage to get in and start destroying the plants. So, I often find myself acting as a watchman throughout the day, staying home to chase them away with stones. You can see my catapult and stones here—that's what they're for. Despite the challenges, the backyard garden has been quite helpful. Sometimes, I'm able to sell some of the produce and reserve the rest for the family to cook." (KII, Eggu, April 2023)

Taking inference from the above views from respondent's backyard gardening offers numerous benefits, including providing fresh and nutritious produce for household consumption,

which can enhance dietary diversity and reduce grocery expenses. It also offers a potential source of additional income through the sale of surplus crops, contributing to financial stability. Moreover, it utilizes available space efficiently and can improve the overall aesthetics of the home environment. However, backyard gardening comes with challenges such as limited space, which restricts the variety and quantity of crops that can be grown. There are also issues with pest control, as domestic animals and insects can damage the plants. Additionally, it requires constant attention and effort to maintain, which can be time-consuming, especially for those who juggle multiple responsibilities. Despite these challenges, backyard gardening remains a valuable strategy for enhancing food security and supplementing household income

Forced Migration

Forced migration, with 59 responses (7.5%), is the least common livelihood strategy to mitigate against the negative vagaries of ASGM but still significant, highlighting the extreme measures some must take due to untenable living conditions. Artisanal and small-scale gold mining (ASGM) activities have significantly impacted the rural communities in the Upper West Region, often leading to forced migration.

According to respondents from these mining communities, many residents displaced by mining activities move to other rural areas in search of viable livelihoods and better living conditions. Respondents revealed that families whose lands have been affected due to ASGM often relocate to distant rural regions, attempting to restart their agricultural activities. However, they face numerous challenges, including land scarcity, disputes over land ownership, and the financial burden of establishing themselves.

Respondents also highlighted a notable trend of rural-urban migration as a response to the disruptions caused by ASGM. Many individuals from these communities migrate to urban centers like WA-the capital of Upper West Region where they seek better opportunities. In Wa, young people from these mining communities often enroll in training programs to become mechanics or learn other trades, aiming to acquire skills for sustainable income. Others migrate further south to cities like Kumasi and Techiman, where they work as farm laborers for established farmers or join the bustling Kumasi Magazine to train as mechanics. However, some of these migrants struggle to find better opportunities and find it difficult to return home. Conversely, those who succeed in their new environments are often able to remit money back to their families, providing crucial

support for their survival. Overall, forced migration due to ASGM activities disrupts the traditional agricultural lifestyle, compelling many to adapt by seeking new livelihoods in both rural and urban settings. In an attempt to validate the above responses from study participants a mechanic apprentice narrated in a focus group discussion that:

"After realizing that farming was no longer viable for me, I told my dad that I needed to move out of the community to seek a better livelihood for myself and the family. When he asked what kind of work I planned to do, I admitted that I didn't know but hoped to figure it out once I reached Wa. I had no 'kobo' (to with, no money) on me by then so my father borrowed some money and gave it to me for the lorry fare. When I arrived in Wa, I decided to learn a skill. I met a friend there and shared my situation with him. He was a welder and introduced me to his friend, a motor mechanic. I was initially asked to pay for my learning tools, like spanners and hammers, and started my training immediately. Today, I can fix people's motor problems and earn an income for my family. Unlike our farmlands, no miner can take away the mechanic skills I have acquired." (KII, Nanga, April 2023).

6.10 Perceptions about the effectiveness of the coping mechanisms to mitigate the adverse effects of ASGM

The results provided in figure 6.10 reflects the perceptions of the 168 respondents representing 52% regarding the effectiveness of various coping mechanisms they asserted to have used to mitigate the adverse impacts of artisanal and small-scale gold mining (ASGM) on agriculture.

From the results less than half of the respondents 57 (33.93%), indicated that the mechanisms they employ were "Very Effective." These respondents likely find that their strategies not only address the immediate impacts of ASGM but also do so in a cost-effective manner, utilizing available resources efficiently. They likely appreciate the high output of their

interventions, and the sustainability of these mechanisms contributes to their positive perception. Sustainable practices that minimize long-term environmental damage and promote agricultural resilience are key factors in the perceived high effectiveness.

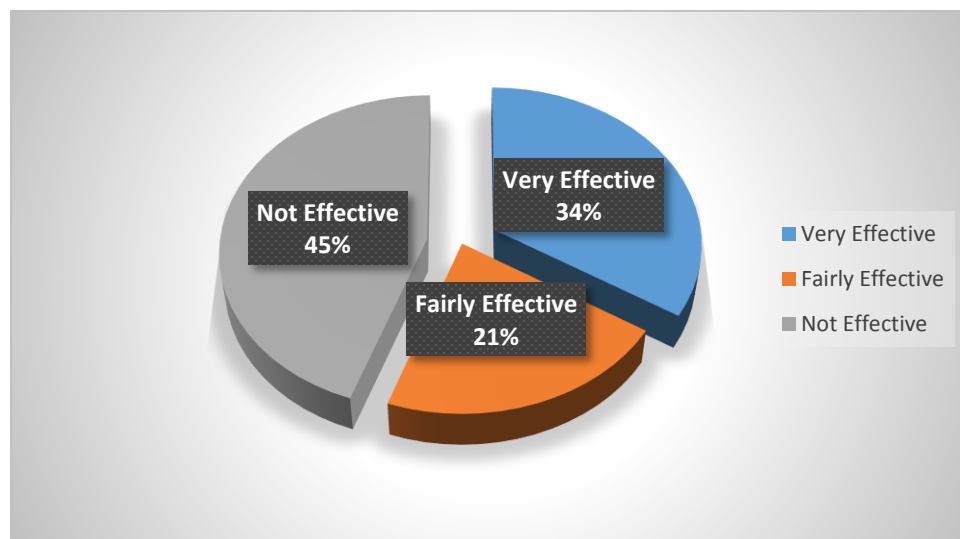


Figure 6.10: Perceptions about the Effectiveness of the Coping Mechanisms to Mitigate the Adverse Effects of ASGM

Source: Field Survey, 2023

On the other hand, 36 respondents (21.43%) described their mechanisms as "Fairly Effective." This group may find that while their strategies have a positive impact, there are limitations. These could include higher costs, limited resource availability, or lower-than-expected output.

A notable portion, 75 respondents (44.64%), stated that their mechanisms are "Not Effective." This significant percentage highlights the challenges faced by a large number of respondents in dealing with ASGM's negative impacts. The ineffectiveness of their mechanisms could stem from prohibitive costs, insufficient resources, or inadequate output.

Overall, the effectiveness of coping mechanisms among respondents was largely influenced by factors such as cost, resource availability, output, and sustainability. The respondents who perceive their mechanisms as very effective likely benefit from a favorable

balance of these factors while those who find their mechanisms ineffective face significant challenges in one or more of these areas.

This above finding disagrees with Botchway's study in 2018 which found out in his study that copying strategies used by respondents in the mining communities of Kwabeng and Akroful in the Atiwa district were very effective (75%) and moderately effective (85.7%) respectively. This study found out that majority of the by inhabitants of the ten mining communities in the Upper West region revealed that the copying mechanisms used as a means of mitigating the adverse effects of ASGM on the livelihoods were either not effective (45%) or fairly effective (21%).

6.11 Relationship between ASGM and Local Economic Development

Artisanal and Small-Scale Gold Mining (ASGM) plays a pivotal role in local economic development by providing direct and indirect employment opportunities, fostering local entrepreneurship, and stimulating related economic activities. In many rural and underdeveloped regions, ASGM serves as a critical source of livelihood for a significant portion of the population, who might otherwise have limited access to formal employment (Osumanu, 2020, Baddianaah, Abdulai & Dordaa, 2023; Twala, 2023). The income generated from ASGM enables miners and their families to invest in essential goods and services, such as education, healthcare, and housing, thereby improving their overall quality of life. Additionally, the presence of ASGM operations often leads to the development of ancillary businesses, including equipment supply shops, food vendors, and transport services, which further invigorate the local economy.

The small-scale gold mining (SSGM) value chain is a complex network of interdependent activities and businesses that collectively drive local economic development. According to Baddianaah et al. (2023), this value chain encompasses a wide array of economic actors, including drivers, shop operators, food vendors, and local craft industries.

Livelihoods created by ASGM leading to Local Economic Development

Despite the negative consequences of ASGM on rural livelihood most especially those that are dependent on land, results from table 6.11 shows a range of livelihoods associated with (ASGM).

Table 6.11 Job Opportunities/ Livelihoods created by ASGM

Livelihoods	Responses	Percent (%)	Percent of Cases (%)	Rank
Main Gold Ore extraction	360	9.28	100	1
Food Vending	356	8.48	98.9	2
Grinding Machine Owners	345	5.1	95.8	3
Buying of gold	329	8.89	91.4	4
Head Porters	275	7.09	76.4	5
Machine operators	239	6.16	66.4	6
Water Vending	231	9.18	64.2	7
Contract Cooks	229	5.41	63.6	8
Stone Crushers and smoothers	215	4.59	59.7	10
Provision Shop Selling	210	5.96	58.3	9
Local Gold Prospectors	198	2.35	55	11
Room services (Rents)	190	5.54	52.8	12
Drug Dealers	178	2.24	49.4	13
Blacksmithing	91	1.29	25.3	14
Chenfang Spare Parts Trade	87	1.8	24.2	15
Sale of Mining Tools	74	1.65	20.6	16
Motor Mechanics	70	5.9	19.4	17
Carpenters	64	1.91	17.8	18
Errands for Miners	54	1.39	15	19
Mining Equipment Mechanics	50	4.9	13.9	20
Others	34	0.88	9.4	21
Total	3879	100	1077.50	

Source: Field Survey, 2023

Note: Multiple Responses

Shop operators and food vendors cater to the daily needs of miners, providing essential goods and services such as tools, safety equipment, and meals. These businesses thrive on the constant demand from the mining workforce, creating a robust local market that supports a diverse range of products and services. Additionally, local craft industries benefit from the mining sector by supplying handmade tools and equipment, often tailored to the specific needs of small-scale mining operations. These industries not only sustain traditional skills and craftsmanship but also

innovate to improve the efficiency and safety of mining practices (Jang & Topal, 2020). For example, a community chief added his voice to the effects of ASGM on the local economy by revealing that:

“We use to say there are no job opportunities in our community but now this mining has come with a lot of opportunities which keeps our men and women very busy very day, at first one could count the number of provision shops in our community here but no you cannot. I won’t even talk of food vending because now because of the increase in population due to mining there is high demand for food so many women in our community are now into food, some even are hired by the sponsors to cook for their mining groups at the mining site” (KII, Goripie, May 2023)

Main gold ore extraction, which garnered responses from 100% of the participants, is the cornerstone of ASGM activities. Buying of gold, with 98.9% of responses, is another critical aspect of the ASGM economy. This activity involves local traders purchasing gold directly from miners.

Local gold prospectors, who accounted for 95.8% of responses, play a vital role in identifying new mining sites. Prospectors typically work independently or in small teams, embarking on long expeditions that can last for days or even weeks. They carry basic tools such as shovels, pans, and metal detectors to help them in their search. Once a potential site is identified, they conduct preliminary testing to assess the quality and quantity of gold. This may involve panning samples of soil or rock to see if they contain gold particles.

Grinding machine operators, with 66.4% of responses, are skilled workers who manage the operation of essential grinding equipment. According to responses from study participants, both miners and non-miners, there are two types of grinding machines: crushers and smoothers.

On the other, the sale of mining tools, which received 17.8% of responses, is a specialized livelihood that supports the mining sector by providing necessary equipment. Interviews revealed that vendors sell a range of tools, from simple hand-held devices to more advanced machinery. These vendors often have shops near mining areas and cater to the specific needs of miners, ensuring they have the right tools for various mining tasks.

When a black smith was contacted with regards to the relationship between his work and ASGM he intimated that:

“Making mining tools for miners to use is what I do here instead of digging for gold. Because the Galamsey boys are buying my chisels, pick axes, and hammers, my business is flourishing. Every day, I sell more than ten hammers and chisels to galamsey guys. In the event that the government bans galamsey, my business will undoubtedly fail. I earn more than GHC 500.00 from my business every week. Since most farmers are switching from farming to mining, I sell more chisels than hoes. Thanks to the money I make from my blacksmithing business, my child is currently enrolled in a teacher training college in Wa and prepared to become a teacher.” (KII, Goripie, March 2023)

Adding a voice to the above assertion from the black smith was a community chief. He reiterated that:

“While we are all aware of the detrimental effects of mining, we also cannot ignore the positive effects and large number of employments it has brought to our town. Simply stroll around the firm and you will notice that it is filled with numerous businesses and activities, such as food and water vending, carpentry, sales of "Chenfang" spare parts, and motor mechanics for our youth. When mining in our villages was ineffective about 10 years ago, you could always observe able men and women lounging beneath trees and in campgrounds during the day. Today, however, you can only see them after they have left their places of jobs. My main concern is that some of these young people no longer value going to the farm and think it is a waste of time, so it will be difficult to get them to go these days.” (KII, Manwe, April, 2023)

The study can confidently assert that mining has increased the local economy of the study area based on the above narratives about how mining has both directly and indirectly created numerous employment opportunities in the study area. This supports the findings of related studies that ASGM has led to the generation of employment opportunities for many rural families in Ghana (McQuilken and Hilson, 2016, Baddianaah, Abdulai, & Dordaa, 2023). Hilson and Garforth's (2013) research also revealed that in Ghana's Eastern Region, ASGM workers invested their mining earnings to pay for their wards' education. Expanding the argument, Yankson and Gough (2019) and Baddianaah et al. (2023) contended that ASGM fared better than large-scale mining in terms of the role that mining played in local economic development.

6.12 Disparities of Income between Miners and Non-Miners

The analysis of tables 6.12a and 6.12b highlights significant differences in monthly income generated from small-scale gold mining and other sources, with agriculture being the primary source of non-mining income. The data from Table 5.1 shows that income from small-scale gold mining is distributed across various ranges, with the highest percentage of miners (40%) earning between GH¢1600 and GH¢2000 monthly. This is followed by 22.5% earning between GH¢1100 and GH¢1500, and 20% earning more than GH¢2100. Smaller percentages of miners earn between GH¢600 and GH¢1000 (15%) and between GH¢100 and GH¢500 (2.5%).

In contrast, Table 5.2 indicates that the majority of individuals relying on other sources of income, mainly agriculture, earn significantly less. A striking 62.81% of these individuals earn between GH¢100 and GH¢500 monthly. This is followed by 24.69% earning between GH¢600 and GH¢1000. Only small fractions of this group earn higher amounts: 4.69% earn between GH¢1100 and GH¢1500, 5.31% earn between GH¢1600 and GH¢2000, and 2.5% earn more than GH¢2100.

The distribution of income ranges highlights a clear disparity between the two groups. Individuals involved in small-scale gold mining tend to earn higher incomes compared to those relying on agriculture and other sources. The higher income brackets (GH¢1100 and above) are predominantly occupied by miners, while the lower income brackets (GH¢100 to GH¢1000) are predominantly occupied by those with non-mining incomes.

The mean monthly income from mining by respondents was approximately GH¢1560.00 (US\$124.33 at an exchange rate of 1 US\$ = GH¢12.547 as of March 7, 2023). This is significantly higher than the mean monthly income from other sources, primarily agriculture, which stands at approximately GH¢595.00 (US\$47.42 at the same exchange rate). This stark contrast underscores the relatively high average income generated from small-scale gold mining compared to other income sources, predominantly agriculture. The substantial difference in income levels highlights the financial appeal of small-scale gold mining despite its potential adverse effects on agricultural productivity and sustainability.

Table 6.12a: A table showing Monthly Income Generated from Mining

Income Range	Frequency	Percentage
100-500	1	2.5
600-1,000	6	15
1100-1500	9	22.5
1600-2000	16	40
2100 +	8	20
Total	40	100

Source: Field Survey, 2023

Table 6.12b: A table showing Monthly Income Generated from other Sources

Income Range	Frequency	Percentage
100-500	201	62.81
600-1,000	79	24.69
1100-1500	15	4.69
1600-2000	17	5.31
2100 +	8	2.5
Total	320	100%

Source: Field Survey, 2023

Table 12c: Paired Samples t-Test Results for Monthly Income from ASGM and Non-Mining Sources

Paired Differences		Mean	Paired Differences				t	df	Sig. (2-tailed)
			SD (σ)	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Earning From Mining Activities (Monthly Income) - Monthly Income from non-mining sources	Range ASGM (Monthly Income)	.67500	1.85897	.29393	.08047	1.26953	2.296	39	.027

Source: Field Survey, 2023

Analysis and Interpretation

The results of the paired samples t-test comparing the monthly income from ASGM activities and non-mining sources (mainly agricultural) provide insightful information about the income differences experienced by individuals engaged in these sectors. The analysis reveals a mean difference of 0.675 units in favor of ASGM activities, indicating that, on average, individuals earn slightly more from ASGM compared to other income sources.

The t-value obtained is 2.296, with 39 degrees of freedom. This t-value is used to determine the significance of the mean difference. The p-value associated with this t-test is 0.027, which is less than the commonly used alpha level of 0.05. This indicates that the difference in monthly income between ASGM activities and non-mining sources is statistically significant.

The paired samples t-test demonstrates that individuals engaged in ASGM activities earn significantly more on average than those relying on non-mining sources of income. The mean difference of 0.675, supported by a significant p-value ($p = 0.027$), suggests that ASGM activities provide a higher average monthly income. The confidence interval further supports this finding, as it does not include zero, reinforcing the conclusion that the observed difference is statistically meaningful. These results highlight the economic advantage of ASGM activities for those involved, suggesting that they may offer better financial opportunities compared to other income-generating activities.

Nonetheless, there is a negative correlation between mining revenue and agricultural revenue. The findings imply that artisanal mining and agriculture are competitive sources of revenue in the research area, despite the fact that it is not statistically significant. This indicates that those who are interested in mining paid less focus on farming. The increased income that miners make in comparison to other sources of income supports the findings of Baddianaah et al. (2021) among mining communities in the Upper West Region's Wa East District.

Besides, Fearon et al. (2015) and Osumanu (2020) made the additional claim that the majority of rural farmers had switched to ASGM in mining sites due to increased earnings from mining activities. While mining can have both beneficial and detrimental effects on nearby people, by adhering to sustainable mining practices, the focus should be on investigating the advantages of artisanal mining.

6.13 Gendered Disparity in relation to ASGM income

The mining industry, historically dominated by men (Dallman & van Dyke, 2013), continues to be a challenging environment for women due to persistent implicit and explicit biases. These discriminatory attitudes significantly contribute to gender disparities, affecting women's access to resources, their control over these resources, and their participation in decision-making processes (Buss et al., 2019). This situation undermines efforts to achieve the Sustainable Development Goals (SDGs), particularly those related to gender equality and inclusive economic growth, within the context of Artisanal and Small-Scale Mining (ASGM).

According to the extant literature, women in ASGM engage in sluicing, water fetching, stone sorting, mine waste transportation, and gold amalgam processing (Arthur-Holmes, 2021; Buss et al., 2019, 2020; Baddianaah, 2023).

The research findings from the interviews reveal a troubling pattern, particularly concerning the payment and working conditions of female miners. Despite the legal minimum wage of GH¢14.88 established by Ghana's National Tripartite Committee as of January 1st, 2023, many women working in these mining sites are not only receiving lower pay than their male counterparts but are also often compensated below this mandated minimum wage. This underpayment is a significant issue, highlighting gender disparities and the exploitation of female labor in the mining sector.

The low-income levels among female miners are primarily due to their engagement in peripheral tasks at mining sites, which are typically lower-paying. Historically, women have had minimal participation in core activities such as exploration, mining, and mineral processing. Consequently, their involvement is often restricted to support roles, including management, clerical work, security, catering, and other related jobs (Akabzaa & Darimani, 2001). These roles, while essential to the overall functioning of mining operations, do not offer the same financial rewards as the more central, male-dominated mining activities. To buttress the above finding during a focus group discussing, Hajia (Pseudo) revealed that:

‘Working in the mines feels akin to a divine endeavor, where I toil tirelessly throughout the day. However, instead of receiving fair compensation to provide for my orphaned children, I often encounter the belief that women do not engage in mining ("galamsey") but should primarily assist their husbands, much like they do in farming. Even obtaining food

to sustain ourselves during work necessitates returning home. It is frustrating to see that the men at the mines seem to benefit disproportionately, accumulating wealth and assets in the name of mining, while our contributions play a significant role in their success'' (FGD, Female, Duu, March 2023).

A 35-year-old woman also resonates that:

“It is the men who have machines since they can afford and only call on us to carry the dug-out sand (Load) to their machines for grinding and they chose to pay you what they want which is usually a paltry amount. We are not paid in cash for doing this kind of grinding and washing work for the men. My brother you will not believe that we are paid with a tin full of the powdered sand (Sample) after we finish grinding every sack of stones. That tomato paste tin which is 2.2kilogram is what we are paid with” (FGD, Manwe April, 2023).

In the current studied communities, women who work at mine sites often bear the economic burden of affording their own food, a sharp contrast to their male counterparts. This self-sufficiency stems from the belief that their work is less physically demanding compared to the men's tasks. One woman, who works at the smoother grinding station, reported that she sometimes has to leave work to find food at home and then return to continue her tasks. This scenario is quite different from the findings of Kambani (2000) and Mwaipopo et al. (2004), where sponsors typically provide food and medicine to workers and subsequently purchase their finds.

The aforementioned findings point to the marginalization of women in ASGM operations with regard to equal labor for equal compensation, and they corroborate the academic findings of Yakovleva et al. (2022) who contend that various forms of discrimination persist in the ASM industry. Therefore, there is a good chance that these plots may hinder Ghana's efforts to meet Sustainable Development Goal 5, which calls for gender equality for all people in all domains of life.

The study corroborates with the findings of Akabzaa and Darimani (2001), women earn significantly less per month on average compared to their male counterparts, who engage in activities like digging out and washing the ore, resulting in much higher monthly earnings for the men. To further validate the perspectives of women regarding their increased vulnerability to receiving fewer benefits from mining rewards compared to men, the study sought to explore the views of men on the issues of rewarding women at the mines. A 49-year-old miner at 'World Bank'—a mining site known for having the deepest mining shaft and operating for over 24 years at Goripie confirmed that:

“The work we do is vastly different from household chores, which can be done while sitting comfortably. Mining requires significant physical strength and energy. "Ndao te y3 la y3 li meehi Ny3 apɔ geba turi yaa ba y3 la la yɔ ɔ daari ohubu bii Siimaa Maalibu" (meaning, my friend, let's be honest with ourselves, look, women's place is in fetching fuel wood and the kitchen). How many women can stay underground for even four hours to load? We stay in the shafts for more than twelve hours, sometimes going underground at night and emerging at dawn. Take a look at that hammer (Miner pointing to a hammer) – you can feel its weight. Do you expect a woman to hold such a hammer, handle a chisel, carry a heavy sack, descend underground for distances equivalent to more than seven electric poles, carry the load on her back, and then climb back up? It's only because there are no other jobs available in the community, and farming is no longer viable, that anyone would suggest their sister, wife, or daughter engage in small-scale mining. Just look at those two women with their basins under the shed, likely gossiping – do you think we should pay them the same as the men? No, we shouldn't.” (KII, Male Miner, Goripie, April, 2023)

The narrative described above supports prior studies on how men's beliefs about their own abilities differ from women's as a trigger for resource control and appropriation (Arthur-Holmes, 2021). Again, this research finding backs up the claims made by Baddianaah (2023, who stated that all of the female participants in his study in North-Western Ghana honestly believe that the underground pit ASGM is not a place they should visit. Women are so afraid of the risks involved in ghetto mining and are not interested in getting involved in it, in addition to the sociocultural discrimination and stereotyping of women in the underground mining.

The male miners emphasized that mining requires significant physical strength and endurance, often involving long hours spent underground, sometimes up to twelve hours or more, including night shifts. The heavy lifting, use of tools like hammers and chisels, and the need to carry substantial loads over long distances underscore the physical intensity of the job.

6.14 Perceived Negative Consequences of ASGM on Rural Livelihoods

The data analysis in 6.15 provides a comprehensive view of the adverse effects of Artisanal and Small-Scale Gold Mining (ASGM) on various aspects of household livelihoods. Using the calculated weighted mean of 3.21 as a benchmark, the study assesses the severity of each variable using a 4-point likert scale of agree, disagree, strongly agree and strongly disagree and draw linkages to household livelihoods through scenarios derived from interviews and focus group discussions.

Insecurity in Mining Communities

The mean score for insecurity is 3.19, slightly below the weighted mean of 3.21, indicating a high perception of insecurity among community members. This high level of perceived insecurity suggests that ASGM activities contribute significantly to a sense of unease and vulnerability within these communities. To buttress the above assertion Nba Dao (Pseudonym) a local farmer voiced That:

"Since the miners came, we've seen more fights and thefts. It's not uncommon now to see families, individuals, and communities fighting over a piece of land because of gold. Goripie used to be one of the most peaceful and harmonious communities, where everyone went about their daily activities without fear or panic. Recently, two of my friends fought with knives over gold proceeds, and one was severely injured. Like the saying goes, every good thing has its bad side. The very gold that provides us with income and improves our well-being is the same gold that has turned into a 'Gbongbori' (a wolf in our Waale dialect), eating us up." (FGD, Male, Goripie, March 2023)

Table 6.14: Perceived Negative Consequences of ASGM on Rural Livelihoods

Perceived Consequences of ASGM on Livelihood	Mean	Std. Deviation (σ)	Perception
Insecurity	3.19	0.79	High Perception
Destruction of Farm Lands	3.40	0.56	High Perception
Drug Abuse/ Alcoholism	3.21	0.88	High Perception
High Cost of Living	3.24	0.67	High Perception
Drift of Farm Labor to ASGM	3.26	0.93	High Perception
High Rate of School Drop Out	3.21	0.87	High Perception
High Prevalence of Mining Related Diseases	3.18	0.87	High Perception
Conflicts/ Tension	3.11	0.71	Low Perception
High Incidences of ASGM Induced Accidents	3.48	0.58	High Perception
Pollution of Drinking Water Sources	3.09	0.65	Low Perception
Prostitution	3.2	0.88	High Perception
High Incidences of Teenage Pregnancy	3.21	0.88	High Perception
Loss of Economic Trees	3.21	0.88	High Perception
Loss of animal husbandry	3.11	0.71	Low Perception

Source: Field Survey, 2023

**Weighted Average (Grand Average) = $45.07/14=3.2$, Less than 3.21 indicate low Perception
3.21 indicates High Perception**

Destruction of Farm Lands

With a mean of 3.40, which is above the weighted mean, the destruction of farm lands is perceived as a significant issue. This high perception highlights the direct impact of ASGM on agricultural activities, leading to reduced food production and income for families who rely on farming. The conversion of fertile farmland into mining sites leaves communities with fewer resources for cultivation, affecting food security and local economies. During a one-on-one interview with a female farmer, she shared that

"Our crops used to thrive, but now the land is ruined, shared Kutum (Pseudonym), a mother of four. We struggle to grow enough food to feed our families, let alone sell at the market. The miners have taken over our best lands, leaving us with nothing. To be able to feed and cater for the family, all of us are now into mining at several mine sites. Take a closer look at our silo where we used to store food crops after the yearly harvest—it's now empty. We have no option but to look for alternative livelihoods and buy food from the

market. *The situation, I must say, is very pathetic, my son.*" (KII, Nanga, Female, March 2023)

Drug Abuse

The mean score of 3.21 aligns with the weighted mean, reflecting a high perception of drug abuse and alcoholism issues in the communities. The socio-economic changes brought about by ASGM, including increased disposable income and stress from disrupted livelihoods; appear to contribute to substance abuse problems. This issue not only affects individuals but also places additional burdens on families and social structures. Nba Saaka (Pseudonym), a community elder elaborated that:

"The younger ones are getting into drugs and alcohol. It's a way for them to cope with the pressures and reduce their pain after a hard day's work in the mines. Some miners mix tramadol with energy drinks, popularly called Asamoah Gyan (Run) or 5-Star, to stimulate their system while working. It's sad to see them waste their lives like this. Some miners even take Gebedol without a doctor's prescription, believing it will help them handle mining stress and pain. Others rely on concoctions prepared by herbalists, hoping to be pain-free or injury-free, but in reality, they are damaging their systems." (KII, Danyoukuraa, Female, April 2023).

To add more evidence to Nba Saaka's observations, a 45-year-old community member who also serves as a landlord to miners disclosed that the situation is dire. He recounted numerous instances where his tenants, young miners, fell into the trap of substance abuse due to the grueling demands of mining work. He therefore reiterated that:

"Let me tell you about a real-life scenario. A miner living in my house took 500 milligrams of tramadol mixed with 5-Star to get high enough for an all-night shift in the underground mines. He ended up sleeping from 8:00 PM until the same time the next day with his room locked. We, his neighbors, thought he had left for the mine site until his friends, with whom he had made plans, came looking for him. They still found him sleeping and had to help us wake him up. He was very weak and clearly still high. We all thought he was dead, not knowing that the mixture of drug substances had overwhelmed his system. This incident

showed us how dangerous drug abuse can be. This guy could have died just like that because of drug abuse." (FGD, Takpo, Male, April 2023)

High Cost of Living

A mean of 3.24 indicates that the high cost of living is a prominent concern, slightly above the weighted mean. The presence of ASGM activities can drive up prices of goods and services, making it harder for local households to afford basic necessities. Inflation in local markets often results from increased demand by miners, who may have higher purchasing power compared to local residents. A retrenched miner who had worked with a mining company down south and had seen and observed the relationship between Mining and cost of living lamented that:

"Prices for everything have gone up. We can't keep up with the costs, and it's hard to make ends meet. Even basic items like food and clothing have become so expensive. The miners' extravagant spending has led to most sellers and service providers increasing their prices. For over two years now, a bottle of 5-Years whisky was selling at 5.00 cedis here, but in non-mining areas, it was sold for 2.50 to 3.00 cedis. Even a single sachet of pure water is priced higher when mining activities are ongoing. My brother, that's how things are priced higher in our community because they think we all gain higher incomes from mining. I used to work at Obuasi Anglogold Ashanti Company and have seen miners buy crates of drinks to wash their cars. I think we are gradually heading towards that in Danyooukuraa, a renowned mining community in the Wa East District," he added." (KII, Danyooukuraa, Male, April 2023).

ASGM operations attract individuals from many places worldwide to mining communities (Burrows & Bird, 2017), leading to higher expenses for necessary commodities including food, clothing, and shelter. Shortages occur when the demand exceeds the supply, resulting in price hikes. The confluence of diminished agricultural output and the burgeoning population in mining communities is expected to exacerbate the inflation of food crop prices. Danyo and Osei-Bonsu (2016) confirmed this discovery, demonstrating that the galamsey region had markedly elevated Consumer Price Indices in comparison to the national mean. The escalating expenses of commodities suggest that the welfare of the inhabitants in the mining communities, who do not

reap the advantages of the supplementary earnings produced by illicit mining, will decline since they will have the ability to get fewer items with their little incomes.

Drift of Farm Labor to ASGM

There is one form of nexus between mining and agriculture that has received very little attention though it is critical for conditioning food production and security. It is labor mobility. Artisanal and small-scale mining and agriculture compete for common labor who often resides in and close to communities that host mining (Al-Hassan & Amoako, 2014). Labor is an indispensable input in agricultural production cycle. The motivation of quick cash from mining often outweighs the long-term benefits of farming, causing a demographic shift in labor. A maize farmer explained:

"Many of our workers have left to work in the mines. We can't find enough people to help with the harvest anymore. It's affecting our ability to grow enough food. Even I'm left with only my wife and children, whose workforce is not enough for my 7-acre maize farm. The few laborers I managed to hire tried to charge me twice the usual rate for farm labor, which overextended my budget. I had to sell the remaining foodstuffs at home just to pay for the labor to work on 4 acres, leaving the remaining 3 acres unattended." (KII, Wuchema, Male, April 2023)

There is therefore gradual shift of family and communal labour supply to hired form of labour which is increasing the cost of crop production in the area considering the capita-handicap nature of rural farmers. In Africa, the declining viability of agriculture has led to a large decrease in agrarian activities and increased mining activities (Banchirigah and Hilson, 2010).

High Rate of School Drop Out

The high rate of school dropout, with a mean of 3.21, reflects a high perception of this issue. ASGM can attract young people away from education due to the immediate financial benefits, thereby affecting their long-term prospects. This trend has serious implications for the future human capital of the communities. A concerned parent Nba Dagiriga lamented that:

"My son, our kids are dropping out of school to work in the mines. They see it as a quicker way to make money, but it hurts their future. Education is their way out of poverty, but they don't see that. The few who are managing to attend school regularly are those who juggle between the mining site and school. They leave the house early in the morning dressed in their school uniforms and return home in the afternoon wearing mining attire. Most of them leave school after the second break, just before noon, and head straight to the galamsey site. This shift between school and mining is becoming more common, but it's not a sustainable solution. It's heartbreaking to see them sacrifice their education for short-term gains, unaware of the long-term consequences." (KII, Manwe, Male, May 2023)

During my visit to the Manwe Junior High School to ascertain the influence of Artisanal and Small-Scale Gold Mining (ASGM) on school enrollment, after my field observations and discussions with parents revealed a concerning trend. Most classes were experienced low enrollment, primarily because students are opting to work in the galamsey (illegal mining) operations instead of attending school.

Teachers at the Manwe Junior High School are also struggling with this issue. They reported that student attendance fluctuates significantly, particularly during peak mining seasons. One teacher mentioned,

"We've noticed that many boys, especially, are absent for long periods. When we follow up, we often find they are working in the mines. WE do sometimes make follow up to the house of such pupil to lay complaints and to convince them back to school but we are always not successful because the parents see nothing wrong with their children working on the minds even on schooling days." (KII, Manwe, Male, May 2023)

One parent-miner noted:

"It's hard to convince my son to stay in school when he can make money daily from the mines. We need the money to survive, but I worry about his future" (KII, Duu, July 2023)

The overall sentiment from my study was one of concern and frustration. The immediate gains from galamsey work are undermining the long-term benefits of education, creating a cycle

that is difficult to break. Both parents and educators are caught between the need for immediate economic support and the desire for a better future through education for their children.

According to Lui (2021), most child labour in artisanal and small-scale enterprises is classified as the most extreme forms of child labour as described by the ILO Convention (No. 182). Employers and organisations should support artisanal and small-scale mining in improving efficiency, production, and prosperity while eliminating child labour. Artisanal and small-scale mining have negative effects on children, such as harmful repercussions on their health, stunted growth, and limited access to education (Nkomo & Mpofu, 2022).

Simultaneously, there is growing proof that ASM promotes educational possibilities and attendance at school (Potter & Lupilya, 2016). As an illustration, parents frequently use their mine earnings to pay for their kids' tuition (Zolnikov, 2020, among others); nonetheless, some diligent kids and young people "mine their path to education." According to reports, kids in Sierra Leone, Kenya, and Mongolia integrate ASM with schooling by attending normal lessons and mining during breaks during the day or the weekend to pay for their tuition (UNESCO, 2018).

High Prevalence of Mining Related Diseases

The mean score of 3.18, just below the weighted mean, indicates a high perception of mining-related diseases. The health impacts of ASGM activities, including respiratory issues such as coughing, cold, skin conditions and malaria were reported as the rampant diseases, from exposure to dust and chemicals, significantly affect the well-being of community members. An in-depth interview with a community health volunteer reported that:

"We've seen more cases of respiratory problems and skin diseases since mining activities increased. It's affecting our health, and we don't have enough medical supplies to treat everyone." (KII, Duu, Male, May 2023)

A nurse who had worked in the mining community (Manwe) for more than 8 years commented that:

"We've seen a significant increase in malaria cases due to the pools of water left by mining operations, which provide ideal breeding grounds for mosquitoes. Nearly every household

has someone suffering from malaria. The number of malaria parasites found in some patients during laboratory tests is alarmingly high, often requiring us to refer them to the Wa Municipal hospital for further treatment due to the limitations of our facility. We are urgently appealing to the District Chief Executive (DCE) and the Member of Parliament to upgrade our CHPS compound to a polyclinic, enabling us to handle more critical ailments from the mining community. I am optimistic that this will happen soon given the impact of ASGM in our community." (KII, Male, Manwe, May 2023)

Conflicts/ Tension

With a mean of 3.11, which is below the weighted mean, conflicts and tensions are still a concern but perceived as less severe compared to other issues. However, they remain a notable problem impacting social cohesion. The competition for natural resources and the social disruptions caused by ASGM can lead to increased conflicts. As described Chief Agyemang (Pseudonym):

"There are frequent arguments and disputes over land and natural resources like gold and not trees, causing significant tension in our community. People who once lived in harmony now harbor distrust towards each other. Let me give you an example, my son. Just two weeks ago, we had to abandon our daily work to resolve a conflict between two families, each of them claiming ownership of a piece of land. When we asked why the land had been left idle without dispute, they explained that local prospectors had used a metal detector and found traces of gold in the soil samples. I had to return to my farm to finish my work and eat the yam I had roasted before being called. Later, I heard that the police had to arrest the two disputants due to the physical altercation that broke out over the land." ((KII, Male, Eggu, May 2023).

In Ghana, the occurrence of artisanal and small-scale mining (ASM) operations, which are sometimes short-term, has led to disputes over land among artisanal miners, mining corporations, local populations, and the government. This phenomenon arises when informal miners trespass onto the territories of established mining corporations or the territories of indigenous populations without getting prior consent (Nyame and Grant, 2014).

High Incidences of ASGM Induced Accidents

A mean of 3.48, the highest among the indicators, signifies a very high perception of accidents induced by ASGM. These accidents cause injuries or fatalities, severely impacting the livelihoods of affected families. The hazardous working conditions in ASGM pose significant risks to workers. Field observations at various mining sites, particularly the ‘Gbegebe’ site at Manwe and the ‘World Bank’ site, reveal a blatant disregard for personal protective equipment (PPE) such as goggles, gloves, nose masks, and metallic boots. To substantiate the above views from miners a female miner recounted that:

“Mining accidents are common in this community. There are many people with fractures of different kinds, ranging from their fingers, limbs, arms, and legs. Others suffer from chronic backaches due to the frequent lifting of heavy materials at the mining site. My husband was recently slacked from a mining pit, fell, and broke his arm. Now, I have the responsibility of fending for our children alone.” (KII, Female, Duu, March 2023)

Pollution of Water Sources

The mean score of 3.09, although slightly below the weighted average, highlights a significant concern regarding water pollution resulting from ASGM (Artisanal and Small-Scale Gold Mining) activities. Previously safe streams for drinking water, farming, and other domestic uses have been compromised due to competition and pollution from ASGM operations. Some mining sites even connect pipes directly to water bodies, causing direct contamination. This same water, used for fishing and irrigation, is also utilized in mining activities, leading to farmers being idle during the dry season due to competition with miners for water resources. This situation not only impacts their livelihoods but also forces them to diversify their income sources, often turning to mining for higher earnings. Additionally, field observations indicate that miners frequently dispose of mercury-contaminated wastewater indiscriminately onto the ground, without considering the risk of contaminating underground aquifers. Dewatering effects are common in many mining communities, making underground water unsafe for drinking.

6.15 Evaluation of the Five Livelihood Assets in the Study Area

Chapter two of this study thoroughly explored the Sustainable Livelihood Framework (SLF), which was employed to evaluate the livelihood assets in the artisanal and small-scale gold mining (ASGM) communities in the Upper West Region. This evaluation focused on the five types of assets or capitals defined by the SLF: human, social, natural, physical, and financial capital. The study did not reveal significant differences in these assets either between or within the three mining districts of the Upper West Region. Therefore, this section aimed to assess these assets based on their availability and accessibility in pursuing the livelihoods in the context of ASGM activities in the study area.

Human Asset

Human capital refers to the economic value of a worker's experience and skills for the effective execution of various livelihood strategies. This includes assets such as education, training, intelligence, skills, health, and other qualities that employer's value, such as loyalty and punctuality. The studied communities possess a capable workforce, with the majority falling within the youthful age range of 15 to 54, as indicated in Figure 4.2.2 under the demographic characteristics of the respondents. In all three districts, the majority of miners are below the age of 45, making them active, agile, and physically equipped to handle the demanding nature of mining activities.

However, the activities of ASGM have negatively impacted the educational and health status of the inhabitants in the ten mining communities under study. As indicated in Table 4.2.4, a significant majority of surveyed miners (62.5%) and non-miners (75%) lacked formal or basic education. This low level of educational attainment limits their ability to engage in meaningful occupations related to education, such as banking, teaching, and nursing (Mihaye, 2013). This insight aligns with the observed prevalence of basic tools and minimal technological application within the small-scale mining sector across the selected mining communities of the Upper West Region. Additionally, the widespread issue of illiteracy complements findings by Awumbila and Tsikata from their 2004 study, which underscored that ASGM activities have played a significant role in escalating the number of school dropouts within mining areas.

According to the study respondents, ASGM activities have had a negative impact on their health, as shown in table 6.7, which indicates that malaria is the most common health problem among locals, with a resounding 65.62% of respondents supporting this claim. People in the study area also suffered from cholera, colds, coughing, musculoskeletal issues, and severe respiratory infections (RTI). Considering the body of evidence that has been analysed thus far, the human capital or assets in the study region are seriously at risk due to ASGM. As a result, measures must be taken to raise productivity and employment opportunities outside of ASGM in order to improve the well-being of the population.

Physical Asset or Capital

Physical capital refers to the basic infrastructure and goods necessary for sustaining livelihoods, including buildings, roads, transportation, water supply, and sanitation systems (Fuseini, 2024). Numerous studies on livelihood evaluations and poverty suggest that the lack of essential infrastructure, such as markets, hospitals, and roads, is a core factor contributing to poverty (DFID, 1999).

The community's infrastructure, particularly concerning water and sanitation needs to be improved. Many boreholes were broken down, while others fail to supply sufficient water due to dewatering effects on the water table in areas with prevalent underground mining. Miners lack well-structured toilets, leading them to resort to open defecation, which jeopardizes the health of the entire mining community.

As previously discussed, artisanal and small-scale gold mining (ASGM) has caused significant air and water pollution across the three districts studied, endangering both miners and non-miners. Additionally, there is indiscriminate discharge and deposit of solid and liquid waste from the mining sites, particularly at grinding mill shops located in the center of communities. This situation highlights the absence of waste collection bins needed for proper waste disposal.

Furthermore, there is a significant deficit in health infrastructure within the mining communities. The geographical isolation of many mining areas limits access to well-equipped and modern health facilities. The most common health facilities in the study area are CHPS (Community-Based Health Planning and Services) compounds and scattered drug stores, which

are inadequate for managing mining-related ailments. Consequently, patients often need to be referred to district, municipal, or regional hospitals located in the capitals of the districts and regions for proper medical attention.

The road networks leading to the mining areas in the study region are in a deplorable state, posing significant dangers to both smallholder farmers and miners. Most of these roads are not tarred, rendering them slippery and muddy during the rainy season. A visit to several mining sites during this season revealed motorbikes and cars stuck in the mud, making access to farms and mining sites exceedingly difficult. This situation has severely impacted farmers' ability to transport their produce to the market, leading some to abandon farming in favor of artisanal and small-scale gold mining (ASGM), as gold is easier to transport than heavy bags of farm produce.

Despite these physical capital challenges, there has been an improvement in housing infrastructure. Some brick and thatched houses have been converted into more durable structures made of concrete and zinc, thanks to the income generated from ASGM activities. However, many miners were observed using faulty and low-grade tools and equipment, which increases their risk of accidents, injuries, and diseases. On the other hand, some miners and farmers have been able to purchase better farming and mining tools with the income from ASGM. For instance, respondents indicated that some miners were able to buy tractors and threshers for farming activities with the income generated from mining.

The mining communities studied suffer from significant infrastructural deficits, including a lack of well-equipped hospitals and clinics, good roads, boreholes, standpipes, and sanitation facilities such as toilets and waste bins. These deficiencies are largely due to the illegal nature of mining in the area. Without licenses and permits, miners operate without accountability to the welfare of the inhabitants of mining communities, neglecting their Corporate Social Responsibility (CSR). Most miners and mining groups are local residents of the communities where they operate, leading to a lack of external pressure to provide infrastructure. This situation is exacerbated by the manner in which land is acquired for ASGM activities, typically involving family lands and leases from community chiefs.

Financial Assets

Since formal financial institutions were not accessible in the study area, the financial capital was found to be inadequate. Because of this, getting credits is extremely tough for both miners and non-miners, and they must rely on friends, family, and mining sponsors. The study's participants' attitude towards saving has also been adversely affected by the absence of banking institutions. The gold purchasers in the mining towns typically risk their financial stability by storing their capital in their homes. A Burkina Faso gold buyer disclosed how he got burned, along with tangible currency that he was unable to even quantify and gold nuggets. Due to the dearth of banks and other financial institutions in the numerous mining settlements, he claimed to have saved it in the house.

Due to the unlawful nature of their business, miners' lack of collateral has made them even more financially vulnerable. The majority of miners cited this to be one of the factors preventing them from obtaining startup funding for their mining operations.

Social Capital

Social capital is the social resources people rely on when implementing various livelihood strategies that require collective effort—such as social connections, networks, relationships, associations, and affiliations (Bernados & Ocampo, 2024). All of the miners in the community who were interviewed revealed that they were all affiliated with some sort of group or association. The leaders of mining associations were found to be responsible for the welfare of the miners, particularly during times of accidents or injuries. In all three districts surveyed, miners were found to be operating in cohesive groups and led by either a chairman or a sponsor.

In addition, small-scale miners were always required to make donations in order to use them as leverage with security personnel and regulatory agencies in the event that they were detained or had their tools seized from the mining site. There were, nevertheless, some areas of mistrust between foreigners who either entered the mining villages to buy or mine gold and the indigenous small-scale miners. Once more, there have been reported instances of disputes within native miners themselves on who controls and manages mining sites and pits.

Natural Capital

Natural resources such as soil, water, air, and genetic diversity, along with environmental services like carbon sequestration, pollution absorption, and the hydrological cycle, are crucial for sustaining livelihoods (Sharma & Birman, 2024). This natural or environmental capital is essential for supporting various rural livelihoods. However, the activities of artisanal and small-scale gold mining (ASGM) in the study area have degraded the quality of water, land, and biodiversity, which are vital for agriculture, the primary occupation of most residents.

ASGM operations have also compromised air quality. Chapter seven of the study, highlights the adverse effects of ASGM on the physical environment, including water pollution, land degradation, and biodiversity loss, as reported by both miners and non-miners. These environmental impacts threaten livelihoods such as farming, animal husbandry, fishing, shea nut picking, and charcoal production, pushing many rural inhabitants toward mining and other jobs to sustain their livelihood portfolios.

Additionally, members of mining communities often view gold as an open-access or common-pool resource, leading illegal miners to exploit the land without regard for sustainable practices. This has resulted in the creation of numerous gullies and uncovered mine pits, the removal of vegetative cover, and increased erosion, thereby reducing the available farmland. In some cases, ASGM activities have restricted farmers' access to land, further endangering the primary livelihood of rural communities.

6.1 Summary of Chapter

This chapter assesses the implications of artisanal and small-scale gold mining (ASGM) on rural household livelihood diversification, assets, and activities in mining areas. It reveals that ASGM has substantially disrupted traditional livelihoods, with a notable impact on agriculture and land-dependent activities. Crop farming emerges as the most affected livelihood, followed by livestock rearing, shea nut picking, and fuel wood fetching. The expansion of mining operations has led to the takeover of farmlands, land degradation, and the creation of uncovered mine pits, which have significantly reduced available farmland and adversely affected agricultural productivity.

Despite these negative impacts, ASGM has provided economic benefits to community members. The study highlights that mining serves as a crucial source of income and improves overall well-being for both miners and non-miners. However, the benefits are unevenly distributed, with non-miners perceiving more significant improvements in income and alternative livelihood opportunities. The proceeds from ASGM are frequently reinvested into agricultural activities, indicating a complex relationship where mining income supports farming operations and helps mitigate some of the adverse effects of mining on agriculture.

Additionally, the chapter examines the varied responses to coping strategies adopted by community members to manage the challenges posed by ASGM. Although a majority of respondents have implemented strategies to address the negative impacts, a significant proportion has not, highlighting potential vulnerabilities. Effective coping mechanisms are essential for sustaining agriculture and livelihood diversification in mining-affected areas. There was a sharp disparity between high mining income and lower agricultural earnings

CHAPTER SEVEN

ANALYSING THE ENVIRONMENTAL EFFECTS OF LAND USE LAND COVER

TRENDS DRIVEN BY ASGM IN THE UPPER WEST REGION

7.0 Overview

The harmful impacts of ASM on the environment and public health in the surrounding communities have been highlighted by authors such as Tschakert & Singha and Armah et al. (2013); Otoo (2021). The primary objective of this chapter is to do a thorough analysis of the environmental repercussions associated with Artisanal and Small-Scale Gold Mining (ASGM) and to ascertain successful strategies for alleviating these effects. ASGM is a substantial economic endeavour that supports both the livelihoods as well as local economies of millions of families in developing countries. This chapter also relied on the interpretation of Landsat images to ascertain the land use land cover changes (LULCC) that have occurred from 2002 to 2022 as a result of anthropogenic factors such as mining, charcoal production, bush burning and farming among others.

7.1 Awareness Level on the Consequences of ASGM on the Physical Environment

The results as displayed in figure 7.1 show the level of awareness of the adverse environmental impacts of ASGM amongst miners and non-miners in the study area. The findings revealed that, out of the 40 miners interviewed, 32 of them, accounting for 80.0% of the respondents, admitted to being cognizant of the adverse effects that mining activities have on the natural environment while a minority of 20.0%, equivalent to 8 miners, indicated a limited level of knowledge pertaining to the environmental consequences in question.

Again, the findings from an analysis of 320 non-miners revealed a greater level of consciousness, as 90.3% (about 289 out of 320) of participants confirmed their knowledge of the adverse effects linked to mining operations. In comparison, a smaller proportion of 9.7%, approximately comparable to 31 out of the 320 individuals who are not engaged in mining activities, indicated a lack of awareness regarding the environmental consequences.

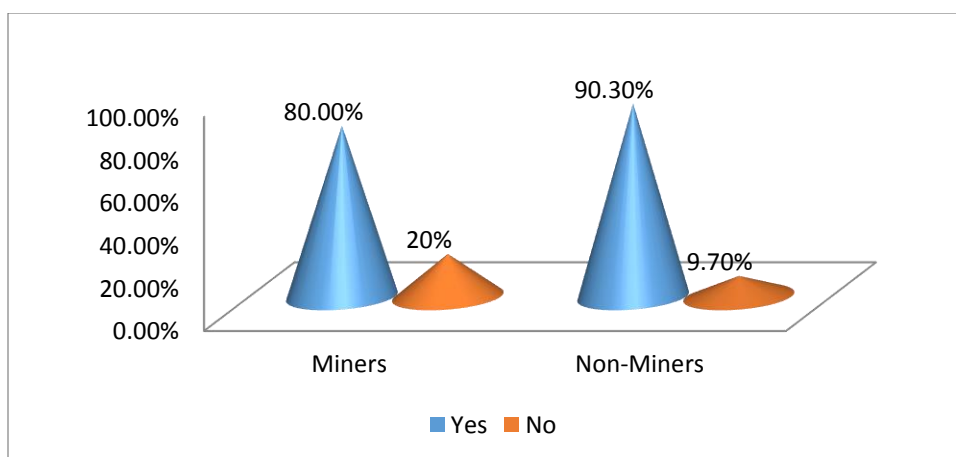


Figure 7.1 Awareness Level of respondents of the Consequences of ASGM on the Physical Environment

Source: Field Survey, 2023

This disparity may indicate that individuals who are not involved in mining have either had greater access to information regarding the subject or experience the consequences of mining more strongly in ways that do not directly impact the immediate livelihoods of miners. The findings of the study indicate that miners' inclination to persist in their mining operations for economic reasons has influenced their perception and willingness to recognize the adverse environmental consequences associated with their activities.

7.2 Perceptions on the Negative Consequences of ASGM on the Physical Environment

The data displayed in table 7.2 indicates the perceived negative impacts of artisanal and small-scale gold mining (ASGM) on the physical environment among two groups: miners and non-miners. Seven key environmental issues were highlighted: loss of vegetative cover, air pollution, noise pollution, water pollution, threat and loss to biodiversity, uncovered mine pits as potential death traps, and soil erosion/removal of topsoil.

Table 7.2a: Negative effects of ASGM on the Physical Environment

Negative Effects of ASGM on the Physical Environment	Miners (n=40)			Non-Miners (n=320)		
	Yes	No	Total	Yes	No	Total
Land degradation	27 (67.5%)	13 (32.5%)	40 (100%)	257 (80.3%)	63 (19.7%)	320 (100%)
Air pollution	34 (85.0%)	6 (15.0%)	40 (100%)	282 (88.1%)	38 (11.9%)	320 (100%)
Noise pollution	24 (60.0%)	16 (40.0%)	40 (100%)	266 (83.1%)	54 (16.9%)	320 (100%)
Water pollution	12 (30.0%)	28 (70.0%)	40 (100%)	97 (30.3%)	223 (69.7%)	320 (100%)
Threat and loss to biodiversity	16 (40.0%)	24 (60.0%)	40 (100%)	258 (80.6%)	62 (19.4%)	320 (100%)
Uncovered mine pits as death traps	26 (65.0%)	14 (35.0%)	40 (100%)	244 (76.3%)	76 (23.8%)	320 (100%)
Soil erosion/Removal of topsoil	21 (52.5%)	19 (47.5%)	40 (100%)	252 (78.8%)	68(21.3)	320 (100%)

Source: Field Survey, 2023

Land degradation

The artisanal and small-scale gold mining sector makes significant contributions to the economy. However, it is crucial to highlight the detrimental impact it has on environmental degradation (Kitula, 2006; Andeyo, 2021). The results from table 7.2 reveal a significant concern highlighted by both miners (67.5%) and non-miners (80.3%) is land degradation. This high level of awareness underscores the visible and immediate effects of ASGM, such as deforestation and habitat destruction. A study observation made to most mining sites reveals indiscriminate felling of trees hence making land susceptible to erosion leading to land degradation. There are a lot of gullies left uncovered after mining activities in the study area making lands unsuitable for agricultural purposes. A community elder mentioned in a key informant interview that

“If you want to know the consequences of ASGM on our lands, it will take you all day. All of the mining sites have had their top soil scraped away. It's shocking that these miners care so little for the land when gold is discovered. They apply shovels, pick axes, and in certain cases excavators, particularly surface miners, to remove trees and dig trenches all around.” (KII, Polee, Danyoukura May 2023)

Soil erosion is a primary sign of land degradation, often accompanied by a decrease in vegetation cover and alterations in vegetation composition (Al-Hassan and Amoako, 2014). This leads to land excavation, which can result in the mortality of animals as they may inadvertently fall into these holes while in motion. Additionally, this activity poses a significant risk to human safety.

This study finding agrees with Bansah and Bekui (2015) who asserted in their research that surface artisanal and small-scale mining practice frequently leads to the extraction of significant amounts of topsoil than underground mining, resulting in the exposure of the land and making it vulnerable to erosion and further degradation. Again, agrees with Oblokuteye (2010) where ASGM was referred to as cause of land degradation through the expansion its activities, resulting in the removal of topsoil in many mining areas.



Plate 7: A hollow created by ASGM



Plate 8: Trenches created by Miners

Source: Field Survey, 2022/2023

Air Pollution

Air pollution is another critical concern, acknowledged overwhelmingly by both groups—85% of miners and 88.1% of non-miners. The activities associated with ASGM, including the dust

from excavation and the use of hazardous chemicals like mercury, degrade air quality. This widespread concern reflects the direct health impacts of polluted air, affecting respiratory health among both miners and the surrounding communities. The grinding workshop in Manwe exhibits a wanton disregard for personal protective equipment (PPEs), as observed during a field observation tour. Every demographic, including men, women, and even infants under a year old, was observed at this mining site without breathing in machine dust. One of the women disclosed when questioned in a focus group discussion about the harmful effects of the dust they were breathing in,

‘My son, the problem of dust is no longer news to me. I have been inhaling dust ever since mining started in this community, and as a result, I suffer from chest pains. Unfortunately, I do not have enough money to relocate away from this dusty environment. Even inside our home, all our belongings, including our eating bowls and cooking utensils, are covered with dust. We have to clean our bowls before every meal to remove the dust; otherwise, we would be consuming it. Dust is everywhere in our living surroundings, and it feels like we are eating dust every day’. (FGD, Female, Manwe, April, 2023)

Another male miner disclosed that:

‘A lot of people in this area are now coughing frequently all due to incessant exposure to large volumes of dust inhaled into their lungs. Such people instead of seeking for medical treatment from a hospital they rather resort to drinking liquid milk in the name of cleaning the dust from their chest’. (FGD, Male, Manwe, April, 2023)

This study results corroborates with Dreschler (2001) when he uncovered in his study that formation of dust and emission of mine gases, particularly during drilling, blasting, grinding, and crushing of ore, contribute to air pollution caused by artisanal and small-scale gold mining activities. The findings didn’t also deviate from those of (Kitula, (2005) and Andeyo (2021) as their studies unearthed a significant health risk posed to miners due the limited space in small-scale underground mining operations which causes dust to build in the stops.

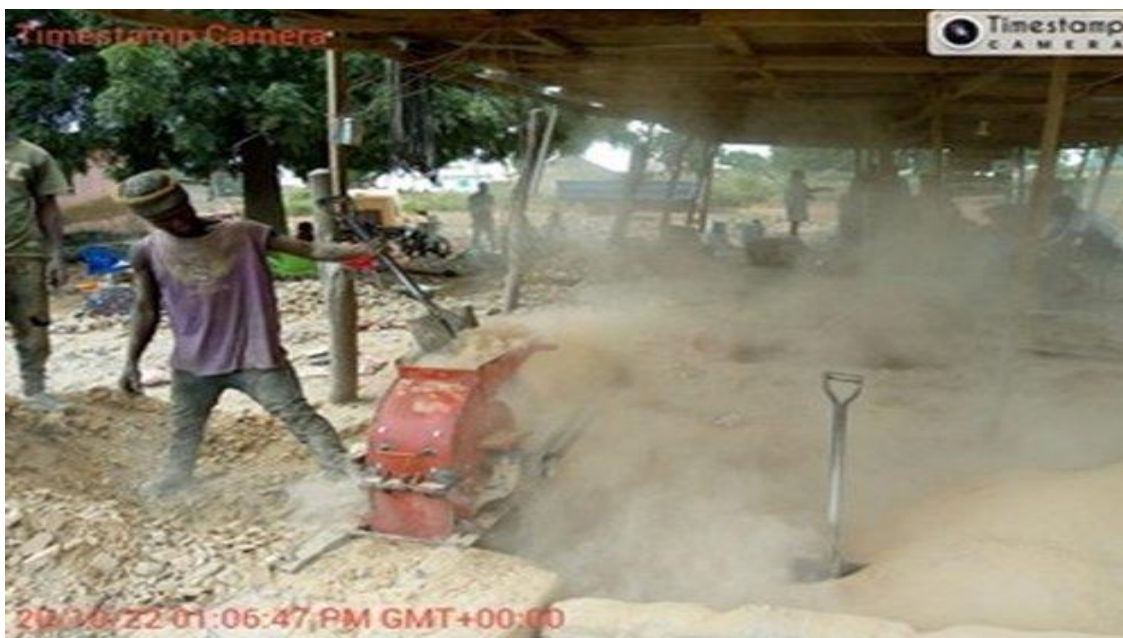


Plate 9: Air Pollution at a mining site Source: Field Survey, 2022/2023

Noise Pollution

Noise pollution is recognized as an issue by 83.1% of non-miners, but only 60% of miners. This gap likely reflects the miners' habitual exposure to the constant noise of machinery and excavation work, use of explosives for blasting may lead them to underplay its significance. The pervasive noise associated with mining activities in the study area not only disrupts human life and behavior. A 48-year-old miner opined that:

‘I have been living with noise from mining grinding machines (Crushers) for more than 10yrs now. If you speak in a low tone to me now, I find it difficult to hear unless you shout. Even my children are used to loud noise because they are living with noise almost every day and sometimes our ears become very heavy. I have visited the only CHPS (Community Health Planning and Services) compound here but no improvement. I think am gradually losing my hearing ability which can lead me to a complete deaf. ‘Karakyyidao’ (lettered person referring to researcher), I now hear very well if only one can shout on top of his you/her voice. Don’t you see how closer I am to you whiles listening? Even to talk to someone I have to speak louder than normal because is like am always within the same decibel of noise. I cannot prevent the noise because the owner of the machine is my sister’s son (cousin) and he sometimes gives me and my children food out of the mining activities.

My wife who lost her school feeding job as a caterer is even a worker there so I have no other option than to live with it.'' (KII, Male, Manwe, March, 2023)

The utilisation of explosives and substantial machinery for excavation results in noise and vibrations that can have significant impacts on both mine workers and the surrounding regions. Prolonged exposure to loud noise can result in temporary or permanent hearing loss. It can also elevate stress levels and have an impact on heart function, potentially leading to cardiovascular illnesses and hypertension (Jariwala et al., 2017). However, my study findings disagree with that of Anyona and Rop (2015a) when they found out that the surrounding settlements infrastructures may experience cracking or even collapse, posing a hazard to human life as such experience was not discovered in my study.

Water Pollution

Interestingly, the acknowledgment of water pollution's impacts is similarly low among both miners (30%) and non-miners (30.3%), suggesting a potential underestimation of this issue. The processes involved in ASGM can introduce toxic substances like mercury and cyanide into water bodies, affecting water quality and aquatic life. The relatively low awareness might be due to the less immediate visibility of these effects compared to other forms of environmental degradation, or possibly a lack of direct linkage to ASGM activities by the affected communities. A miner confirmed their activities negative effects on water pollution by mentioning that:

‘‘I understand you're referring to how the Galamsey people are ruining water bodies down south. We use water in a different way. We don't carry our samples to the water and wash them; instead, we wait for others to go to the stream and fetch us in large containers (Kufour Gallons) using ‘Jaaba’ lorry (Tricycle). Another way use water that I can say is polluting water bodies is the method of using long water hose to pipe the water from the dam to our mining site for use. That is why we are saying our colleagues down south are making this work difficult for us here in the north’’. (KII, Manwe, March 2023)

Another miner in Polee revealed that:

‘‘We go to the stream location but don't wash inside; instead, we divert the water into a different pool for mining activities. I do not believe we are destroying water bodies as we have been witnessing in the news every day.’’ (FGD, Polee, April 2023)

An analysis of the respondents' narrations highlights a unique form of water pollution and a shortage of water for agricultural purposes. There was another concern raised by gardeners who rely on this same water bodies for their dry season irrigation. A gardener complained that

‘‘The way the galamseyers use water does not benefit our garden business at all. Each mining site can require 60 yellow gallons of water every day, and there are over 15 mining sites and more than ten grinding mill stations in this community alone. Now, you have a pen and paper use that, calculate and compare the quantity of water they use each day. Their enormous use of water has frequently thrown us out of business during the dry season due to shortage of water. If the government could aid us with one of the one village, one dam projects, I believe it will help.’’ (KII, Manwe, April 2023).



Plate 10: Mining Polluted Water



Plate 11: Water Channeled to a Mining site

Source: Field Survey, 2022/2023

Despite the above revelations, ASGM operators often attempt to downplay the severity of their actions by comparing their pollution levels to those in the southern ASGM regions, implying that their impact is less significant. However, regardless of these comparisons, the undeniable reality is that water pollution is occurring. The miners' justifications cannot obscure the fact that their activities are contributing to water shortage and its contamination, which affects not only their immediate surroundings but also the broader community. The water they use in their mining

processes introduces pollutants that compromise water quality, rendering it unsuitable for drinking, cooking, and agricultural activities.

My study's finding agrees with that of Nthambi and Orodho (2015) who demonstrate that the practice of artisanal sand mining in Kathiani, Machakos County, Kenya has resulted in a decrease in the amount of water in rivers and the drying up of rivers for other use such as agriculture. Nyame and Grant (2014) observation that the practice of artisanal gold mining in Ghana has resulted in the introduction of mercury into water bodies as a consequence of the gold amalgamation process, hence leading to water pollution agrees with this study.

Nevertheless, my research found no evidence of subsurface water pollution in any of the ten mining settlements in the Upper West Region. It only discovered community members' beliefs that underground ASGM was to blame for some of their malfunctioning boreholes and standpipes owing to de-watering effects. A probe from the Environmental Protection Agency discovered that there are no such records on underground water pollution, even at mine sites

Threat and Loss to Biodiversity

The threat and loss to biodiversity is a major concern for non-miners (80.6%), significantly more than for miners (40%). This disparity likely reflects a greater recognition among non-miners of the ecological impacts of ASGM, including the loss of flora and fauna. Mining operations disrupt ecosystems, leading to habitat destruction and species displacement or extinction. The lower acknowledgment by miners may be influenced by their economic dependence on ASGM, which could overshadow environmental considerations.

The destruction of natural habitats to facilitate mining operations has led to the depletion of key ecosystem services formerly provided by these biological resources. Notably, the medicinal and nutritional benefits derived from the local flora and fauna are no longer accessible. Community members report the loss of critical vegetative elements such as leaves, barks, roots, and stems, which were once utilized for medicinal purposes.

An elder from the community, when queried about the ramifications of such ecological degradation, expressed profound concern over the disappearance of these natural resources. He noted the irreversible loss of traditional medicinal practices that had been passed down through generations and had been a cornerstone of their cultural and physical well-being. His remarks were:

"While mining has allowed us to feed, clothe, and educate our children, it's also had some serious drawbacks, particularly in terms of the availability of certain plants that were once

common. For example, Neem trees used to be found in every corner of our community, but now, as an elder, I can walk around and count all the Neem trees that remain. 'Nye, sunsungree dao tonna kuŋ baŋ bigihi ati baahi, Kyaa jaa ka salmabiihi Kye baahi'—to with the usefulness of the Neem tree cannot be narrated to exhaustion, but unfortunately, they've been largely cut down by miners. Back when there were no drug stores around, we would harvest Neem leaves. We'd boil these leaves and either steam over the pot or drink and bathe in the cooled concoction to help treat malaria, stomach upsets, and fever. Now, due to the impact of mining on these we have lost these valuable trees." (KII, Male, Manwe, April, 2023)

Further interview with community members and other opinion leaders reveals several important plant species have been decimated. Some recounted among the species affected by mining activities as shea tree (*Vitellaria paradoxa*), known for its valuable nuts used in shea butter production; the locust bean tree (*Parkia biglobosa*), whose seeds are a staple in local foods; the kapok tree (*Ceiba pentandra*), with its cotton-like fiber used in various traditional applications; the monkey guava (*Diospyros Mespiliformis*), a source of fruit and wood; and mahogany (of various species), highly prized for its durable, high-quality timber. These losses highlight the adverse impact of mining on biodiversity and the local ecosystem, which has historically supported the livelihoods and cultural practices of these communities.

When a woman, who has lived in one of the affected communities for over thirty years, was asked about the impact of mining activities on tree species and their connection to her livelihood, she highlighted the shea tree (*Vitellaria paradoxa*) as a critical example. The decline of these trees due to mining activities has led to a significant loss of income for her and others who depend on harvesting and processing shea products. This situation underscores the broader socioeconomic impacts of environmental degradation caused by unchecked ASGM practices. She asserted that:

"The gathering of shea nuts, which used to start at 4 in the morning, has become a nightmare for us. We used to depend on these nuts because agriculture isn't as productive as it used to be. The income from processing the shea nuts into oil, selling them raw, and even the fruits themselves have all been lost due to the ruthless actions of miners. Imagine waking up at 4:00 am, only to find that the tree you were counting on has been cut down for gold mining. And there's more to worry about. The few shea

trees that are still healthy and thriving enough are usually near the mining areas, and it's scary getting too close. We're genuinely afraid of the miners; they could be high on drugs or armed with things like guns, knives, or machetes. Actually, there was this one time, a fellow villager... uh, what was her name... ah, yes, Nma Hayon (Pseudonym), she was attacked by some miners on her way to the bush to collect shea nuts. She had to toss her basin aside and run for her life."(KII, Female, Polee, April, 2023).

In addition to concerns about the loss of common tree species due to mining activities, respondents in field interviews also expressed distress regarding the impact on local wildlife. They noted that animals such as rabbits, rats, antelopes, deer, and squirrels, among others, have suffered greatly as their natural habitats have been destroyed by mining operations. These animals, which once lived in proximity to the community and were an integral part of the local ecosystem, have now been forced to migrate deeper into the wilderness to find suitable living conditions. This displacement not only affects the biodiversity of the area but also disrupts the traditional interaction between the community members and these animals, some of which were regarded as close to domesticated due to their frequent interactions with humans. A community chief who added his voice on the above revelations disclosed that:

"As the chief of our community, I've observed devastating changes due to the mining activities here. 'Karichyi Dao', to wit, lettered person, let me share how drastically things have changed for us, particularly for our hunters. Previously, hunters could simply walk a short distance from our village to find game like deer and antelopes. Now, these animals have fled deep into the wilderness to escape the disruption caused by the mines. Our hunters must now use trucks to travel to distant villages just to begin their hunt. This not only increases their costs but also diminishes the time they can actually spend hunting." (KII, Male, Duu, April, 2023)

Another community member who indicated he was born and bred in a mining community opined that:

"We've lost our traditional bush meat, which was once a staple in our diet. These days, rather than relying on the meat we hunted, we find ourselves having to buy fish or meat from private vendors. It's a significant change from the past when our meals were directly sourced from our immediate environment." (KII, Male, Wuchema, March, 2023)



Plate 12: Trees Felled by Miners

Field Survey, 2022/2023

To buttress the above findings, field observations conducted at several mining sites, such as 'Gbegebe,' 'World Bank,' and 'KodaNaahu,' highlight significant environmental impacts, particularly the widespread clearance of economically important trees to facilitate mining operations. At these sites, a variety of valuable species, including the shea tree, ebony, baobab, neem, and kapok, are routinely cut down. This deforestation has multiple adverse effects: it reduces biodiversity, disrupts ecosystems, and removes critical resources that local communities rely on for economic and medicinal purposes.

The above findings agree with Mathada (2014) who found that small-scale mining disrupts processes that build, connect, and preserve habitat, which in turn affects the structure and function of habitat. Again, it aligns with the study of Abdulgafar and Ishola (2014), small-scale and artisanal gold mining often involves clearing land and cutting down trees to make way for mining. The destruction of natural habitats has a devastating effect on local ecosystems, driving animals to seek refuge elsewhere or even kill them.

Table 7.2b: Some Endangered Plant Species of the Mining Communities Due To ASGM

Scientific Names	Common English names	Local Names (Waale)	Importance/Uses
Vitex Doniara	Black Plum	Haara	Leaves used as food, edible fruits, young leaves for curing malaria; headache; fuel wood for cooking, Roof frame, forage for livestock
Balanites Aegptiaca	Desert Date	Gango Dao	Fruit Edible, Seed for Oil, Medicinal, Manufacture of Soap
Bombax Costatum Kapokier	Red Silk-cotton Tree	Vorgaa	Medicinal, Fruit Edible, Woods Building Materials, Cooking Soap
Lannea Microcarpa	African Grape	Nansarsungsugree	Fruit, Medicinal, Making Drinks
Borassus Aethiopum	African Fan Palm	Konkonga	Making Of Palm Fans, Fruit Edible
Ceiba Pentandra Kapok	Kapok Tree	Goŋo Dao	Plywood Manufacturing, Light Weight Joinery Material, For Pillow Making, Purpose for Headache, Dug Out Canoes
Deuterium Microcarpum	Sweet Detar	Kpagraa Dao	Medicine For Malaria, Wounds, Fruit Edible, Edible Leaves
Parkia Biglobosa	African Locust Bean	Duo Dao	Edible Fruits, Medicine for Treating Malaria
Vitellaria Paradoxa	Shea Tree	Tangaa	Edible Fruits, Medicine for Skin Diseases, For Making Cooking Oil, Pomade for Skin, Fuel Wood
Diospyros Mespiliformis	Ebony	Gaa	Edible Fruits, Medicine for Malaria, Fuel Wood, Fodder for Cattle (Protein)
Adamsonia Digitata	Baobab	Tuo	Edible Fruits, Fresh Leaves Edible, Medicine For wounds. making drink, Toothache,
Azadirachta Indica	Neem	Sungsugree	Useful In Detoxification, Insects And Mosquito Repellent, treating stomach upset, Fungal Infection, Treat Wounds, treat fever

Source: Adapted from Cobbinah et al., (2012) and modified (2023).

7.3 Land Use Land Cover Analysis of the Nadowli-Kaleo District

Table 7.3 highlights significant land use changes over the study period. The results show an increase in water bodies from 2002 to 2010, with further growth between 2010 and 2022. Closed vegetation decreased significantly from 9082.90 hectares in 2002 to 3461.64 hectares in 2010, but then rebounded to 6025.58 hectares by 2022. Open vegetation consistently expanded from 79602.88 hectares in 2002 to 94785.91 hectares in 2010, and slightly decreased to 89079.44 hectares in 2022. Built-up areas also saw a steady rise from 5492.10 hectares (4.87%) in 2002 to 8269.66 hectares (7.33%) in 2010, reaching 10913.35 hectares (9.68%) by 2022. This continuous increase in built-up areas suggests a reduction in bare lands over the 20-year period.

Table 7.3a: Statistics of Land Use and Land Cover of Nadowli-Kaleo

LULC Classes	2002		2010		2022	
	Area (ha)	Percent (%)	Area (%)	Percent (%)	Area (%)	Percent (%)
Bare lands	18360.59	16.28	6465.08	5.73	5996.85	5.32
Built-up	5492.10	4.87	8269.66	7.33	10913.35	9.68
Closed vegetation	9082.90	8.06	3461.64	3.07	6025.58	5.34
Open vegetation	79602.88	70.60	94785.91	84.06	89079.44	78.99
Water bodies	220.71	0.20	247.91	0.22	279.13	0.25
Total	112,759.18	100	112,761.97	100	112,762.58	100

Source: Field Survey, 2023

The data indicates that 18360.59 hectares of land remain without vegetative cover, primarily due to human activities such as charcoal burning, farming, fuel wood collection, and mining. These activities, driven by the need to sustain livelihoods, have significantly degraded the physical environment of the Nadowli-Kaleo District (Laari et al., 2016). Illegal mining and the operations impacted water bodies and vegetation. Secondly, prospecting activities of Azumah Resources Limited, which involve heavy machinery, have particularly caused devastation to the physical environment. The use of such machinery can clear vast tracts of land, including economically valuable trees.

The steady increase in built-up areas is linked to the influx of workers and their families due to mining activities. Improved infrastructure and a growing population can also diversify local livelihoods, leading to the development of new businesses and services such as retail and transportation. Closed vegetation areas experienced an initial decline but later increased. In 2002, closed vegetation covered 9082.90 hectares (8.06% of the total area), dropping to 3461.64 hectares (3.07%) by 2010. However, by 2022, the area had risen to 6025.58 hectares (5.34%). This fluctuation suggests periods of deforestation followed by reforestation or natural vegetation recovery. The increase in closed vegetation from 3461.64 hectares to 6025.58 hectares is partly due to the halt in activities such as farming, charcoal burning, and mining by the local inhabitants, enforced by military protection of Azumah Resources' concession. Consequently, ASGM activities and other economic activities by the local population now occur mainly at the periphery of the company's concession. To substantiate the above claim, a community elder who doubles as farmer during a key informant interview lamented that:

"We are no longer permitted to enter the concession of Azumah Resource Company because the government has leased it to them. They have now set up a military camp in the middle of the concession, claiming it is to prevent us from engaging in illegal mining on Azumah's land. This area includes several acres of farmland and economic trees, vital to our livelihoods. We can no longer farm, collect fuel wood, or produce charcoal on any land within Azumah's concession without risking our lives due to the presence of armed military personnel. Even women who used to pick shea nuts are often mistaken for trespassers and have their basins and cutlasses confiscated by the military. With our traditional means of survival taken away, we are now forced to prospect and mine on adjacent lands, just meters away from Azumah's concession, to avoid conflict." (KII, Nanga, May 2023)

In contrast, the decrease in closed savannah from 9,082.90 hectares (8.06% of the total area) in 2002 to 3,461.64 hectares (3.07%) in 2010 can be attributed to the surge in human activities such as farming, charcoal burning, and mining, which caused significant physical damage to the land and economic trees. To illustrate the possible causes of this decline in closed savannah, a young miner from Wuchema shared:

"Back then, this entire area was covered with trees where we collected fuel wood and herbs. However, the advent of mining has led us to cut down these trees and leave behind uncovered mine-pits. We didn't do this without reason; it was for the survival of our families. Farming has become less viable due to unpredictable rainfall and the high cost of fertilizers on our overused lands. How can we have gold and still go hungry because of trees and land?" (KII, Wuchema, May 2023)

Open vegetation consistently occupied the largest portion of the area throughout all three years, aligning with the findings of Baddianaah, Baatuuwie, and Adongo (2022). In 2002, open vegetation covered 79,602.88 hectares, accounting for 70.60% of the total area. This expanded to 94,785.91 hectares (84.06%) by 2010. Although the area slightly decreased to 89,079.44 hectares by 2022, it still represented 78.99% of the total area. The prevalence of open vegetation indicates that it remains the dominant land cover type in the region.

The increase in open vegetation can be attributed to the decrease in closed vegetation caused by human activities such as mining, farming, charcoal burning, and fuel wood harvesting. The growing population has led to the expansion of settlements, resulting in more bare lands and built-up areas. Additionally, mining activities in areas such as Saan, Sampina, Nanga, and the Wuchema mining enclave have significantly contributed to the reduction of closed vegetation, thereby increasing open vegetation. A 2013 report by the Ghana News Agency (GNA) indicated that both legal mining concessions and illegal mining activities have surged in the study area since 2000. The report highlighted that gold exploration concessions belonging to Azumah Resources Limited, Castle Minerals, and Carlie Minerals in the Nadowli-Kaleo District have been encroached upon by illegal miners, negatively impacting the environment and water bodies (GNA, 2013). This finding aligns with the research of Larry et al. (2016) and is consistent with Agyeman (2007), who also noted that mining activities commonly lead to vegetation loss.

Water bodies have remained a minor component of the total area but have shown a slight increase over the years. In 2002, they covered 220.71 hectares (0.20%), which increased to 247.91 hectares (0.22%) in 2010 and further to 279.13 hectares (0.25%) by 2022. The gradual increase in water bodies may be due to natural changes or improvements in water resource management.

The Normalized Difference Vegetation Index (NDVI) statistics for the years 2000, 2010, and 2022 are displayed in Table 7.4. The purpose of generating these statistics was to correlate the

NDVI data with the Land Use and Land Cover (LULC) maps produced for the study area, thereby supporting the observed trends of environmental degradation due to LULC changes. In NDVI analysis, negative values typically indicate clouds, water, and snow, while values near zero are associated with rock and bare soil. Very low NDVI values (0.1 and below) correspond to barren areas such as rock, sand, or snow. Moderate NDVI values (0.2 to 0.3) represent shrublands and grasslands, whereas high values (0.6 to 0.8) indicate temperate and tropical rainforests.

Table 7.3b: NDVI Statistics for the years 2002, 2010 and 2022 for Nadowli-Kaleo District

Year	Low NDVI	High NDVI
2002	-0.2	0.48
2010	-0.09	0.41
2022	-0.04	0.45

Source: Field Survey, 2023

The NDVI statistics presented in Table 7.4 for the Nadowli-Kaleo District show variations in vegetative health over the years. In 2002, the NDVI values ranged from a low of -0.20, indicating poor vegetation cover, to a high of 0.48, indicating healthy vegetation. By 2010, these values had changed from -0.09 to 0.41, and by 2022, from -0.04 to 0.45. These shifts from -0.20 to -0.04 and from 0.48 to 0.45 over the study period suggest a decline in the overall health of green vegetation in the area. This reduction in vegetative health is likely due to the mining activities in the region, as supported by findings from Laari et al. (2015) and Bid (2016), which indicate that mining operations adversely affect vegetation health.

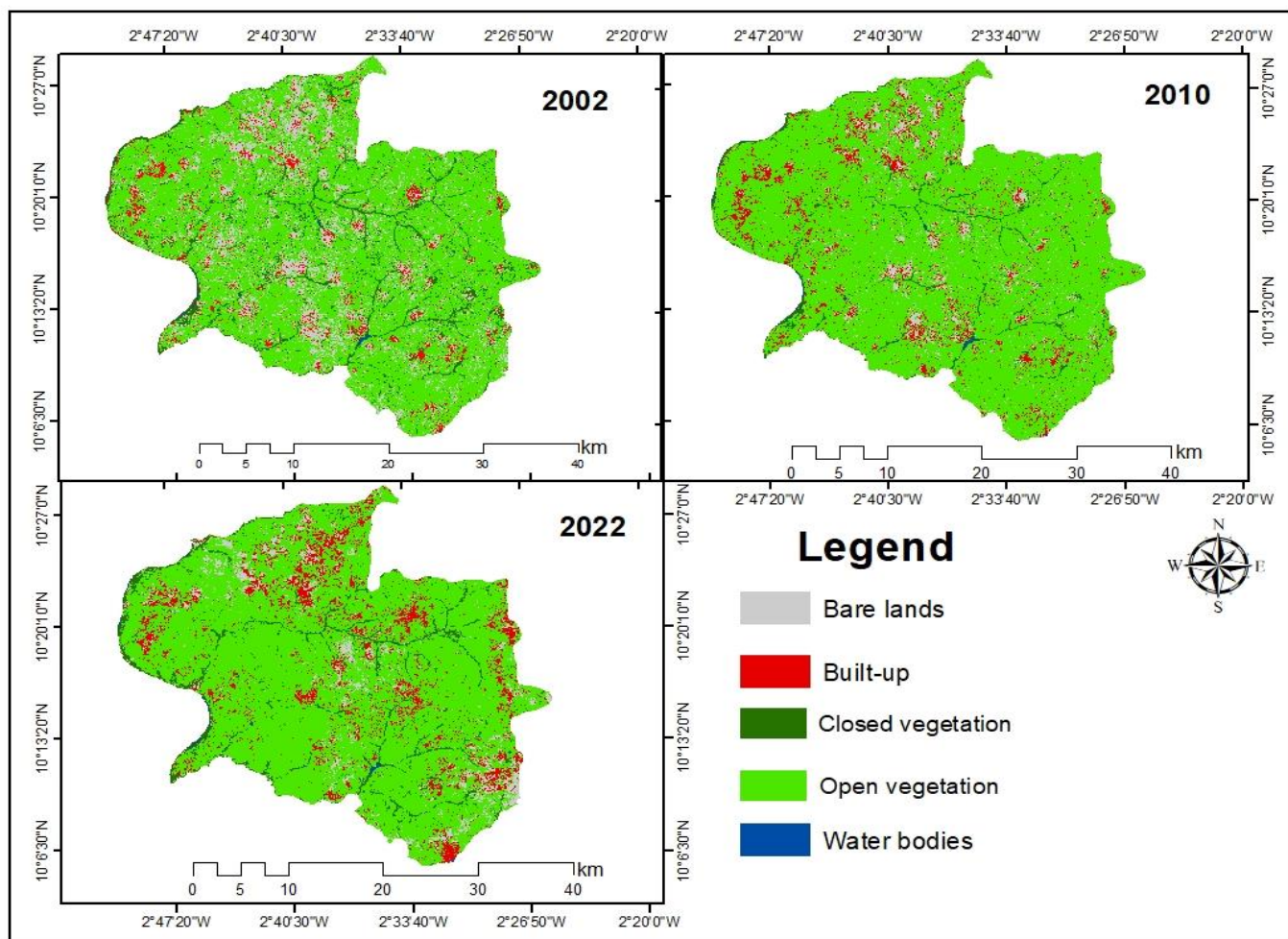


Figure 7.3a: LULC Maps of Nadowli-Kaleo District for the years 2002, 2010 and 2022

Source: Author's Construct, 2023

Table 7.3c: Change Detection Statistics between 2002 and 2010 for Nadowli-Kaleo District

Change Type	Area change (ha)	
	2002-2010	2010-2022
No Change	4463.367	1043.411
Change to Built-up	4057.277	1235.753
Change to Closed vegetation	13.492	73.998
Change to Open vegetation	9818.077	3638.904
Change to Water bodies	0.379	0.183
Change to Bare lands	1182.091	826.426

Source: Field Survey, 2023

The change detection statistics for the Nadowli-Kaleo District reveal notable shifts in land use between the periods 2002-2010 and 2010-2022. During 2002-2010, a substantial area of 4463.367 hectares remained unchanged, while 4057.277 hectares transitioned to built-up areas, indicating significant urban development. The most substantial change was observed in open vegetation, with 9818.077 hectares being converted, suggesting extensive land use activities, possibly for agriculture or development. Conversely, changes to closed vegetation and water bodies were minimal.

From the table, between 2010 and 2022, the area that remained unchanged significantly decreased to 1,043.411 hectares, indicating more dynamic land use changes during this period. The conversion to built-up areas reduced to 1235.753 hectares, yet the change to open vegetation remained significant at 3638.904 hectares. The increased change to closed vegetation (73.998 hectares) suggests some minimal rate of small-scale mining. The areas changing to bare lands slightly decreased to 826.426 hectares, reflecting ongoing but slightly reduced land degradation. Overall, these trends underscore ongoing expansion in settlement, agricultural expansion, and limited galamsey activities.

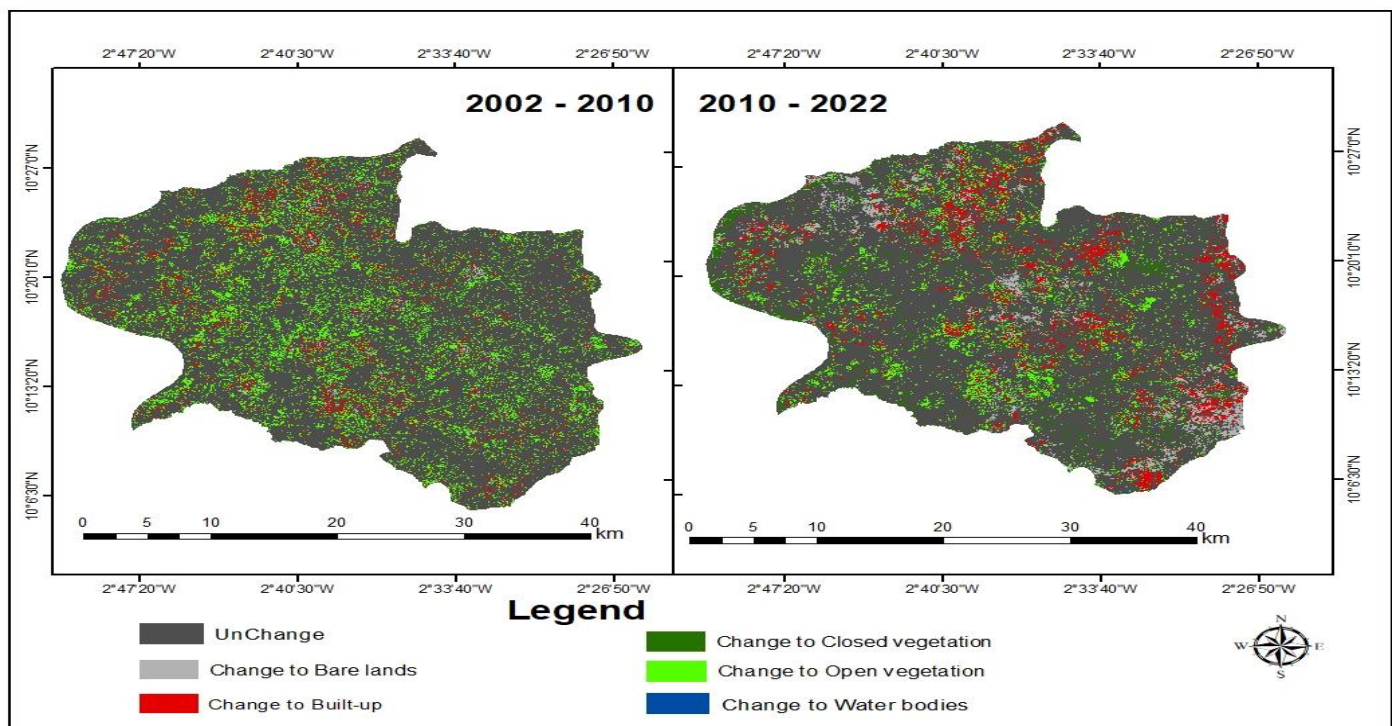


Figure 7.3b: Change Detection Maps for Nadowli-Kaleo for the years 2002, 2010 and 2022
Source: Author's Construct, 2023

7.4 Land Use Land Cover Analysis of the Wa West District

Table 7.4a: Statistics of Land Use and Land Cover of Wa West

LULC Classes	2002		2010		2022	
	Area (ha)	Percent (%)	Area (%)	Percent (%)	Area (%)	Percent (%)
Bare lands	4133.97	2.78	5801.67	3.91	7755.84	5.22
Built-up	15009.57	10.11	33115.14	22.30	37439.91	25.21
Closed vegetation	2774.61	1.87	1643.22	1.11	4864.23	3.28
Open vegetation	126183.33	84.96	107615.97	72.46	98024.22	66.00
Water bodies	412.38	0.28	337.86	0.23	429.66	0.29
Total	148513.9	100	148513.9	100	148513.9	100

Source: Field Survey, 2023

The results displayed in Table 7.4 indicate that bare lands showed a gradual increase over the three time periods. In 2002, bare lands covered 4,133.97 hectares (2.78%). This area increased to 5,801.67 hectares (3.91%) in 2010 and reached 7,755.84 hectares (5.22%) by 2022. This trend could indicate land degradation, deforestation, or the conversion of vegetated land to non-vegetated land, possibly due to mining activities or other human activities such as farming. To substantiate these statistical data, a community elder shared during a key informant interview:

"From my observations over the past 12 years, the majority of the degraded lands in our community are due to the activities of both local residents and individuals from various parts of Ghana who engage in illegal mining. These miners arrive without proper regulation and strip the land of its resources. In their field clearing process, they cut down a significant number of trees, not only to clear space but also to construct temporary shelters at the mining sites. This deforestation, combined with their extensive digging operations, leaves vast areas completely barren and devoid of vegetation. The impact on the environment is severe, as the once lush and fertile land is now reduced to a wasteland, exacerbating soil erosion and damaging the ecosystem." (KII, Polee, April 2023)

This narrative, combined with the statistical evidence, underscores the fact that small-scale mining is a significant human activity contributing to the increase in bare lands over the 20-year period. These findings align with those of Amproche et al. (2022).

Built-up areas exhibited a substantial and consistent rise over the years. In 2002, Built-up areas occupied 15,009.57 hectares (10.11%). By 2010, this had more than doubled to 33,115.14 hectares (22.30%), and by 2022, it further increased to 37,439.91 hectares (25.21%). This significant growth in built-up areas reflects ongoing urbanization and development within the district, driven by population growth which is likely due to the influx of miners from other parts of the country hence the need for increase in infrastructure for settlements. While some of these settlements were observed to be temporal structures within the mining site occupied by miners most of them were permanent structures. Field interviews revealed that some community members had cleared lands and built houses for miners and foreign gold buyers to accommodate themselves at a monthly rent. An interview with a lead miner mentioned that:

"Over the past few years, our community has witnessed a significant increase in the construction of houses, primarily driven by the influx of people attracted by mining activities. As more workers and their families move in, the demand for housing, businesses, and services has surged, leading to rapid development. Additionally, miners have constructed new buildings, and many residents have upgraded their traditional mud and thatch houses to concrete structures due to the income generated from mining. What concerns me most is that many farms have been converted into residential and mining areas, severely impacting food production and the livelihoods of us, the local residents, who rely on farming." (KII, Takpo, May 2023)

These findings align with those of Obodai (2022), who noted that the clearing of forests for farming and mining has resulted in increased settlements and bare land. Obodai's research also identified a significant rise in residential construction to accommodate the influx of people moving to Amansie South for employment in the mining sector. This trend has not only transformed the landscape but also put immense pressure on local infrastructure and resources. The study emphasized how the rapid expansion of built-up areas has encroached on agricultural lands, exacerbating food insecurity and disrupting the livelihoods of farming communities.

Closed vegetation has experienced significant fluctuations over the years. In 2002, it covered 2,774.61 hectares (1.87% of the total area). This decreased to 1,643.22 hectares (1.11%) by 2010, likely due to deforestation or conversion to other land uses. However, by 2022, the area of closed vegetation increased to 4,864.23 hectares (3.28%), possibly indicating a halt in the prospecting activities of Azumah Resources Company in the Wa West District. This increase could also be attributed to the exhaustion of gold around the district mining enclave and the temporary ban on illegal mining activities in Takpo enforced by the military.

These findings are consistent with those of Obodai (2022), who observed a gradual reduction in illegal mining activities in the closed vegetation of the Amansie South District between 2017 and 2022, attributed to the government's ban from March 2017 to December 2018 and ongoing efforts to combat illegal mining. Obodai also noted that the government imposed a temporary ban on the importation of excavators into Ghana on May 1, 2019, as part of measures to curb illegal informal mining operations.

In 2002, open vegetation was the dominant land cover class, occupying 126,183.33 hectares, which accounted for 84.96% of the total area. However, this category experienced a reduction over the years, dropping to 107,615.97 hectares (72.46%) in 2010 and further to 98,024.22 hectares (66.00%) by 2022. The decrease in open vegetation suggests significant land use changes, likely due to farming activities, charcoal burning, and mining activities.

The above findings are consistent with the assertions of Goudie (2019), who argue that the intricate relationships between humans and their natural environments form the foundation for human livelihood and sustenance. Through the extraction of resources, human activities significantly impact the natural environment.

Water bodies remained a minor but relatively stable component of the total area throughout the period. In 2002, water bodies covered 412.38 hectares (0.28%). This slightly decreased to 337.86 hectares (0.23%) in 2010, but increased again to 429.66 hectares (0.29%) by 2022. These slight variations in the area of water bodies could be attributed to natural hydrological changes, water resource management, or the impacts of human activities such as mining and urban development.

The NDVI values presented in Table 7.8 were used as a reference to support the observed land use and land cover (LULC) changes in the years 2002, 2010, and 2022. Analyzing these NDVI values allows for a quantitative assessment of the variations in vegetation health and density over these years, providing a clear indication of the impact of human activities and natural processes on the landscape. This approach highlights the importance of remote sensing data in monitoring and understanding LULC dynamics, supporting a comprehensive analysis of environmental changes and their implications for sustainable land management.

Table 7.4b: Summary of NDVI Statistics Wa West District

Year	High NDVI	Low NDVI
2002	0.477	-0.258
2010	0.413	-0.118
2022	0.480	-0.058

Source: Field Survey, 2023

The NDVI values displayed in table 7.4b above for the Wa West District from 2002 to 2022 indicate significant fluctuations in vegetation health within the mining areas. In 2002, the high NDVI of 0.477 and low NDVI of -0.258 reflect a wide range of vegetation conditions, from healthy, dense vegetation to severely degraded areas. By 2010, the high NDVI decreased to 0.413, suggesting a decline in vegetation health, likely due to intensified mining activities and land disturbances. However, the low NDVI improved to -0.118, indicating some recovery in the most degraded areas. By 2022, the high NDVI value increased to 0.480, surpassing the 2002 level, suggesting a significant recovery in vegetation health, potentially due to effective reforestation and land management practices. Concurrently, the low NDVI value further improved to -0.058, reflecting continued rehabilitation of previously degraded lands. Overall, these trends highlight the dynamic interplay between mining activities and vegetation health, with periods of decline followed by notable recovery efforts.

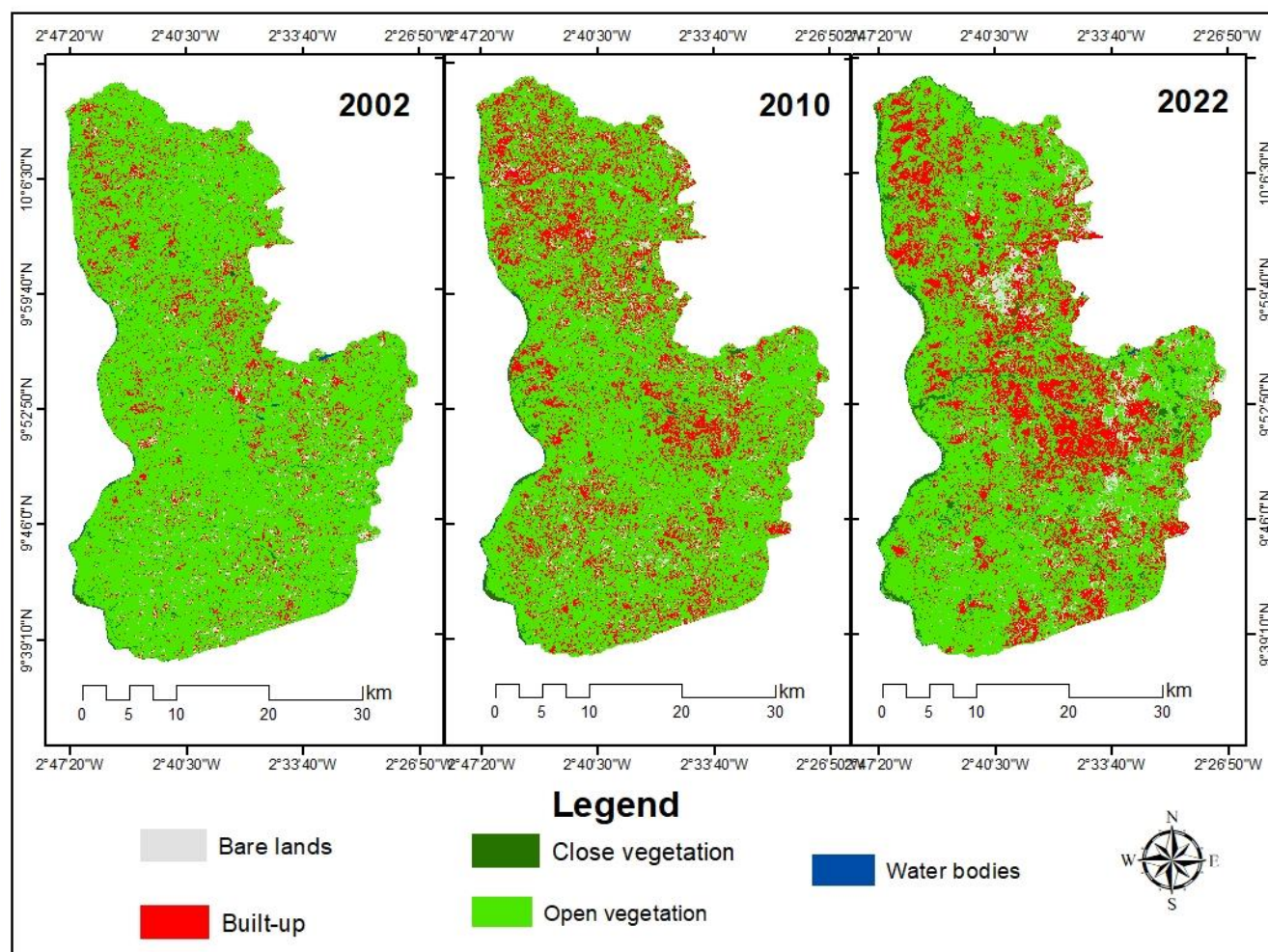


Figure 7.4a: LULC Map of Wa West District for the years 2002, 2010 and 2022
Source: Field Survey, 2023

Table 7.4c: Change Detection Statistics for the years 2002, 2010 and 2020

Change Type	Area change (ha)	Area change (ha)
	2002-2010	2010-2022
No change	104409.6	933.485
Change to Built-up	26342.51	1720.465
Change to Close vegetation	1104.29	24.299
Change to Open vegetation	11258.05	2873.818
Change to Bare lands	5269.387	2316.329
Change to Water bodies	42.9189	0.157

Source: Field Survey, 2023

Table 7.4c above shows the change detection statistics for Wa West District between 2002-2010 and 2010-2022 indicate significant shifts in land use and cover. During 2002-2010, the area that remained unchanged was vast at 104,409.613 hectares, while a substantial 26,342.509 hectares transitioned to built-up areas, reflecting urbanization and development pressures. Changes to open vegetation (11,258.051 hectares) and bare lands (5,269.387 hectares) were also notable, suggesting substantial land use activities, likely driven by agricultural expansion and mining.

In the period 2010-2022, the unchanged area drastically reduced to 933.485 hectares, indicating more dynamic land use changes. The area converted to built-up land decreased to 1,720.465 hectares, but the change to open vegetation increased significantly to 2,873.818 hectares, indicating possible recovery or new vegetation growth in previously altered areas. The area changing to bare lands (2,316.329 hectares) continued to be significant, likely due to ongoing mining activities. The minimal changes to water bodies in both periods highlight the relatively stable but pressured state of water resources in the district.

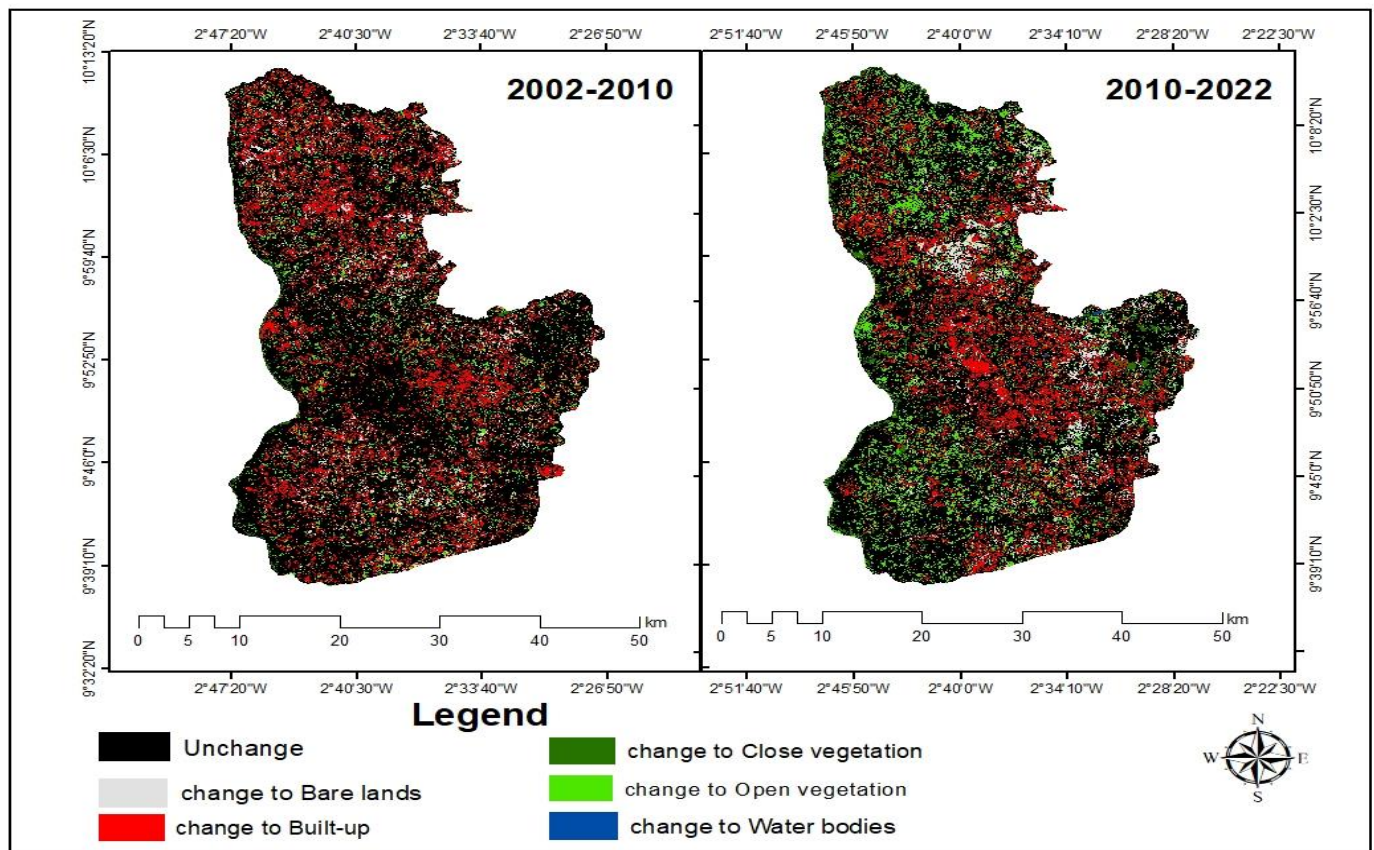


Figure 7.4b: Change map for Wa West for the years 2002, 2010 and 2022

7.5 Land Use and Land Cover of Wa East

The provided Table 7.5a illustrates the changes in land use and land cover (LULC) for the years 2002, 2010, and 2022, detailing the area (ha) and percentage of the total area for categories such as bare lands, built-up areas, closed vegetation, open vegetation, and water bodies.

Table 7.5a: Statistics of Land Use and Land Cover of Wa East

LULC Classes	2002		2010		2022	
	Area (ha)	Percent (%)	Area (%)	Percent (%)	Area (%)	Percent (%)
Bare lands	4356.18	1.01	4680.18	1.09	8302.32	1.93
Built-up	19841.13	4.62	47017.71	10.95	47054.7	10.95
Close vegetation	4072.95	0.95	8592.48	2.00	7507.89	1.75
Open vegetation	401,182.6	93.39	369,010.53	85.90	366,511.86	85.32
Water bodies	103.86	0.02	255.78	0.06	179.91	0.04
Total	429556.7	100	429556.7	100	429556.7	100

Source: Field Survey, 2023

Bare lands have seen a significant increase over the years. In 2002, bare lands covered 4,356.18 hectares, making up 1.01% of the total area. By 2010, this increased to 4,680.18 hectares, representing 1.09% of the total area. The trend continued into 2022, with bare lands expanding to 8,302.32 hectares, accounting for 1.93% of the total area. This increase is likely due to the expansion of mining activities in communities such as Kende, Goripie, Duu, Danyuokuraa and Manwe in the Wa East District, where land is often cleared to access mineral deposits. Illegal mining, in particular, has significantly contributed to land degradation, resulting in more bare lands. While farming activities also play a role, the extensive land disturbance caused by mining is the primary factor.

The widespread detrimental effects of illegal mining on vegetation cover are highlighted by the low NDVI values, indicating significant impacts on ecosystem services and human well-being (Abaidoo et al., 2019). The degradation of land and vegetation quality due to illegal mining is consistently noted across various studies (Barenblitt et al., 2021; Baddianaah et al., 2022). Amproche et al. (2020) and Abaidoo et al. (2019) reported increases in bare land and mined areas by 80% and 60.4%, respectively, underscoring the severe environmental damage caused by these

activities. Therefore, there is a need to ensure strict enforcement of environmental regulations and prioritize the implementation of comprehensive land reclamation projects.

Built-up areas have significantly increased over the years. In 2002, built-up areas covered 19,841.13 hectares, accounting for 4.62% of the total area. By 2010, this had risen dramatically to 47,017.71 hectares, representing 10.95% of the total area. This trend continued into 2022, with built-up areas slightly increasing to 47,054.7 hectares, maintaining 10.95% of the total area. This rise is attributed to the influx of miners from other parts of Ghana, leading to a population increase and the consequent need for more housing. Many landlords have constructed new buildings to profit from renting to immigrants and foreigners involved in gold buying and sponsoring mining activities. Additionally, community members who have benefited financially from mining have built new residential buildings, while others have upgraded their old brick houses to block and concrete structures. Temporary settlements have also been erected at mining sites to accommodate workers.

From 2002 to 2022, the expansion of built-up areas was consistent with findings from related studies (Kumi-Boateng & Stemn, 2020; Baddianaah et al., 2022). For instance, Abaidoo et al. reported an 87.3% increase in built-up areas in Tarkwa between 2007 and 2016. However, this study observed a more modest 10.95% increase in built-up areas over the entire period, indicating that the impact of illegal mining on infrastructure and settlement expansion is not as pronounced as in the southern sector. This may be due to the rudimentary nature of the mining activities and the specific scope of the study area. Despite this, the cash generated from illegal mining leads some individuals to invest in building houses (Pokorny et al., 2019; Baddianaah et al., 2022), thereby contributing to local development.

Closed vegetation showed varying trends over the years. In 2002, closed vegetation covered 4,072.95 hectares, making up 0.95% of the total area. By 2010, this area had more than doubled to 8,592.48 hectares, accounting for 2.00% of the total area. However, by 2022, closed vegetation decreased to 7,507.89 hectares, representing 1.75% of the total area. The initial increase in closed vegetation could be attributed to government efforts to protect forests and vegetation from the detrimental effects of illegal mining, particularly following the March 2017 moratorium on all small-scale mining activities. This initiative was reinforced by the Inter-Ministerial

Committee on Illegal Mining (IMCIM), established by the Ghanaian government through the Ministry of Lands and Natural Resources. Additionally, Operation Vanguard, a task force comprising police, military, fire service, and immigration officers, was deployed to enforce the ban. This task force undertook rigorous actions, including arresting and prosecuting numerous small-scale miners, seizing mining equipment such as excavators, and, in some cases, employing stringent measures against offenders.

The above findings align with those of Baddianaah et al. (2022), who observed similar trends in their study. They found that the closed savannah or forest cover, which occupied 56,187.5 hectares (15.3%) in 2000, subsequently reduced to 35,538.03 hectares (9.7%) in 2010. However, by 2020, this area recorded a gain, increasing to 58,475.07 hectares (15.9%). They attributed this fluctuation to the Ghanaian government's strategies to curb small-scale mining operations in forested zones, which included the deployment of military forces to enforce the directive. However, the slight decrease in closed vegetation from 2010 to 2022 suggests that some areas might have been cleared again, possibly for renewed mining activities or other forms of land use.

Open vegetation, the most dominant land use class in the Wa East District, has experienced a significant decline over the years. In 2002, open vegetation covered 401,182.6 hectares, which was 93.39% of the total area. By 2010, this area had decreased to 369,010.53 hectares, representing 85.90% of the total area. The trend continued into 2022, with open vegetation further reducing to 366,511.86 hectares, accounting for 85.32% of the total area. This reduction is primarily attributed to human activities such as mining and farming. Notably, the presence of Azumah Resources Company conducting prospecting activities, along with local peoples' involvement in illegal mining, has led to significant deforestation and land degradation, thereby reducing open vegetation areas. Despite some efforts to protect these areas, the impact of mining remains substantial. The above findings disagree with the findings of Baddianaah et al (2022) who found that in Wa East open vegetation experienced a reduction of 139,360.71 hectares representing (38%) between the years 2000 and 2022.

Water bodies have shown fluctuations over the years. In 2002, water bodies covered 103.86 hectares, constituting 0.02% of the total area. By 2010, this area had increased to 255.78 hectares, making up 0.06% of the total area. However, by 2022, water bodies had decreased to 179.91

hectares, representing 0.04% of the total area. The reduction in water bodies within the mining communities of Wa East can be attributed to gold ore washing along the banks and the redirection of water sources to mining and grinding sites, which often involves the use of pipes that pollute the water and decrease its availability for other uses. Additionally, the competing demands from dry season farmers further strain these water resources. To support this, a gardener in Manwe lamented that:

‘‘There have always been conflicts over water usage between us and the miners. During the dry season, instead of resorting to commercial water sources, miners continue to use the same dam as us. This is particularly troubling because they sometimes bring gold ore to wash at the bank of the dam, leading to water pollution. Additionally, numerous grinding mills have been erected close to the dam, where they have easy access to water, further contaminating it through the use of long pipes and hoses. This constant pollution and overuse of the dam’s water by the miners often result in water shortages during the dry season, severely impacting our ability to irrigate our vegetables, which are vital for our survival.’’ (KII, Manwe, June, 2023)

The analysis of data reflects significant land use and cover changes in the Wa East District from 2002 to 2022. The increase in bare lands and reduction in vegetation underscore the impact of mining activities. Built-up areas have expanded due to the influx of miners and the construction of new housing and temporary settlements. Efforts to protect forests and vegetation have shown some success but face challenges from ongoing mining activities. Water bodies are under pressure from both mining-related pollution and agricultural use.

The study's finding of an increase in water bodies from 0.02% to 0.06% between 2002 and 2010 aligns with Hausermann et al. (2018), who found that the magnitude of the water class in mining landscapes increased by 13,000%, covering 200 hectares along portions of the Offin River between 2008 and 2013.

However, the decrease in water bodies from 0.06% in 2010 to 0.04% in 2022 underscores the well-documented effects of artisanal and small-scale gold mining (ASGM) on water resources. This finding aligns with Baddianaah et al., who observed an increase in water bodies to 0.07% in

mining districts between 2000 and 2022. Illegal mining activities lead to increased water turbidity, siltation, river channel diversion, and chemical pollution (Amproche et al., 2020; Macháček, 2020).

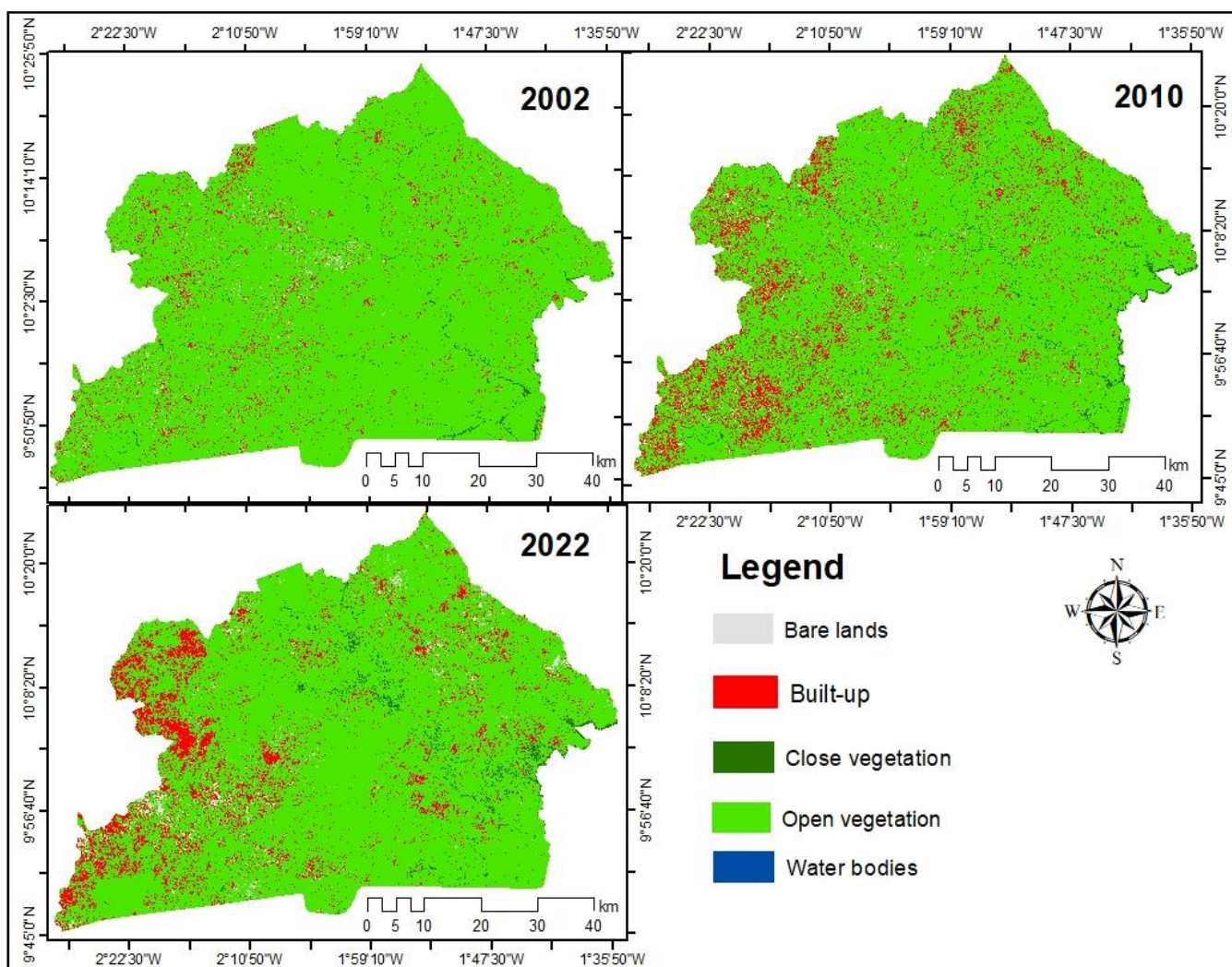


Figure 75a: LULC Map of Wa East District

Source: Field Survey, 2023

Table 7.5b: Summary of NDVI Statistics for Wa East District

Year	High NDVI	Low NDVI
2002	0.51049	-0.14094
2010	0.4005	-0.05824
2022	0.495369	-0.09951

Source: Field Survey, 2023

The NDVI statistics in Table 7.5b for the Wa East District were generated to measure vegetation health over 20 years, providing supporting evidence for the observed LULC changes. In 2002, the high NDVI was 0.51049, while the low was -0.14094, indicating a range from healthy vegetation to significantly degraded areas. By 2010, the high NDVI had decreased to 0.4005, and the low NDVI had improved to -0.05824. This reflects an overall decline in vegetation health but a reduction in the most severely degraded areas, likely due to intensified mining activities and associated land disturbances. By 2022, the high NDVI increased to 0.495369, approaching the 2002 level, suggesting some recovery in vegetation health, potentially from reforestation efforts or improved land management practices. However, the low NDVI value of -0.09951, while better than in 2002, indicates that areas of poor vegetation health still exist. Overall, the NDVI trends highlight the dynamic interplay between mining activities and vegetation health in the district, showing periods of decline followed by partial recovery over the two decades.

Table 7.5c: Change Detection Statistics for the years 2002, 2010 and 2022 for Wa East

Change Type	Area (ha) 2002-2010	Area (ha) 2010-2022
Unchanged / No change	236.923	376.774
Changes to Built-up	955.517	1302.229
Changes to Close vegetation	15.056	34.014
Changes to Bare lands	594.506	2074.87
Changes to Open vegetation	2990.752	2677.414
Changes to Water bodies	0.152	3.146

Source: Field Survey, 2023

The results in table 7.5c depicts the merged change detection statistics for Wa East District reveal significant land use transformations between the periods 2002-2010 and 2010-2022. The area that remained unchanged increased slightly from 236.923 hectares in the first period to 376.774 hectares in the second period, indicating some stabilization in land use. Notably, there was a substantial increase in the areas converted to built-up land, rising from 955.517 hectares to 1302.229 hectares, reflecting ongoing urbanization and development pressures.

Changes to bare lands saw a dramatic rise from 594.506 hectares to 2074.870 hectares, suggesting intensified land degradation, likely due to mining activities. The conversion to close vegetation increased modestly from 15.056 hectares to 34.014 hectares, indicating some reforestation or natural vegetation recovery efforts. However, the areas changing to open vegetation decreased from 2990.752 hectares to 2677.414 hectares, pointing to a reduction in these vegetated areas over time.

Finally, changes to water bodies remained minimal but increased from 0.152 hectares to 3.146 hectares, highlighting minor yet notable shifts in water resource distribution and usage. The resultant changes above are translated into the map below:

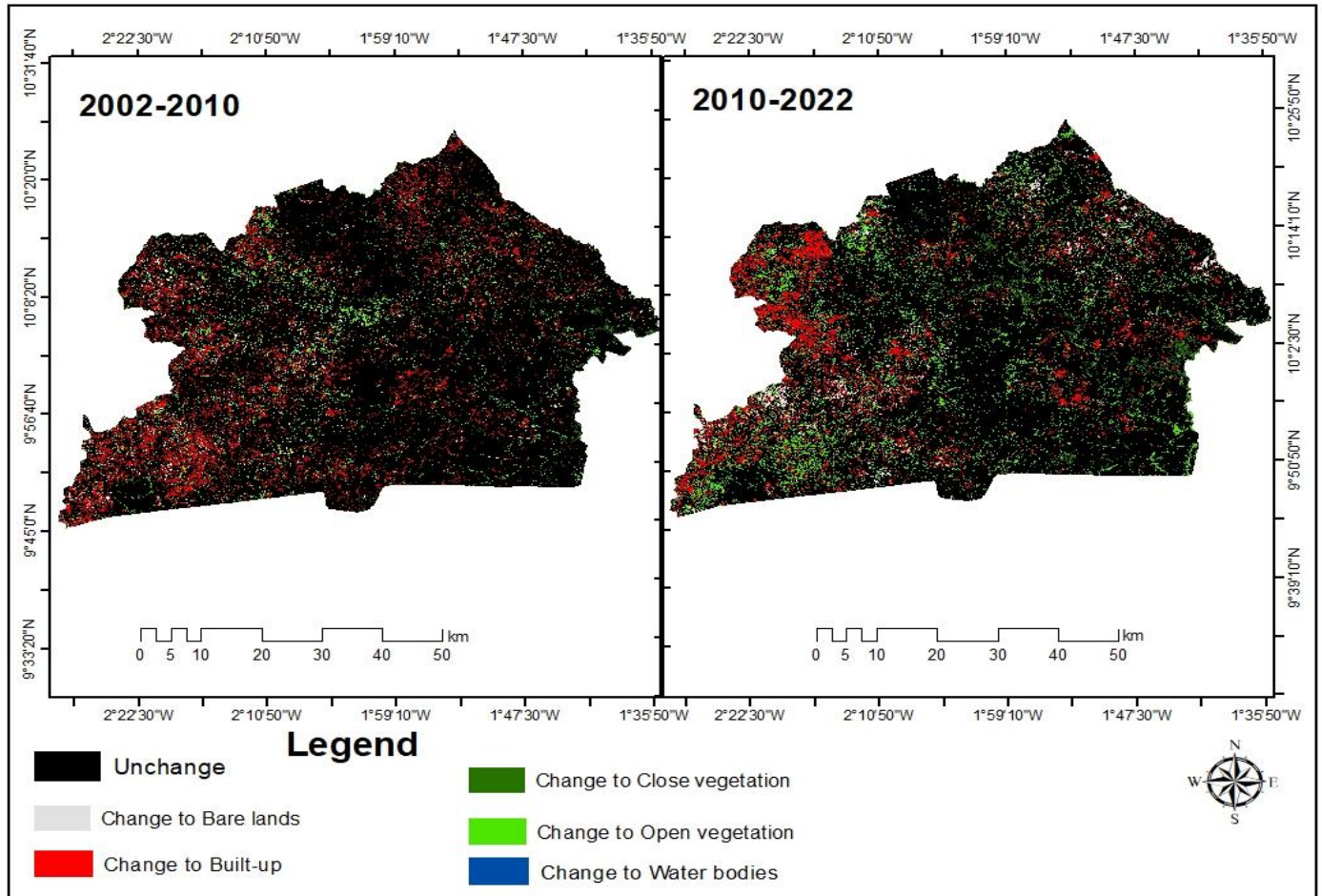


Figure 7.5b: Change Map for Wa East

Source: Field Survey, 2023

7.6 Accuracy Assessment

The overall accuracy represents the percentage of correctly classified pixels (Congalton, 1991). It is achieved by dividing the total number of correctly classified pixels by the number of actual or references pixels. To gain a better knowledge of the research area's LULC variations, a post-classification analysis was performed including the user's accuracy and producer's, overall accuracy, and Kappa coefficient. The overall accuracy and Kappa coefficient for Wa West district were therefore 85.7% and 0.82 respectively (Table 7.6). Wa East was 87.9% and 0.85 respectively (Table 7.7), and Nadowli-Kaleo district was 88.2% and 0.85 respectively (Table 7.8). The accuracy

statistics indicate that classification outcomes are accurate and applicable to further interpretation or analysis.

Table 7.6a: Accuracy Assessment Results for Wa West.

Class Name	User values	Producer values	Number corrects	Producer accuracy	User accuracy
Water bodies	28	28	28	100	100
Built-up	44	46	37	80.3	84.1
Bare lands	36	39	28	71.8	77.8
Close veg	42	43	40	93.0	95.2
Open veg	60	54	47	87.0	78.3
Total	210	210	180		
Overall accuracy = 85.7%					
Kappa coefficient = 0.82 (82%)					

Source: Field Survey, 2023

Table 7.b: Accuracy Assessment Results for Wa East.

Class Name	User values	Producer values	Number correct	Producer accuracy	User accuracy
Water bodies	27	27	27	100	100
Built-up	43	42	36	85.7	83.7
Bare lands	31	32	24	75.0	77.4
Close veg	40	45	40	88.9	100
Open veg	57	52	47	90.4	82.5
Total	198	198	174		
Overall accuracy = 87.9%					
Kappa coefficient = 0.85 (84.6%)					

Source: Field Survey, 2023

Table 7.6c: Accuracy Assessment Results for Nadowli-Kaleo

Class Name	User values	Producer values	Number correct	Producer accuracy	User accuracy
Water bodies	32	32	32	100	100
Built-up	50	49	43	87.8	86
Bare lands	40	38	29	72.5	72.5
Close veg	43	49	43	87.8	87.8
Open veg	65	62	56	90.3	86.2
Total	230	230	203		
Overall accuracy = 88.2%.					
Kappa coefficient = 0.85 (85.1%)					

Source: Field Survey, 2023

7.7 Summary of Chapter

This chapter presents a comprehensive analysis of the spatiotemporal variation in land use and land cover (LULC) across three districts in Ghana's Upper West Region: Nadowli-Kaleo, Wa West, and Wa East. The study utilizes satellite imagery from 2002, 2010, and 2022 to examine changes in bare lands, built-up areas, closed vegetation, open vegetation, and water bodies. The findings reveal significant LULC transformations primarily driven by human activities such as farming, charcoal burning, and especially artisanal and small-scale gold mining (ASGM). In the Nadowli-Kaleo District, bare lands decreased due to regulatory enforcement, while built-up areas increased significantly, indicating urbanization linked to mining activities. Similarly, Wa West saw a rise in built-up areas and bare lands due to mining and urban development, whereas Wa East experienced substantial increases in built-up areas and bare lands, reflecting the intensive impact of illegal mining.

The chapter also highlights the environmental implications of these changes, including deforestation, land degradation, and water pollution, which adversely affect local ecosystems and community livelihoods. The Normalized Difference Vegetation Index (NDVI) statistics support the observed LULC changes, showing fluctuations in vegetation health over the years. The accuracy assessment of the satellite imagery classification confirms the reliability of the findings, with overall accuracies and Kappa coefficients ranging from 85.7% to 88.2% across the three districts. The study underscores the need for effective land management and strict enforcement of environmental regulations to mitigate the negative impacts of ASGM and promote sustainable development in the Upper West Region.

CHAPTER EIGHT

**EXAMINING THE ROLES AND EFFECTIVENESS OF REGULATORY
INSTITUTIONS, TRADITIONAL AUTHORITIES, LAWS AND GOVERNMENT
POLICIES GOVERNING THE MINING SECTOR**

8.0 Introduction

Institutions, as described by Borkowski (2023), encompass both formal standard operating procedures and informal practices that collectively shape relationships and predict the behavior of organizations. In this regard, legislations and institutions as component of the livelihood framework are charged with carrying out statutory functions thus, they are the ones issuing mining lease and license and at the same time regulating and overseeing mining activities within mining affected communities (Kazapoe et al., 2023).

The mining sector in Ghana is governed by a framework of regulatory institutions, laws, and government policies designed to ensure sustainable and responsible mining practices (Bansah, 2023). Key regulatory institutions include the EPA, the Commission as well as the District Assemblies (Mensah-Odum et al., 2023). Several laws and policies underpin the regulatory framework governing the mining sector. However, some of these laws have legal flaws, such as ambiguities in the regulations and inadequate enforcement mechanisms, which undermine their effectiveness (Morolo, 2023). The resulting impacts on rural livelihoods may include reduced water quality, loss of arable land and health problems for inhabitants of mining communities (Adator, 2023). The environmental effects of artisanal and small scale gold mining include deforestation, soil erosion and water contamination, which further exacerbate the challenges faced by these communities (Adranyi et al., 2023) Therefore, a critical examination of these regulatory institutions, laws, and policies is essential to identify strengths, weaknesses, and areas for improvement to ensure that mining activities contribute positively to sustainable rural livelihood amongst people living in selected ASGM communities in the Upper West Region.

8.1 Obtaining a Legitimate Mining License

There are two main pieces of legislation that governs small-scale mining in Ghana; The Small-Scale Gold Mining Law (PNDCL 218) passed in 1989. Amphibious to the foregoing, the Minerals and Mining Act 2006 (Act 703) also has a critical role to play in governing this sector (Baddianaah et al, 2023). Pursuant to Section 82-99 of the Minerals and Mining Act, 2006 (Act 703), this piece of legislation details on the general procedures that a proponent has to adhere to in as far as obtaining a mining license is concerned. The powers to issue mineral rights and licences reside in the Minister of Lands and Natural Resources (MLNR) alone. This decision is made in consultation with a technical committee that is supposed to be comprised under the Minerals Commission. As such, the small-scale mining is mainly limited to Ghanaians who have acquired licence to engage in the mining exercise in small scale under supervision and monitor from the legal mining firm (Ofosu & Sarpong, 2023).

All the 40 miners stated that they lacked a mining permit for their operation. The findings reveal that all the miners present in the selected towns were involved in unlawful business. These are some of the ugly deeds of the small-scale miners which compounded the negative impacts in the Upper West Region since the mining operations were carried out in a condition of illegality.

8.2 Reasons for Mining without Valid License

The primary problem that is critically related to the mining activity, which is mining without a proper license, affects the environment and the local population. It is significant to obtain a small-scale mining license to work with since it allows mining to take place in a manner that does not lead to environmental degeneration of the resources besides the legal compliance (Johnson et al, 2023).

Licensed operations also contribute to government revenues through taxes and fees, support local economies, and provide safer working conditions for miners (Bansah, 2023). This study seeks to explore the reasons behind the prevalence of unlicensed mining, aiming to uncover the underlying challenges and barriers that prevent miners from obtaining proper licenses. By addressing these issues, the study aims to propose solutions that can enhance regulatory compliance and foster a more sustainable and legally compliant mining sector.

Lack of a Legal Mining license Miners being the respondents listed down some of the reasons for working without a mining license. Respondents' awareness of specific mining licenses

was also assessed with 42% stating that they had no knowledge of any mining licenses, while 31.7%, mentioned that they do not have adequate funds to pay the registration fees as legal small-scale miners. Also, 14.3% of respondents indicated that that the procedures for getting a license for small scale mining are cumbersome because of delays made by the licensing authorities. Additionally, 11% of the miners said that they currently do not know where to get a valid mining license. The above outcome is illustrated in the figure 9. 1:

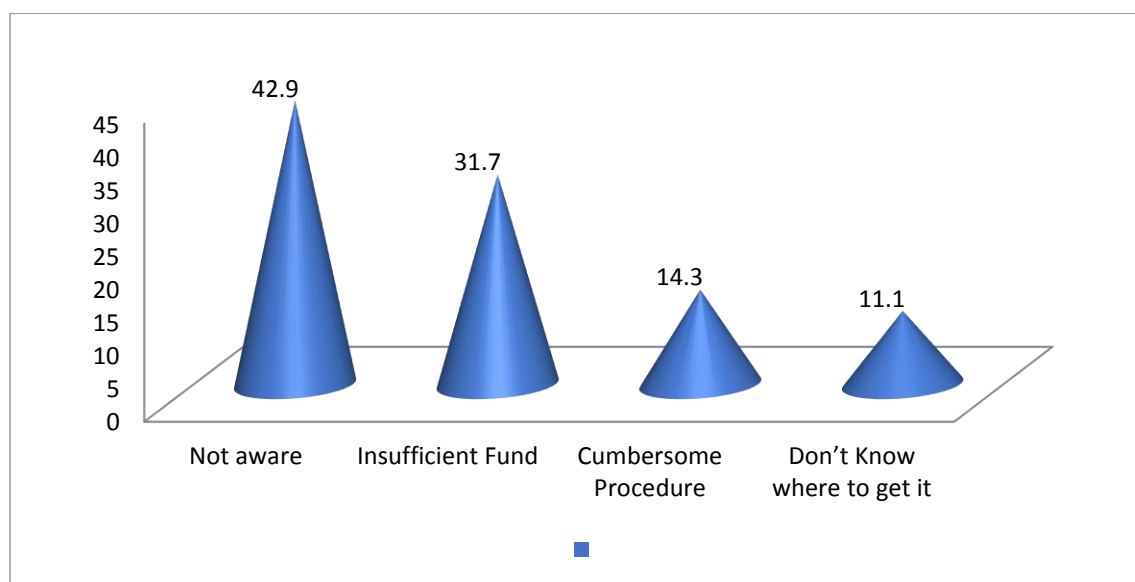


Figure 8.2: Reasons for Mining without Valid License (Source: Field Survey, 2023)

A key informant interview with an officer of the Wa District Minerals Commission attests to this fact by asserting that:

“The issue of miners not being licensed stems from the perceived bureaucratic nature of the small-scale mining license procedure. To address this, an online application portal has been introduced, allowing applicants to comfortably apply and submit the necessary documents from home. Additionally, the license fee for small-scale mining is approximately GH¢4,000.00. However, there are other costs involved, including cadastral searches and site plan preparation, among others.” (District Office, Minerals Commission Wa, April, 2023)

To validate the above information regarding the cost of ASGM license application fees and the shift to an online application process, a lead miner in Goripie shared the following insights during an interview:

“The processes involve in acquiring a mining license is so hard that even if I am able to afford the money I won’t even venture. ‘Ndao en nyimanga karikyih bawala mang bang Ankarameng’ to with ‘How many small-scale miners knows people in Accra such that you will have to go and stay and start following ‘big men’. The bribes alone you will have to pay several officers before you get your documents pushed to the next stage. As at now no miner can mention a specific amount been the cost for acquiring a small-scale mining license. The last time I checked it was close to GH¢ 100,000.00. Just ask yourself whether I have that amount as a ‘galamseyer’. If I had that amount, I will even go and buy a Chenfangs (A Chinese Manufactured Machine for grindings stones) to start crushing or grinding stones for more revenue’”. (KII, Goripie, March 2023)

Another miner shared that:

“The online application process in obtaining an ASGM by government has not made a significant difference. What is the difference if you apply for a mining license online but still go to Accra to seek approval from influential figures and political apparatchiks? Now, I am operating without a license. Look at me, working at a mining site, covered in dirt. If I knew how the operations of a computer apply for a mining license, do you think I would be here? No, I would likely be in an office, maybe even at the Minerals Commission. The commission believes they have solved the paperwork issue, but for us miners, it's the same story. I tried the online process and ended up spending almost four months in Accra, dealing with paperwork and constant demands to see this person or bring that document. If you don’t have the required documents, you have to pay additional fees. I became so frustrated that I couldn't even cover my hotel bills and returned home without a license. The government should subsidize the mining license fees and simplify the process. Otherwise, we will continue to operate without licenses, making enforcement difficult while we continue to earn our livelihood.” (KII, Goripie, March 2023).

Drawing inferences from the response provided by the Minerals Commission, it is evident that there is no fixed amount for acquiring a small-scale mining license, as the officer only gave an approximate figure. It was also discovered that neither the illegal miners nor the license-granting institution has a clear understanding of the exact costs involved in obtaining a valid small-

scale mining license. The process involves several ancillary costs, such as cadastral searches and site plan preparations, making it burdensome for applicants.

Moreover, it was unearthed through interviews that most miners were not familiar with information and computer technology hence, many lack the knowledge to apply online. The licensing process is particularly arduous for small-scale miners who have never travelled to Accra, the capital city, for business purposes. The frustration and difficulties encountered, along with stories from other unsuccessful applicants, discourage many from attempting to obtain a license.

These findings align with the arguments of Hilson (2001) and Adomako-Kwakye and Mensah (2023). Hilson (2001; as cited in Ampaw et al., 2023) identified multiple factors contributing to illegal mining in Ghana, which were acknowledged by respondents, such as economic necessity, lack of alternative livelihoods, and the cumbersome nature of the licensing process. Adomako-Kwakye and Mensah (2023) further asserted that miners often do not intend to disregard the law but are driven to illegal mining due to the overwhelming frustration and bureaucratic hurdles they face when attempting to obtain a license. The difficulties are compounded for miners who lack familiarity with information technology and cannot easily access the online application system. This discourages legal compliance and pushes miners towards illicit operations, where they operate without oversight, leading to significant environmental degradation and jeopardizing the livelihoods and health of inhabitants of mining communities.

8.3 Respondents' Awareness on Regulatory Bodies

The results presented in figure 8.6 illustrate the level of awareness of the existing mining regulatory bodies among miners and non-miners. Among miners, 57.5% expressed awareness, while only 31.56% of non-miners indicated similar awareness. This suggests that miners are generally more informed about the regulatory bodies overseeing mining activities compared to non-miners. This higher level of awareness among miners can be attributed to their direct involvement in the mining industry, which likely necessitates a better understanding of the regulatory environment to comply with legal and operational requirements. Miners' day-to-day activities and interactions with regulatory bodies for licenses, permits, and compliance checks may also contribute to their heightened awareness.

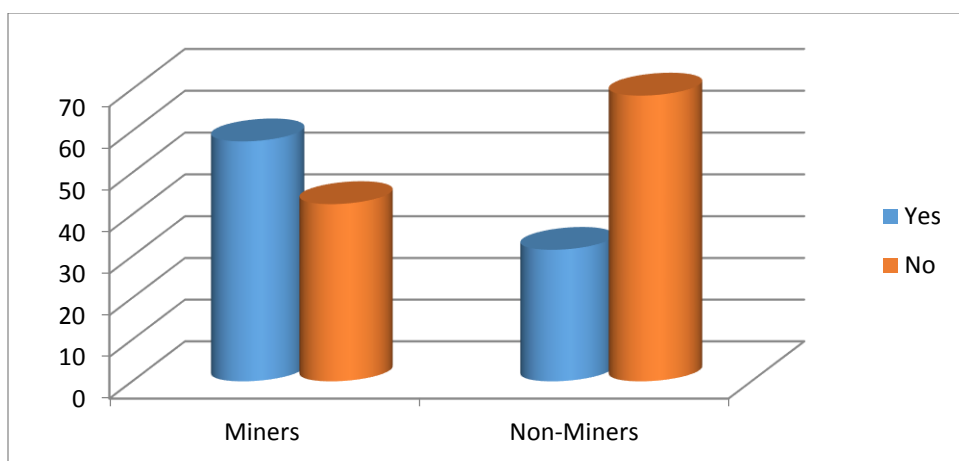


Figure 8.3: Respondents' Awareness on the government regulatory bodies on mining
Source: Field Survey, 2023

In contrast, non-miners, who may not have direct dealings with these regulatory bodies, show a lower level of awareness at 31.56%. This lower awareness among non-miners could be due to their lack of direct engagement with the mining sector and its regulations. Non-miners might only have peripheral or indirect exposure to information about mining regulations, which could explain their relatively limited knowledge.

Table 8.4: Respondents' perception concerning periodic visit to mining sites by Mining Regulatory Institutions

Response	Miners		Non-Miners	
	Frequency	%	Frequency	%
Yes	11	27.5	39	12.2
No	29	72.5	281	87.8
Total	40	100	320	100

Source: Field Survey, 2023

The data on respondents' perceptions regarding periodic visits to mining sites by regulatory institutions highlights a stark contrast between miners and non-miners. Among miners, a notable 72.5% believe that regulatory institutions do not conduct periodic visits, suggesting a significant lack of presence or enforcement activities from these institutions in the mining areas. This perception could indicate either an actual deficiency in regulatory oversight or a lack of visibility in the enforcement process, leading miners to feel largely unmonitored.

On the other hand, 87.8% of non-miners also believe that these institutions do not carry out regular site visits. This overwhelming consensus among non-miners further reinforces the notion that regulatory institutions may not be engaging effectively with stakeholders outside the mining industry. If both miners and non-miners largely perceive a lack of oversight, it raises concerns about the effectiveness of institutional monitoring and enforcement efforts.

Interestingly, only 27.5% of miners and 12.2% of non-miners believe that these institutions visit mining sites periodically. The notably lower percentage among non-miners suggests that those not directly involved in mining have an even stronger perception that regulatory bodies are absent. This could imply that the institutions' efforts—if they exist—are not well-communicated or that their visits are infrequent enough to go unnoticed by the broader public.

Overall, the findings suggest a widespread belief that mining regulatory institutions are failing to carry out their oversight responsibilities consistently. This perception indicates weaknesses in enforcement mechanisms, resource limitations, or ineffective regulatory policies.

Table: 8.5 Rating the Effectiveness of Regulatory Institutions Associated with ASGM Activities

Name of Organization	Effective	Very Effective	Ineffective	Very Ineffective	Total
EPA	57 (17.8%)	34 (10.6%)	102 (31.9%)	127 (39.7%)	320(100%)
DA	57 (17.8%)	31 (9.7%)	100 (31.2%)	132 (41.2%)	320(100%)
MC	61 (19.1%)	29 (9.1%)	115 (35.9%)	115 (35.9%)	320(100%)

Source: Field Survey, 2023

Note: EPA=Environmental Protection Agency, DA=District Assembly, MC=Minerals Commission

The analysis of the effectiveness of regulatory institutions associated with ASGM (Artisanal and Small-Scale Gold Mining) activities reveals a concerning perception of inefficacy across all three organizations: EPA, DA, and MC. A significant majority of respondents rated these institutions as either *Ineffective* or *Very Ineffective*, with both categories collectively making up more than two-thirds of the total responses for each institution.

Among the three regulatory bodies, the DA (District Assembly) had the highest percentage of respondents (41.2%) rating it as *Very Ineffective*, indicating a particularly strong perception of

failure in its regulatory role. The EPA (Environmental Protection Agency) follows closely, with 39.7% of respondents also expressing strong dissatisfaction with its effectiveness. The MC (Minerals Commission), while still heavily criticized, had a slightly more balanced negative rating, with 35.9% of respondents in both *Ineffective* and *Very Ineffective* categories. This suggests that, while still widely viewed as ineffective, MC's performance might be perceived as marginally better than DA and EPA.

In contrast, the number of respondents who rated the institutions as *Effective* or *Very Effective* is considerably lower. The EPA and DA both received only 17.8% in the "Effective" category, while MC had a slightly better rating at 19.1%. The highest positive rating—*Very Effective*—was received by EPA (10.6%), followed by DA (9.7%) and MC (9.1%), all of which are considerably low. This indicates a general lack of confidence in these institutions' ability to regulate ASGM effectively.

Overall, the data suggests that public perception of regulatory institutions in ASGM is largely negative. The consistently high proportion of *Very Ineffective* and *Ineffective* ratings implies that there are serious gaps in the enforcement, oversight, or engagement strategies of these institutions. The slightly more favorable perception of MC compared to the others could be due to its direct mandate over mining regulation, but the fact that over 70% of respondents still view it as ineffective suggests deeper structural challenges across all three institutions.

These findings underscore the urgent need for institutional reforms, improved enforcement mechanisms, and increased stakeholder engagement to enhance the effectiveness of ASGM-related regulations. Without significant changes, these institutions risk continued erosion of public trust and may struggle to effectively manage the challenges associated with ASGM activities.

8.6 Nature of Relationship between ASGM operators and Regulatory Agencies

The relationship between mining and its regulatory agencies can significantly impact the efficacy of mining regulations and the overall sustainability of mining operations (Mulaba-Bafubandi et al., 2023). When miners feel supported and understood, they are more likely to comply with regulations, leading to safer mining practices, reduced environmental impact, and improved working conditions. In turn, this compliance enhances the agencies' ability to monitor and regulate activities efficiently (Ismail et al., 2023).

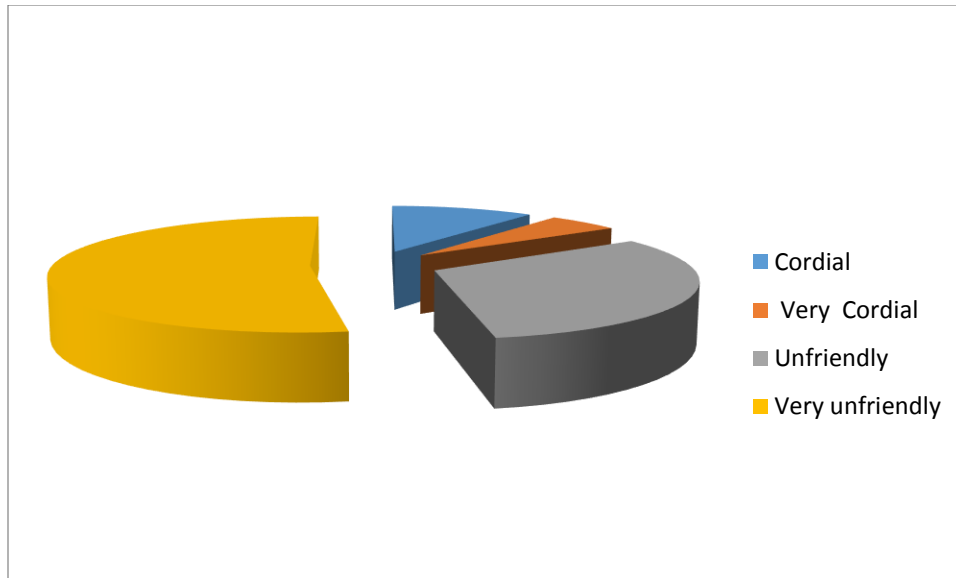


Figure 8.6: Nature of Relationship between ASGM Operators and Regulatory Agencies
Source: Field Survey, 2023

The results in figure 8.7 indicate a significant level of unfriendliness between ASGM operators as well as mining regulatory agencies in the study area. With 30% of responses indicating unfriendly and 50% indicating very unfriendly, it is evident that majority of the respondents had hostile relationship with the regulators. The high level of unfriendliness as revealed through interviews reveal several factors, including the perceived bureaucratic nature of the licensing process, undue intimidations at meted out to them at mining sites, insufficient support for miners, and frequent clashes with police and military over enforcement and compliance issues.

The strained relationship has critical implications for the regulation of illegal mining activities. When miners feel that regulatory agencies are not approachable or supportive, they are less likely to comply with legal requirements and more likely to engage in illegal mining practices.

In contrast, the low percentages of cordial (10%) and very cordial (5%) interactions suggest that only a small portion of miners experience positive relationships with regulatory agencies. This limited friendliness was due to a few miners who have begun the process of registering for licenses under community mining schemes or those who have had positive experiences with supportive regulatory officials. These miners might be more open to compliance and collaboration, seeing the benefits of adhering to legal frameworks and the support they receive during the licensing process.

8.7 Strategies Employed by State Institutions Responsible for Governing and Regulating the Mining Sector

The Minerals Commission Act, 1993 (Act 450), which established the MC, grants the Commission the authority as the principal regulator and manager of mineral resource utilization in Ghana. According to section two (2) of the Act, the MC is tasked oversee the coordination, development and implementation mineral resource policies (Ainuson, 2023). This includes ensuring compliance with regulations, promoting efficient and sustainable exploitation of minerals, and coordinating efforts to optimize the benefits derived from Ghana's mineral wealth. The Commission also plays a key role in advising the government on matters related to minerals and developing strategies to enhance the mining sector's contribution to the national economy (Asuamah- Yeboah, 2023).

The Minerals Commission functions collaboratively with the EPA to effectively reduce the negative impacts of ASGM. This partnership is crucial in developing and implementing measures that solves the environmental repercussions of ASGM. Together, they work to ensure that mining activities are conducted responsibly, reducing the use of harmful chemicals, improving waste management, and enhancing environmental monitoring and rehabilitation efforts.

Key informant interviews with the Minerals Commission and Environmental Protection Agency of Wa District reveals that they play several critical roles in managing and mitigating the environmental impacts of mining activities. These roles encompass field monitoring visits, education in best mining practices, and the implementation of land reclamation bonds.

Field Monitoring Visits

According to the Minerals Commission, they periodically visit mining areas and sites to obtain first-hand information about mining activities and their compliance with mining regulations. These visits are crucial for monitoring and ensuring that mining operations adhere to the established guidelines and standards. However, these inspections sometimes cause chaos and confusion, as unregistered miners or those without the necessary environmental permits attempt to evade the authorities. This often leads to incidents where miners sustain injuries while trying to

escape. An officer of the Wa District Minerals Commission has this to say concerning some of the difficulties they encounter during field visits:

“One of the main challenges we face is that our visits sometimes cause chaos and confusion. This often happens because the miners are not registered with the Minerals Commission or do not have the necessary environmental permits. When we arrive, they try to escape, leading to situations where miners may sustain injuries.” (KII, Minerals Commission, March 2023)

To further substantiate the information regarding field monitoring visits by the Minerals Commission, insights were sought from the Environmental Protection Agency (EPA) due to the collaborative role played by both institutions. The EPA emphasized the importance of these joint efforts in ensuring that mining activities adhere to environmental and safety regulations but gave a contrary view. The EPA officer revealed that:

“We typically avoid visiting illegal mining sites, as their operations are unlawful, and monitoring them would imply endorsing their activities. It would be similar to a police officer inspecting how a thief is stealing. Illegal miners are often armed and ready to defend what they consider their own, which poses a significant risk to us. When we do visit illegal mining sites; it is usually because residents have lodged concerns regarding the adverse impacts of ASGM on their livelihood. During these times, we go with the police to shut down the illegal operations, not to monitor or supervise their activities. What we do is that we (EPA) visit mining sites when we it is established that they have records with us in terms of holding an environmental permit from us giving them the right to mine with environmental regulations using the Environmental Assessment Regulation (LI 1652).” (Officer, EPA, March 2023)

A youth miner in a focus group discussion buttressed the above by disclosing that:

We feel unsafe whenever we receive information from our informants that officers from the Minerals Commission are visiting mining towns because we know what we are doing is illegal, but we have no other viable living alternative. We normally do not go to the mining site on that day, but if we do, we will be on high alert. The last time we heard the sound of

a pickup truck like the Minerals Commission, we had to flee, leaving our tools and goods behind. Our culinary women kicked our still-on-fire food away in an attempt to avoid regulatory organizations. DonJee (a miner's alias) even injured his arm during the escape attempt.’’ (FGD, Male, Nanga, April 2023)

This observation also buttressed Hison's (2001) findings where he argued that the unlawful activities of miners are due to poor regulation and supervision on the part of regulatory bodies

Land Reclamation Bonds

An officer from the Minerals Commission disclosed that the implementation of land reclamation bonds is a strategic measure adopted to ensure the rehabilitation of mining sites after the cessation of mining activities. Mining groups or companies are required to post a bond, serving as a financial guarantee that land reclamation will be conducted according to specified standards. However, information from the commission indicates that land reclamation in mining communities, particularly in the Upper West Region, presents significant challenges due to the illicit nature of the miners. Tracking which mining group left trenches uncovered is exceptionally difficult because these miners are elusive and often abandon the mining fields without leaving a trace. The Commission's strategy, while well-intentioned, faces substantial obstacles in these regions, highlighting the need for enhanced monitoring and enforcement mechanisms to address the issues posed by illegal mining activities. An officer from the minerals commission revealed that:

“One of our core mandates for registered mining companies is to restore disturbed lands after mining activities and before their final exit from the mining site. However, unregistered miners are not bound by these regulations and cannot be held accountable. They often leave mining pits uncovered because they have nothing at stake, having not entered into a reclamation bond with either mining regulatory institutions. This lack of accountability results in significant environmental damage and degraded farmlands’’ (KII, MC, Wa, March 2023)

To support the Minerals Commission's assertion about their role in ensuring that artisanal and small-scale gold mining (ASGM) operators restore damaged lands, the study aimed to

investigate why these miners often leave mining pits uncovered after ceasing their activities. During a key informant interview, a leader of a mining group in Danyoukuraa revealed that...

“We usually do want to restore destructed lands back for other uses such as farming but most of the time we are lured by good news of gold boom in other areas so where attention is shifted to digging for more gold than focusing on covering old mine-pits. Instead of using the money gained from the old mine site we rather prefer to use it to move our mining materials, tools and equipment to new mining areas. You yourself you know is easy to destroy than to construct.” (KII, Danyoukuraa, April 2023)

From the analysis done thus far on land reclamation, it is abundantly clear that miners’ pursuit of monetary gains in mining often takes precedence over environmental conservation and the restoration of livelihoods, such as farming. For artisanal and small-scale gold miners, the immediate financial rewards from mining activities are significantly more compelling than the long-term benefits of land reclamation

An interaction with an officer at the Minerals Commission office disclosed the expensive nature of land reclamation as one of the factors deterring ASGM operators from undertaking land reclamation exercises after closure of mines: He revealed that:

“Land reclamation after mines is an expensive and resource-intensive process, often beyond the means of small-scale miners who operate on limited budgets. Even some registered mining companies sometimes abandon pits uncovered due the financial component involved. Restoring mined land involves not only filling in pits and replanting vegetation but also addressing soil contamination and erosion. These activities require specialized equipment, expertise, and substantial financial investment, which many artisanal miners are unwilling or unable to afford. Consequently, the cost of reclamation is a significant deterrent, leading miners to shift their operations to new, promising sites rather than investing in the restoration of their former mining areas”. (KII, MC, Wa , March 2023)

This cycle of prioritizing immediate financial gain over land reclamation and the high financial cost of restoring land perpetuates environmental degradation, leading to long-term

adverse effects on local ecosystems and agricultural productivity in the mining communities. When mining pits are left uncovered, they disrupt the natural landscape, causing soil erosion, water contamination, and loss of vegetation. This degradation diminishes the land's fertility and its capacity to support agriculture, which is often a critical livelihood for local communities.

From the foregoing discussions, it is evident that regulatory institutions function more effectively when miners are officially registered and adhere to the requirements set forth in key legislative frameworks such as the Minerals and Mining Act, 2006 (Act 703), the Minerals Commission Act, 1993 (Act 450), and the Environmental Protection Agency Act, 1994 (Act 490), particularly through the Environmental Assessment Regulations (LI 1652). These laws establish clear guidelines and standards for mining operations, ensuring that miners engage in responsible and sustainable practices, including land reclamation. However, in the study area ASGM operations were found to be operating without valid mining licenses. This lack of formal registration and oversight makes it challenging for regulatory agencies and institutions to effectively govern and regulate ASGM activities in the Upper West Region

8.8 Challenges Impeding the Smooth Regulation of ASGM Activities

Lack of Viable Block out Areas for Small Scale Gold Mining

According to the Wa District's Mineral Commission officer, one of the significant challenges facing the Minerals Commission is the lack of viable block out areas designated for small-scale mining activities. Block out areas is specific zones identified and reserved exclusively for small-scale miners to conduct their operations legally and sustainably. These areas are crucial for managing and regulating the small-scale mining sector, which is an essential source of livelihood for many rural communities in Ghana. However, the absence of such designated areas poses several problems for the Minerals Commission and the small-scale mining sector. The absence of sufficient block out areas leads to several issues. These forces small-scale miners to operate in unauthorized locations, often encroaching on lands designated for other purposes, such as agriculture, conservation, or large-scale mining. This encroachment results in conflicts between small-scale miners and other land users, leading to social unrest and legal disputes.

Another challenge revealed by the minerals commission was:

“With a fairly small workforce, the office in Wa is the only one that serves every district in the Savannah and Upper West regions. The commission's office in the Savannah region is still under development; the completion date is unknown. Because you have a lot of areas to monitor and submit reports correctly, this makes our task quite difficult” (KII, Minerals Commission, Wa, March 2023)

Interference by the Political Class

The Assistant Programs Officer of the EPA Wa Office, revealed in an interview that one of the major challenges faced by their office in the execution of their duty is undue interference by the political class. Political influence often undermines the EPA's ability to enforce environmental regulations effectively and independently. Politicians, driven by various agendas, often exert pressure on the EPA to overlook violations or expedite approvals for mining, even when these projects pose significant environmental risks. This finding corroborates the results of the study by Crawford and Botchwey (2016), which identified the collusion between district assemblies, state regulatory agencies, and illegal miners as a key factor responsible for the recent galamsey (illegal mining) problems in Ghana.

Poor Coordination among Regulatory Institutions

Poor coordination among mining regulatory institutions was revealed as one of the challenges militating against the effectiveness of mining governance in the study area. Agencies such as the Minerals Commission, Environmental Protection Agency (EPA), and District Assemblies often operate in silos, leading to duplicated efforts and inefficiencies. To substantiate the above claim an EPA officer mentioned that:

“There is an urgent need for cooperation among institutions such as the Minerals Commission and the District Assemblies to work effectively. Often, it appears that we are duplicating efforts when, in reality, we could achieve better outcomes by working collaboratively. This lack of coordination complicates our tasks, leading to wasted time and resources. It is particularly frustrating to invest effort to embark on a project, only to

discover that another institution has already completed it without proper consultation. Enhanced collaboration would streamline our work and improve overall efficiency''. (KII, EPA, Wa District, March 2023)

The lack of collaboration results in inconsistent enforcement of regulations, where one agency may undertake activities without informing or consulting the others, causing overlaps and gaps in regulatory coverage. Consequently, this disjointed regulatory environment not only wastes valuable time and resources but also impedes the ability to address environmental and social impacts comprehensively

In order to deal with the challenges associated with small-scale mining in Ghana, there is the need for an integrated approach involving all relevant stakeholders to address the multifaceted challenges confronting the mining sector. Such collaboration in the form of a taskforce is essential because it is impossible for any single state institution or organization to effectively monitor the activities of the artisanal small-scale mining sector.

Logistical and Staff constraints

Another challenge revealed by EPA through interview is logistical constraints which is hampering the effectiveness of the Environmental Protection Agency (EPA) in the policing of ASGM activities in the Upper West Region. The poor condition of their vehicles severely limits the agency's ability to visit and monitor mining sites regularly. These logistical challenges undermine the EPA's capacity to oversee mining activities effectively, respond to environmental violations promptly, and ensure compliance with environmental standards. To support this assertion, the EPA Programs Officer revealed several logistical constraints faced by the agency. He noted,

"We are logistically constrained in many ways, including the lack of offices and staff in many districts of the Upper West Region. The Wa District office is responsible for overseeing the entire region, except for the Sissala East District. We used to have an office in Nandom, but it was recently closed down. As a result, we now have only two EPA offices regulating environmental activities in the Upper West Region." (KII, EPA, Wa District, March 2023)

The officer further highlighted that the EPA's inability to establish offices in all eleven districts, especially in the three key mining districts of Nadowli-Kaleo, Wa East, and Wa West, significantly hampers the regulation of Artisanal and Small-Scale Gold Mining (ASGM) activities. This lack of local presence makes it challenging to effectively monitor, manage, and enforce environmental compliance, rendering the regulation of ASGM activities very ineffective in the Upper West Region.

Roles of District Assemblies and Traditional authorities in ASGM in the study areas

District Assemblies are mandated to play a pivotal role in the regulation of Artisanal and Small-Scale Gold Mining (ASGM) activities within their jurisdictions. Their responsibilities are clearly defined to ensure that mining operations comply with both national laws and local regulations.

The district assemblies in the three-mining district according to their planning officers have played various supervisory roles, as stipulated in the Act 703 of 2006 mining act. As part of their mandate, respondents asserted that these assemblies conduct regular visits to ASGM communities to oversee activities and educate miners on the importance of obtaining legal mining licenses. To buttress the above assertion a one of the district planners mentioned that:

“The District Small Scale Mining Committee is effective because it keeps track of all mining sites and report on activities of ASGM through their periodic visits to mining communities to sensitize them on the need to get mining license. We normally do this with the EPA and the MC.” (KII, Wa West District, April 2023)

To validate the statement made by the Wa West Development Planning Officer regarding the assemblies' role in governing mining activities, a member of the District Mining Committee of Wa East District expressed the following opinion:

“Occasionally, the District Assemblies, in collaboration with the District Security Council (DISEC), conduct visits to illegal mining sites with the intent to halt these unlawful activities. Unfortunately, when arrests are made, the perpetrators often do not face the stringent penalties outlined in the Minerals and Mining Act 2006 (Act 703). Instead, they are frequently released due to the intervention of political leaders or traditional authorities

within the mining communities. This undermines the enforcement of mining regulations and perpetuates the cycle of illegal mining.’’ (KII, Wa East District, April 2023)

To substantiate the claim made by the districts regarding role in regulating ASGM activities through the District Small Scale Mining Committees, a lead miner with over 16 years of experience offered a dissenting view. He revealed that:

“Despite the formal role of the District Small Scale Mining Committees in regulating mining activities, the reality on the ground is quite different. In my extensive experience as miner, I have observed that these committees often lack the necessary authority and resources to enforce regulations effectively. Many miners operate without proper oversight, leading to widespread non-compliance with safety and environmental standards.’’ (KII, Nanga, May, 2023)

To verify the information shared by the youth miner regarding the alleged extortion of money by the police, a planning officer offered a contrasting perspective, highlighting a more dangerous behaviour commonly exhibited by miners. He shared that:

“What we frequently come across is a perilous negligence of regulations exhibited by the miners themselves. They often elude our inspections by concealing themselves in the bush and subsequently resuming their illicit activities after our departure. This greatly hinders the ability to effectively implement any type of legislation. When miners abandon their equipment during these evasions, there are protocols in place to ensure that the tools are only given back after verification and payment of fines for illicit acts. Our visits serve the purpose of not only collecting fines, but also verifying the safety and long-term viability of mining methods. In order to accomplish these objectives, it is imperative that we obtain greater collaboration from the miners.’’ (KII, Wa West District, May, 2023)

Challenges impeding against the effective performance of District Assemblies in relation to ASGM

The first challenge mentioned by the officers is the pervasive corruption and political interference. Influential individuals frequently intervene to protect illegal miners from facing the

consequences of their actions. According to one district officer, this interference not only undermines their efforts but also perpetuates unsafe and unsustainable mining practices.

Another challenge identified is the lack of resources and logistical support necessary for proper monitoring and enforcement. As one officer explained:

"We frequently face challenges due to inadequate funding, insufficient staffing, and a lack of logistics, which significantly hampers our ability to perform our duties effectively. At times, we even lack the fuel necessary to power our vehicles, making it difficult to reach mining sites that are often situated deep in the bush." (KII, Wa East, May 2023)

Additionally, there was a reported persistent gap in communication and coordination between various governmental and local authorities. A district assembly member noted that:

"The District Assembly's efforts to combat illegal mining are hindered by a lack of collaboration among various agencies and traditional authorities. This often leads to a duplication of efforts, resulting in a waste of time, energy, financial resources, and logistics. Instead of conducting individual visits to mining sites, we could more efficiently use a single vehicle and share fuel and resources, maximizing our collective impact." (KII, Wa West, April 2023)

Lastly, the involvement of chiefs as mining regulatory collaborators often derails the efforts of District Assemblies in policing illegal mining activities in mining communities. This issue was highlighted by a member of the District Small Scale Mining Committees in Wa East. He stated that:

"Some chiefs and landlords, who are supposed to enforce mining laws and policies, have already leased their lands for artisanal and small-scale gold mining (ASGM) activities. This has led to conflicts between mining regulatory institutions and these local authorities over the ownership of illegal mining concessions, significantly complicating our regulatory efforts. Just few months ago, a regulatory team faced fierce opposition from a local chief who had leased land to illegal miners, resulting in a prolonged standoff that hindered enforcement actions." (KII, Wa East, May 2023)

Despite the oversight responsibilities of the district assemblies aimed at achieving environmental stewardship and promoting sustainable mining, field data indicates that their efforts have not yielded the desired results. Field observations by the researcher in various mining communities revealed a wanton disregard for mining standards and safety protocols as stipulated by existing policies.

Firstly, my field observation reveals that miners were processing gold without adhering to basic safety measures, such as wearing nose masks, protective helmets, metallic footwear, and ear protectors. Alarming, some miners were found working at mining sites barefooted, even while working underground. Additionally, several miners were seen washing gold samples with mercury using their bare hands, with waste water being discarded indiscriminately, posing significant health risks.

Furthermore, visits to mining sites where surface mining was practiced, particularly in areas such as Eggu, Nanga, and Polee, revealed numerous uncovered mine pits and massive gullies left after mining activities. Trenches dug by excavators were left exposed, rendering the land unproductive and hazardous. In some instances, farmlands were encroached upon by illegal miners, and in other cases, farming and mining were occurred in close proximity, with only a few meters separating them.

Roles of Traditional Authorities in ASGM governance and Regulation in the study areas

Traditional authorities are intended to serve as the primary regulators of ASGM in their respective communities (Agbesinyale, 2023). However, they often become entangled in ASGM activities, shielding those who violate mining regulations and laws. This behaviour compromises the physical environment and adversely affects rural livelihoods within the community. They frequently negotiate the terms and conditions under which mining can take place. This authority over land access grants them considerable influence over mining activities. To substantiate this when a lead miner was asked about how he got access to the land he was mining with his group he revealed that:

“Upon hearing of the discovery of gold in a nearby community, I immediately decided to investigate. I drove there with three of my associates. Our first stop was to visit one of the

elders who had close ties to the chief. The elder graciously took us to meet the chief himself, where I expressed my interest in extracting gold from the community. The chief's initial concern was what personal benefits he would receive rather than how the community would profit. I assured him that, should the gold deposits prove to be of significant economic value, I will handsomely reward and provide him with a monthly royalty from the gold proceeds. Satisfied with my proposition, the chief promptly instructed two of his elders to show me the area where the gold had been discovered and to allocate a portion of the 'concession' for my operations. Although no formal paperwork was signed, we reached a verbal agreement. Today, that chief has accumulated substantial wealth from the mining activities''. (KII, Takpo, April 2023)

It is obvious that chiefs at the mining communities regulate ASGM activities differently from what is done at the national level using state agencies like minerals commission and the environmental protection agency. Banchirigah (2008) explains as cited in (Bansah, 2023) the role of Chiefs as local authorities:

‘Despite mineral rights being vested in the presidency and chiefs playing no role in the approval of a mining concession, rural inhabitants see them as figures of authority. Thus, in areas that are relatively ‘un-policed’, as many galamsey camps are, chiefs stand to benefit financially from prospective miners by ‘endorsing’ their activities: Contrary to this, artisanal miners are allowed ‘permission to mine ‘at a cost’ in the area of operation of the large-scale mining companies’.

Although the national government in Ghana often views the majority of artisanal and small-scale mining (ASM) activities as illegal, or "Galamsey," the reality on the ground is different. Many Galamsey miners operate with permission under local regulations or traditions. ASM operators prefer these customary systems because they are simpler and more manageable compared to navigating state bureaucracy. Additionally, the relationships between ASGM operators and local communities tend to be cordial and sometimes even symbiotic; largely because of the mutual socio-economic benefits they share (Nyame and Blocher, 2010).

The study also sought to gather the perspectives of the traditional rulers in the mining communities to understand their knowledge and involvement with the District Small Scale Mining Committees (DSSMCs). Shockingly, it was revealed that the chiefs and their elders in these mining communities were consistently excluded from DSSMC operations and meetings. The traditional rulers described this exclusion as an unfortunate situation, expressing their disappointment and concern over the lack of engagement and representation in decisions that significantly impact their communities. This exclusion not only undermines the traditional authority but also hinders the potential for collaborative efforts to address mining-related issues and promote sustainable development in these regions. A chief revealed that:

"I have yet to receive a single invitation from the DSSMC to attend a meeting, let alone participate in any actions," said one of the chiefs. "I haven't even heard of that committee before, so how am I supposed to know how they operate? I just sit in the community and see people driving by to the mining sites, but I have no idea who they are or what their mission is. It feels like the committee has no respect for us, the chiefs. How can we solve the mining issues if we're being completely left out?" (KII, Polee, May 2023)

The discussion clearly reveals a significant disconnect between the traditional rulers of mining communities, who are the custodians of the lands where Artisanal and Small-Scale Gold Mining (ASGM) activities occur, and the state agencies responsible for governing and regulating these activities. The poor collaboration among stakeholders of small-scale mining confirms one of the major challenges faced by stakeholders in small-scale mining as argued by Baddianaah et al (2023).

8.9 Some Flaws in the Existing Law, Regulatory Framework and Policy Governing the Mining Sector in Ghana

In obtaining a mineral license, the principal statute governing mining operations in Ghana is the Minerals and Mining Act, 2006 (Act 703), which has been revised in 2010, 2015, and 2019. The Environmental Assessment Regulations of 1999 and the Environmental Protection Agency Act of 1994 both lend credence to this law (Buertey et al., 2023). Although these extensive laws are in place, regulatory institutions are not doing a good job of enforcing them, and stakeholders are not doing enough to ensure compliance.

The Minerals and Mining Act deals with every issue to do with mining and its control in Ghana and is perhaps the biggest legal change resulting from the virtues of liberalization and deregulation. In this regard, the 2006 Act corresponds to ‘more investment-friendly legislation’ in terms of standard practices in the industry’ (World Bank, 2008b). However, the new mining regulatory framework seems to lack adequate mechanisms of measuring the performance of the mining firms in the health, safety, and environmental management aspects (Ayee et al., 2011; as cited in Zhang et al., 2023).

Therefore, this section of the study seeks to conduct a comprehensive review of the Minerals and Mining Act, 2006 (Act 703) to identify some flaws in the law and the challenges faced by regulatory institutions in implementing, enforcing, monitoring, and ensuring compliance with the established regulations. It is important to note that some of the gaps identified during the review were supported with literature from other scholars, substantiating the study's findings and providing a robust analysis of the issues at hand. The review identified the following deficiencies:

8.9.1 Ineffective Oversight and Management of the Artisanal and Small-Scale Mining Sector

The absence of a precise legal delineation between artisanal mining and small-scale mining has resulted in a scenario where artisanal miners frequently engage in activities that are not in compliance with legal regulations. Furthermore, the current legislative framework lacks precise definitions for the tenure and acquisition processes of artisanal mining licences. The Minerals and Mining Act 2006 (Act 703) necessitates the modification of Sections 82 to 89 in order to clearly distinguish between artisanal and small-scale mining, taking into account factors such as certification and the extent of the operational land.

Furthermore, the portions of the Act pertaining to the issuance of small-scale mining licences and leases do not include the requirement of training as a prerequisite for obtaining these rights. This exclusion is a notable policy deficiency, since it neglects to guarantee that miners possess the requisite expertise and understanding to carry out their operations in a secure and environmentally responsible manner.

8.9.2 Inability to achieve the goals of the Environmental Impact Assessment (EIA)

Although there is a mandate for all new mines to conduct Environmental Impact Assessments (EIAs), Annual Environmental Reports (AERs), and Environmental Audit Reports (EARs), the efficacy of these procedures has been constrained. Communities affected by mining

operations often face obstacles in accessing these reports, which hinders their ability to get direct information about the negative social, environmental, and health consequences, as well as the impact on their means of living (Ayee et al., 2011). The effectiveness of the Environmental Protection Agency (EPA), which was created by the EPA Act, 1994 (Act 490) and is responsible for granting environmental licences to mineral rights

The public hearings, intended to allow proponents or mining companies to publicly unveil the adverse effects and possible bonded mitigation measures and community members to provide input on EIA documents, frequently become mere exercises in gaining social capital such as trust for the mining companies. These hearings often fail to clearly outline the adverse impacts of mining operations and the mitigation measures as a requirement enshrined in the Environmental Assessment Regulation, 1999 (LI 1652).

Moreover, the mining corporations themselves are responsible for conducting the necessary impact evaluations, yet there is inadequate supervision. The EIAs are frequently maintained in confidentiality, composed in specialised jargon that proves challenging for individuals outside the field to comprehend, and are deficient in comprehensive social impact assessments and genuine community engagement (Akabzaa, 2000; Akabzaa, Seyire, & Afriyie, 2007). These issues contribute to a dearth of substantial engagement and openness in the environmental assessment process, reducing the potential advantages of these regulatory measures (Ayee et al., 2011; Reynolds, 2023).

8.9.3 Lack of an Open Competitive Process for Acquiring Prospecting and Mining Licenses

The proposed changes to Section 13 of the Minerals and Mining Act, 2006 (Act 703) do not include provisions for the competitive auctioning of mineral rights. All concessions are allocated on a first-come, first-served basis, regardless of the known host mineral deposits. However, strategic minerals such as bauxite, manganese, and iron ore are exceptions to this rule. Prior to obtaining a licence, firms are required to first submit plans for these strategic minerals (Boakye et al., 2023). The acquisition of exploration or prospecting rights does not include a transparent bidding or tendering process. Instead, licenses are awarded to individuals or organisations through an administrative system. Confidentiality is maintained for all transactions, enabling the potential for undisclosed earnings and tax evasion.

As per the Minerals and Mining Act of 2006, firms are required to request mining leases, which can be granted by the Minister for Mines based on the advice of the Minerals Commission. Concessions are designed and awarded based on a first-come, first-served basis as a result of negotiations between the government, mining firms, chiefs, and local populations. The absence of competition and openness has caused many people to assume that firms are unfairly gaining legal advantages.

Furthermore, all lease agreements and negotiations pertaining to mining concessions are maintained in strict confidentiality, with non-disclosure clauses included in mining concessions and leases to safeguard company interests. These restrictions for nondisclosure enable a lack of clarity and responsibility (Ayee et al., 2011).

Besides, the secrecy surrounding mining transactions and the inclusion of nondisclosure clauses in mining concessions prevent regulatory bodies from effectively monitoring and enforcing environmental and social standards. This lack of accountability compromises the integrity of regulatory institutions and hinders their ability to ensure sustainable mining practices.

8.9.4 Stricter Sanctions for small-scale miners compared to those for large-scale miners

The consequences for breaking the law are notably milder for large-scale mining companies compared to the harsher penalties imposed on small-scale miners. The 2006 Mining Act outlines offences in the mining sector that may attract sanctions. For instance, individuals who buy or sell minerals without a license face a minimum fine of 3,000 penalty units, imprisonment for up to five years, or both. In contrast, more serious offences primarily involving large-scale mining receive significantly lighter penalties. For example, failing to notify the Minerals Commission and the Geological Survey Department about the discovery, reconnaissance, and export of radioactive minerals results in a fine of no more than the cedi equivalent of US\$50,000 or imprisonment for a maximum of two years, which may be combined with a US\$50,000 fine (Ayee et al., 2011).

This disparity in sanctions affects mining regulation and the operations of mining companies, creating an uneven playing field. Large-scale mining companies, facing less stringent penalties, may be less deterred from violating regulations, potentially leading to greater environmental degradation and negative impacts on community health and livelihoods. On the

other hand, small-scale miners, burdened with harsher punishments, may feel unjustly targeted, fostering resentment and reducing their willingness to comply with regulations. This imbalance not only undermines effective regulation but also exacerbates the adverse effects of mining operations on local communities, who bear the brunt of environmental and social harm.

8.9.5 Acquisition of land for potential mineral extraction

The act of expropriating land for mining purposes creates substantial controversy. The government's management of this matter has been inadequate, mostly because of the perceived inequity towards the impacted populations and the lack of transparency in the regulations governing expropriation. Significantly, the 2006 Minerals and Mining Act is in conflict with the provisions of the 1992 Constitution regarding this issue, resulting in a multitude of grievances from mining several mining communities. The Mining Act establishes the legal framework for mandatory land acquisition for mining purposes. However, according to the Constitution, mineral rights are held by the president on behalf of the people. Expropriation is only permitted if fair and sufficient compensation is provided, and individuals with a stake in the land, such as the owners, have the right to appeal to the High Court regarding compensation matters.

The ambiguities in interpreting these rules have led to compensation determinations being left to negotiations between the parties concerned, frequently ending in protracted litigation. The absence of established standards for compensation norms and property assessments in mining zones intensifies these concerns. As a result, the legal framework has not effectively dealt with the problems related to expropriation and compensation. This failure presents significant challenges in the mining industry, ranging from the initial extraction process to the eventual closure and decommissioning of mining sites (Ayine and Gyan, 2009).

8.9.6 The 2006 Minerals and Mining Act (730) Fail to Require Continues Consultation and Negotiations with Host Communities by Mineral Right Holders

The absence of explicit provisions in the Ghana's 2006 Minerals and Mining Act requiring mineral right holders to consult and negotiate on issues and decisions affecting host communities is a significant oversight. This lack of mandatory consultation leaves communities vulnerable to the adverse impacts of mining activities without a formal mechanism to voice their concerns or influence decisions that affect their lives and environment. Agricultural productivity may decline

due to contaminated soil and water, leading to food insecurity and economic instability. Furthermore, without formal negotiation processes, communities may not receive fair compensation or adequate measures to mitigate the impacts of mining.

This can result in long-term social and economic hardships, including displacement and loss of ancestral lands. Without these provisions, mining companies are not legally obligated to engage with local communities in meaningful dialogue or to consider their input when making decisions about mining operations. This can lead to feelings of disenfranchisement and mistrust among community members, who may perceive that their interests and well-being are being overlooked in favor of corporate profits.

The African Mining Vision (AMV) Action Plan (2011) emphasizes the importance of establishing multi-stakeholder mechanisms to ensure broad participation in the decision-making, monitoring, and evaluation of mineral projects. This approach recognizes that mining activities have far-reaching impacts on local communities, the environment, and the economy. By involving various stakeholders, including government agencies, mining companies, local communities, and civil society organizations, the AMV aims to promote transparency, accountability, and inclusivity in the mining sector. This collaborative framework is designed to ensure that the voices of all affected parties are heard and considered, leading to more sustainable and equitable mining practices (Busia & Akong, 2017).

Similarly, the ECOWAS Directive, specifically Article 16(4), mandates that mining companies engage in consultations and negotiations with local communities on important decisions throughout the mining cycle. This directive underscores the necessity of continuous and meaningful dialogue between mining companies and host communities. It ensures that communities are not only informed but actively involved in decision-making processes that affect their lives and environment. Such consultations are crucial for addressing the concerns of local populations, ensuring fair compensation, and implementing measures to mitigate negative impacts (ECOWAS Commission, 2019). This study therefore asserts that the inclusion of a provision in Ghana's Act 703, mandating mineral right holders to engage in consultation and negotiation with host communities, will greatly enhance the mining sector's rapport with these people.

8.10 Summary of Chapter

This chapter delves into the roles and effectiveness of regulatory institutions, traditional authorities, laws, and government policies governing the mining sector in Ghana, particularly focusing on the Upper West Region. The chapter emphasizes the need for a cohesive regulatory framework to ensure sustainable and responsible mining practices. It highlights the critical functions of regulatory institutions like the Environmental Protection Agency (EPA), Minerals Commission, and District Assemblies in overseeing mining activities. Both government and traditional institutions play significant roles in managing Artisanal and Small-Scale Gold Mining (ASGM), balancing sustainability with immediate economic benefits. However, many miners operate without proper licenses due to bureaucratic hurdles, high costs, and lack of awareness. The chapter reveals that 42% of miners were unaware of the licensing process, and 31.7% could not afford the fees. Interviews with miners and officials from the Minerals Commission highlight the cumbersome nature of the licensing process, with miners citing corruption, bureaucratic delays, and high costs as major deterrents.

The chapter also addresses the roles and effectiveness of the Minerals Commission and EPA, which conduct field monitoring visits, educate miners on best practices, and implement land reclamation bonds. Poor vehicle conditions and limited funds restrict the EPA's ability to monitor mining sites effectively. Additionally, the EPA's limited presence in key mining districts exacerbates the problem. Traditional authorities, while playing a significant role in regulating ASGM by granting land access and mediating conflicts, often prioritize their interests over environmental and community welfare, complicating regulatory efforts. Poor coordination among regulatory institutions leads to inefficiencies and duplicated efforts, necessitating enhanced collaboration. The chapter identifies deficiencies in the Minerals and Mining Act, 2006 (Act 703), such as vague definitions, inadequate training requirements, and ineffective Environmental Impact Assessment (EIA) processes. It critiques the first-come, first-served approach to issuing mining licenses, highlighting risks of corruption and lack of transparency, which undermine the regulatory institutions' ability to enforce standards effectively. The chapter concludes that addressing these issues is crucial for promoting sustainable mining practices and safeguarding the environment and livelihoods in mining communities.

CHAPTER NINE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

9.0 Introduction

This chapter of the thesis is a pivotal section that encapsulates the study's key results, aligning them with the research objectives. It highlights the summary of the study based on the objectives. Following the summary of findings, the conclusions drawn from the research are presented. These conclusions synthesize the findings, interpreting the data in the context of the research objectives. They provide a deeper understanding of what the data means and how it relates to the questions posed at the outset of the study. Preceding this is the conclusions drawn to address the implications of the findings, exploring the broader impact and relevance of the results. The recommendations section serves as guide future actions, whether they involve policy changes, further research, or practical implementations based on the conclusions. The contribution of this thesis to knowledge as well as its limitations was comprehensively covered under this chapter. Finally, the study suggests areas for further research, based on the gaps identified during the study.

9.1.0 Summary of Findings

The study summarises its findings under the following headings:

9.1.1 Mode of Operations of Artisanal and Small-Scale Gold Mining

The study reveals that 42.5% had their lands through family inheritance, and 20% of them had their mining lands from chiefs. This means that majority of the landholdings in the study area are done through informal means for mining purposes.

The results from the study revealed that majority of 35 respondents representing 87.5%, have not received training as small-scale miners. The reasons behind this from the respondents were multifaceted, including a lack of training programs, the illegal nature of artisanal and small-scale miners, perceived irrelevance of training by the miners, or other hindrances such as cost or time constraints.

The responses show that 78% of the miners are engaged in surface mining methods whiles 22% are also engaged in the underground mining known as open pit method. The analysis of

surface mining methods among 31 artisanal and small-scale gold miners reveals that 18 representing 58.1% of the miners were into dig and wash method (*Tupɛ ge in the Waale dialect*).

The findings indicated that majority (95%) the people who ventured into ASGM business entered pointed agricultural vulnerability to climate variability indicating it as a critical issue. This high percentage underscores the severe the need to invest in agriculture in order to make it more viable.

The research also showed that unemployment was ranked as one of the highest motivators for ASGM, with 82.5% of respondents identifying in multiple response. This high percentage indicates a significant lack of education for formal employment opportunities and the unviability of the agricultural sector due to mining and other natural factors like climate change.

9.1.2 Socio-Economic Implications of Artisanal and Small-Scale Gold Mining

With regards to the influence of ASGM on insecurity in the study area, the data demonstrated that vast majority of categories of respondents, 77.5% of miners and 87.2% of non-miners, affirmed that artisanal and small-scale gold mining influences insecurity in all the selected mining communities. Some of the most rampant insecurity implications mentioned were stealing, armed robbery and violent attacks.

Again, on the consequences of ASGM on socio-cultural practice, the analysis revealed that substance abuse emerges as the most prevalent issue, affecting a greater percentage of non-miners (64.50%) than miners (55.56%). This high prevalent rate of drug abuse was as a result of the influx of miners from other parts of the country who come in to adulterate the culture of the mining communities thereby influence others to also become drug addicts. The intake of prescribed drugs according miners was to generate an extra energy and also to suppress their pain after mines work.

Besides, analysis of the community perception regarding the socio-economic benefits derived from Artisanal and Small-scale Gold Mining (ASGM) reveals a significant impact on providing alternative livelihoods, with about 24.08% of respondents identifying it as a key benefit. This suggests that ASGM serves as a critical alternative to traditional employment, particularly in communities where other lucrative job opportunities may be scarce. The creation of jobs, noted by 18.37% of respondents, complements this view, indicating that ASGM is a substantial employment

generator, crucial for sustaining local economies and reducing dependency on single-industry economies.

The investigation also discovered that the percentages of miners and non-miners who attribute the poor sanitation situation in mining areas to the activities of ASGM. Notably, 72.5% of miners and a higher percentage of non-miners, at 82.18%, agree that small-scale gold mining activities contribute to poor sanitation.

Also, evidence from this study indicates that a higher percentage of non-miners (73.1%) perceived that ASGM contributes to the contraction of some diseases compared to miners (52.5%). Malaria was mentioned as one of the dominant health issues among respondents, with a higher percentage of 65.62% followed by Skin diseases (7.19%) and acute respiratory infections (RTI) (6.25%).

9.1.3 Implications of ASGM on Rural Household Livelihood Diversification, Assets, and Activities

From the results displayed, it was revealed that more than 77% of miners and 90.3% of non-miners admitted that artisanal and small-scale gold mining (ASGM) has a negative impact on their livelihoods. The various livelihoods affected by ASGM, as reported by both miners and non-miners, include crop farming, livestock rearing, shea nut picking, trading, fuel wood fetching, hunting, and fishing

Besides, the analysis carried by this study on farming systems provides valuable insights into the extent of agricultural commercialization. The data indicates that majority of respondents, 71.56%, engage in subsistence farming. This high percentage highlights that most community members rely on small-scale agriculture primarily for their own consumption rather than for commercial purposes. This was attributed to the inability of most farmers to financially shoulder the burden of now expensive agriculture. They lamented the high prices of cost of fertilizer, high cost of tractor services and the high rent of farm labor as results of high income from ASGM.

The study results indicated a range of livelihoods negatively impacted by ASGM, with a notable emphasis on agriculture and land-dependent activities with crop farming emerging as the predominant livelihood, with 301 responses accounting for 94.06% and animal husbandry 69.06%

of the total. This suggests that a significant portion of the community relies on crop farming for their sustenance and income which has been destructed by mining activities.

The study results on the reliance of coping mechanisms to mitigate the adverse effects shows respondents who diversify into artisanal and small-scale gold mining (ASGM) were the most common coping mechanism, with 138(82.14%) responses while other respondents' improvised ways of filling post-mine pits in a form of land reclamation for farming activities were represented by 95 (56.55). This implies a considerable effort by individuals to mitigate environmental degradation and repurpose mined land for other uses.

Furthermore, in the study area, the payment system for women differs significantly from traditional monetary compensation. Instead of receiving direct financial remuneration, women are often compensated with a quantity of the processed smooth soil, proportional to the number of bags they have handled at the grinding machine. This form of payment in kind reflects a broader issue of economic inequity, where women are relegated to receiving compensation that do not immediately address their financial needs

Finally, the study revealed a high rate of school dropout, with a mean of 3.21, reflects a high perception as compared to the weighted average of 3.2 about the negative effects of ASGM on rural livelihoods. ASGM attracts young people away from education due to the immediate financial benefits, thereby affecting their long-term prospects. This trend has serious implications for the future of the study area human capital of the communities.

Despite the negative consequences of ASGM on rural livelihood most especially those that are dependent on land, the study results show a range of livelihoods associated with (ASGM) such as main gold ore extraction (100%), food vending (98.9), grinding machine operators (95.8%), gold buyers (91.4), head porters (76.4%), water vending (64.2%), local gold prospectors (55%) among others.

9.1.4 ASGM Effects on the Physical Environment and Possible Ways of Mitigation

The results show a high level of miners (80.0%) and non-miners (90.3%) admitted to being cognizant of the adverse effects that mining activities have on the natural environment. Again, the study revealed a significant concern highlighted by both miners (67.5%) and non-miners (80.3%) is land degradation. This high level of awareness underscores the visible and immediate effects of ASGM, such as deforestation and habitat destruction.

The study results reveal a significant concern highlighted by both miners (67.5%) and non-miners (80.3%) is land degradation. This high level of awareness underscores the visible and immediate effects of ASGM, such as deforestation and habitat destruction. A study observation made to most mining sites reveals indiscriminate felling of trees hence making land susceptible to erosion leading to land degradation.

With regards to the land use land cover changes as a result of ASGM, the study shows a notable decline in closed vegetation, especially between 2002 and 2010, across all districts. For instance, Nadowli-Kaleo experienced a reduction from 8.06% in 2002 to 3.07% in 2010, with a slight recovery to 5.34% by 2022. This fluctuation is attributed to deforestation for mining, farming, and charcoal burning.

The study also showed an increase in bare lands across all districts, with Wa East experiencing the most significant rise from 1.01% in 2002 to 1.93% in 2022. This trend is largely due to mining activities that clear vegetation and soil, leaving the land barren.

The study identified significant spatiotemporal variations in land use and land cover (LULC) across the Nadowli-Kaleo, Wa West, and Wa East districts from 2002 to 2022. One of the key findings was a substantial increase in built-up areas, particularly linked to the influx of mining workers and their families. This trend was most pronounced in Nadowli-Kaleo, where built-up areas rose from 4.87% in 2002 to 9.68% in 2022, and similarly in Wa West and Wa East.

Additionally, the study revealed an increase in bare lands, particularly in Wa East, where bare lands expanded from 1.01% in 2002 to 1.93% in 2022. This increase is largely attributed to mining activities that strip the land of vegetative cover.

Finally, while the area covered by water bodies increased slightly over the study period, these remained a minor component of the total land area, with slight improvements in water resource management being offset by the pressures of mining activities.

9.1.5 Roles and Effectiveness of Regulatory Institutions, Traditional Authorities, Laws and Government Policies Governing the Mining Sector in Ghana

The study revealed that all 40 miners interviewed lacked a mining permit, indicating that unlicensed mining is rampant in the selected towns. Respondents' awareness of specific mining licences was also assessed with 42% stating that they had no knowledge of any mining licence, while 31.7%, mentioned that they do not have adequate funds to pay the registration fees as legal small-scale miners.

The analysis from the reveals a significant awareness gap among and non-miners and miners within the mining communities regarding mining policies and laws. A greater majority of miners (90%) indicated they do not have knowledge about these policies and laws, leaving only 10% who feel informed.

Besides, the study identified poor coordination among key regulatory institutions such as the Minerals Commission, EPA, and District Assemblies. This lack of coordination results in duplicated efforts, inefficiencies, and gaps in regulatory coverage.

Finally, the study uncovered that EPA and MC faced significant logistical constraints, including poor condition of vehicles, lack of funds for fuel and maintenance, and insufficient staffing. These limitations severely restrict their ability to visit and monitor mining sites regularly, hindering effective oversight and enforcement.

9.2 Conclusions

The study concludes that local customs and the roles of familial and chieftaincy structures in plays vital roles in the in-land distribution and the permission of illegal mining activities thereby making the governance and regulation of ASGM a daunting task. The informal nature of these transactions may pose challenges for regulatory oversight and sustainable land management practices. It was aslo concluded that the preference for surface mining methods, particularly "dig and wash," was driven by factors such as accessibility, lower cost, and simpler techniques. The study concludes that the severe effects of the unprofitability nature of agriculture due to both natural causes such as climate variability and anthropogenic ones like artisanal and small-scale

gold mining has driven lots of individuals to seek alternative livelihoods in the mining sector. Strengthening agricultural practices and infrastructure could mitigate the effects of climate change, reduce the over dependency on mining, and improve overall livelihood sustainability in the region.

The study concludes that emergence of ASGM and the influx of miners from other parts of the country has led to cultural adulteration, influencing substance abuse, armed robbery, teenage pregnancy and general insecurity in the mining communities. Again, the study findings highlight the significant health impacts of ASGM activities on the community, emphasizing the need for improved health interventions and preventive measures to mitigate the spread of mining-related diseases.

The study concludes that artisanal and small-scale gold mining (ASGM) has significantly disrupted various livelihoods, with a particular emphasis on agriculture and land-dependent activities. Crop farming, as the predominant livelihood for a substantial portion of the community, has been notably affected by mining activities. This disruption underscores the critical dependence of the community on agriculture for sustenance and income, highlighting the need for measures to address the negative impacts of ASGM on these vital land-based livelihoods. The study concludes that diversifying into artisanal and small-scale gold mining (ASGM) was a prevalent livelihood strategy among other strategies for individuals dealing with the vulnerabilities of ASGM. These coping strategies highlight the community's proactive measures to address the challenges posed by ASGM and to sustain their livelihoods and environmental health.

The study concludes that land degradation as a significant concern for both miners and non-miners, highlighting the visible and immediate impacts of ASGM, including deforestation and habitat destruction. This underscores the urgent need for sustainable mining practices and environmental conservation efforts to mitigate the adverse effects of ASGM on the land. The research also suggests that decline in closed vegetation in the study area is largely due to the impact of human activities such as illegal mining and farming, which have led to deforestation and land degradation with the former as the major contributor.

The Study concludes that prevalence of unlicensed mining activities is primarily due to the miners' lack of knowledge, financial constraints, and the complex and bureaucratic licensing procedures. This widespread non-compliance leads to significant environmental degradation and poses health risks to both miners and local communities. Finally, the study suffices that the poor coordination among regulatory institutions significantly hampers their ability to effectively

manage and regulate mining activities thereby causing the persistent stay of illegal mining activities despite all efforts at clamping and regularizing it. This disjointed approach leads to wasted resources and diminished regulatory impact.

9.3.0 Recommendations

The study made the following recommendations based on its findings:

9.3.1 Promotion of Underground Mining

Since underground mining is the type of artisanal and small-scale gold mining method that is found to cause less environmental degradation in the study area, the Minerals Commission and the Environmental Protection Agency should therefore promote it by encouraging ASGM operators to practice it more, as it is less (22%) practiced by ASGM operators in the study area. Because underground mining has a far smaller surface impact, less land must be cleared, protecting forests and other natural habitats. By minimizing deforestation and biodiversity loss, this technique contributes to the preservation of forests. Additionally, because it doesn't disturb huge amounts of soil, it decreases soil erosion while preserving soil stability and averting landslides. Therefore, promoting underground mining can be an effective strategy for reducing the environmental footprint of ASGM activities.

9.3.2 Provision of Sanitation Facilities

The study revealed that a majority of miners (72.5%) and an even higher percentage of non-miners (82.18%) agree that small-scale gold mining activities contribute to poor sanitation. This is largely due to the lack of toilet facilities and waste bins, which exacerbates the sanitation issues in the study area. Mine wastes, both liquid and solid, are frequently found littered throughout the mining communities with impunity. In order to address this critical issue, the study recommends that the Ministry of Sanitation and Water Resources, in partnership with District Assemblies and mining groups, to implement comprehensive sanitation programs in mining communities and at mining sites. These programs should prioritize the construction and maintenance of adequate sanitation facilities, including toilets, waste disposal systems, and clean water supply points. Moreover, regular sanitation education and awareness campaigns should be conducted by the Environment and Sanitation Department of the various district assemblies to encourage proper hygiene practices among miners and community members. By improving

sanitation infrastructure and promoting hygienic practices, we can significantly reduce health risks and enhance the quality of life for those living and working in mining areas. This initiative will require coordinated efforts and continuous monitoring to ensure its effectiveness and sustainability.

9.3.4 Establishment of Well-Equipped Hospitals at the Mining Areas

The study found out that Acute Respiratory Infections (RTI) was one of the critical mining related diseases as well as other serious injuries from mining which are very difficult to handle by the health facilities located within the ASGM location. All the health facilities interrogated on their ability to deal with critical health problems from the mining revealed that their facilities were only best at minor ailments and antenatal and post-natal services. To address this critical shortage of adequately equipped hospitals in mining communities, it is imperative that the Ministry of Health, in collaboration with the ministry of local government rural development (MLGRD), Non-Governmental Organizations (NGOs) into health and other relevant stakeholders prioritize the establishment well equipped and upgrading of healthcare facilities in the study area. This initiative should include the provision of modern medical equipment, sufficient supplies, and trained medical personnel to ensure the delivery of timely and effective medical care. Additionally, an emergency response system should be developed to handle urgent medical situations efficiently, thereby reducing the risk of preventable deaths and alleviating the burden on families who suffer the loss of loved ones due to inadequate medical services.

9.3.5 Periodic Sensitization and Educational programs

The Minerals Commission and the Environmental Protection Agency should as a matter of urgency build a strong rapport between small-scale miners and regulatory institutions is essential, as the study revealed that most respondents perceive the relationship between these stakeholders as hostile and unfriendly. This strained relationship has significant implications for the regulation of illegal mining activities. When miners view regulatory agencies as unapproachable or unsupportive, they are less likely to comply with legal requirements and more likely to engage in illegal mining practices. To address this, regulatory institutions should periodically visit mining communities to conduct educational programs on the negative environmental consequences of artisanal and small-scale gold mining (ASGM) as well as the need of applying sustainable mining practices. These programs should focus on the destruction of land and water bodies, which are

critical for the miners' survival, and how these activities affect their economic resources and livelihoods.

Educational efforts could be made engaging and accessible through various mediums such as drama shows, poetry recitals, film screenings, debates, radio talk shows, and essay writing competitions, presented in both local dialects and English. These initiatives would highlight the adverse effects of mining activities and foster a better understanding of the importance of sustainable practices. By employing culturally relevant and interactive methods, these educational programs can help build a friendly relationship between miners and regulatory institutions, promoting cooperation and compliance with environmental regulations.

9.3.6 Amendment of the Minerals and Mining Act 703 of 2006

The Ministry of Lands and Natural Resources in cooperation with the Minerals Commission should find it very prudent to evaluate the mining laws and policies, particularly the Minerals and Mining Act 703 of 2006. This study, through its document review, unearthed flaws that make the fight against ASGM governance a daunting task. These policy flaws serve as conduits through which many mining laws and regulations are flouted with absolute impunity.

The power and responsibilities of the Environmental Protection Agency and the Minerals Commission are established in this legislation, which needs amendment. Despite revisions in 2010 and 2015 (Ayee et al., 2011; as cited in Zhang et al., 2023), the new mining regulatory framework appears to lack adequate tools for assessing the performance of ASGM in the areas of safety, health, and environmental management. This oversight impacts the livelihoods of those living in mining areas. Therefore, addressing these policy flaws is crucial for improving ASGM governance and ensuring sustainable mining practices.

9.3.7 Establishment of Viable Block out Areas for Small Scale Gold Mining

The study recommends that the Minerals Commission, through its Geological Survey Department, should prepare a database of designated areas for small-scale mining in the Upper West Region. This initiative aims to limit or reduce environmental damage and preserve several acres of land and trees from devastation. According to the Mineral Commission officer for the Wa

District, one of the biggest obstacles to their job is the lack of workable block-out areas set aside for small-scale mining operations. These designated areas are critical for the effective management and regulation of the industry. However, the absence of clearly defined block-out areas presents numerous challenges for ASGM governance and regulation for both the Minerals Commission and the small-scale mining sector. Small-scale miners, who often use rudimentary techniques for gold prospecting, are compelled to operate in unapproved areas. This frequently leads to encroachment on land allocated for large-scale mining, conservation, or agriculture. In the study area, miners were found using metal detectors—a method described as "trial-and-error" to prospect for gold. This involves digging and creating multiple trenches over vast pieces of land, resulting in significant environmental degradation.

9.3.8 Coordination and Collaboration among regulatory Agencies

Poor coordination among mining regulatory institutions was revealed as one of the challenges militating against the effectiveness of mining governance in the study area. Agencies such as the Minerals Commission, Environmental Protection Agency (EPA), and MMDAs (Metropolitan, Municipal and District Assemblies) often operate in silos, leading to duplicated efforts and inefficiencies. The lack of collaboration results in inconsistent enforcement of regulations, where one agency may undertake activities without informing or consulting the others, causing overlaps and gaps in regulatory coverage. The Ministry of Lands and Natural Resources should facilitate this enhanced coordination by establishing inter-institutional committees and regular coordination meetings can help streamline efforts and improve regulatory efficiency. Consequently, this disjointed regulatory environment not only wastes valuable time and resources but also impedes the ability to address environmental and social impacts comprehensively

9.3.9 Retooling of the Environmental Protection agency

Another challenge revealed by EPA through interview is logistical constraints which is hampering the effectiveness of the Environmental Protection Agency (EPA) in the policing of ASGM activities in the Upper West Region. The poor condition of their vehicles severely as revealed by the programs officer of EPA limits the agency's ability to visit and monitor mining sites regularly. These logistical challenges undermine the EPA's capacity to oversee mining

activities effectively, respond to environmental violations promptly, and ensure compliance with environmental standards. The government of Ghana should therefore provide additional vehicles and provision of enough funds for fuel to aid in the execution of their mandate. The roads leading to mining areas are normally characterized by rocky but narrow, slippery and undulated in nature making calling for the use of stronger vehicles for easy access to mining sites for supervision.

9.3.10 Decentralization of Regulatory Offices to Mining Districts

The study also discovered that the Minerals Commission office in Wa is the single institution serving both the Upper West and Savannah regions, and it is limited by a lack of staff. As a result, the Ghanaian government should immediately create Minerals Commission offices in all Upper West Region districts, particularly mining regions. This would bring regulatory organizations closer to their areas of operation, allowing for faster interventions and more effective regulation of mining activities. The study also indicated that the EPA's inability to establish offices in all eleven districts, particularly in the three key mining districts of Nadowli-Kaleo, Wa East, and Wa West, significantly hampers the control of Artisanal and Small-Scale Gold Mining (ASGM) activities. Currently, the Environmental Protection Agency (EPA) only has offices in Tumu (in the Sissala East District) and Wa (the regional capital), with none specifically in the crucial mining districts. This lack of local presence severely limits the EPA's ability to effectively monitor, manage, and enforce environmental compliance, rendering ASGM regulation in the Upper West Region ineffective. To solve this institutional lapse, the study recommends that the Ghanaian government, through the Ministry of Science, Environment, and Innovation, open EPA offices in all districts and municipalities, notably the Upper West Region's three mining districts, as soon as possible. This would strengthen the agency's ability to monitor mining activities, resulting in improved environmental compliance and more effective regulation.

9.3.11 Mechanizing the Agricultural Sector

The study found that the inhabitants of the area are disadvantaged in terms of access to natural resources, particularly land, due to ASGM operations. A majority of respondents highlighted the destruction of farmlands by miners, and others noted the reduction in the size of farmlands because of mining activities. The widespread encroachment on farmlands by miners has

made agricultural activities, especially farming, increasingly difficult. In order to address this conundrum, this study recommends that the Ministry of Food and Agriculture (MOFA), in collaboration with district assemblies, promote mechanized agriculture in the region to make farming more attractive, especially to the youth. This can be achieved by introducing advanced technology in crop and animal husbandry. The government, through MOFA, can establish Agricultural Mechanization Departments (AMD) in all the three districts affected of the study area. Additionally, MOFA, in partnership with district assemblies and agricultural NGOs such as the German Agency for International Cooperation (GIZ), can encourage farmers in mining areas to form vibrant Farmers Based Organizations (FBOs) to protect their common goal of increasing agricultural productivity.

9.3.12 Investment in Irrigation Infrastructure

The study revealed significant competition over water usage between small-scale miners and farmers, with miners diverting water to their sites using long hoses. Farmers have reported that this excessive water use has led to water shortages and pollution of water bodies. To address these issues, the study suggests that the Minerals Commission should encourage farmers to dig boreholes at mining sites, thereby reducing their reliance on natural water bodies. Furthermore, the government should extend its One-Village-One-Dam (1V1D) initiative and the Planting for Food and Jobs (PFJ) program to the study area. With these initiatives the study recommends that the Ministry of Food and Agriculture collaborate with various mining districts to construct state-of-the-art irrigation dams specifically ensure all-year-round farming instead of dependence on rain-fed farming, thus enhancing livelihood protection in the study area. This strategy would improve water management, boost agricultural productivity, and reduce conflicts over water resources between miners and farmers.

9.3.13 Provision of Credit to Farmers

The data indicates that a significant majority of respondents, 71.56%, engage in subsistence farming. This high percentage underscores the reliance of most community members on small-scale agriculture primarily for their own consumption rather than for commercial purposes. According to respondents, the primary reasons for practicing subsistence farming include a lack of capital to extend farmlands and insufficient funds to purchase essential farm inputs such as

fertilizer and insecticides. Many of these farmlands have been used for over fifty years, and without fertilizer, they cannot produce sufficient yields for commercial purposes.

Given this context, the study recommends that the Ministry of Food and Agriculture, in collaboration with the District Assemblies, should facilitate the creation of Farm Based Organizations (FBOs). These FBOs would enable farmers to access loans from banks and other financial institutions either as individuals or as group on conditions that are flexible, that might be regarded as flexible repayment periods due to the issue of gestation in the agricultural sector., allowing them to finance their agricultural activities more effectively. This initiative has the potential to reduce the number of farmers who rely on ASGM as an unsustainable source of financing their farming activities, thus promoting more sustainable agricultural practices and improving livelihoods.

9.3.14 Land Reclamation

The study found that abandoned mining pits left after ASGM operations have negatively impacted both crop farming and animal rearing. These pits render the land unsuitable for farming activities, creating obstacles that limit farmers' access to their farmlands and increase the time required to reach their farms. In some cases, these pits pose serious hazards, acting as death traps for both farmers and their livestock. Livestock farmers reported that these dangerous pits have caused numerous accidents involving their animals, further complicating agricultural activities as their source of livelihood in the area. The study therefore deemed it imperative to recommend that the Forestry Commission in collaboration with district Assemblies should intensify their operations by tree planting and re-grassing degraded lands. This Land reclamation here will have the tendency to increase farmland sizes lost to miners and to enhance agricultural activities as a form of livelihood.

9.3.15 Ensuring Gender Equality and Sustainable Livelihoods

Gender equality must be promoted in order to provide a sustainable livelihoods and development. Against this backdrop, the study made a recommendation part efforts to achieve the United Nations sustainable development goal five (SDG) (5) which seeks to achieve gender equality and empower all women and girls. Furthermore, in the study area, the payment system for

women miners differs significantly from traditional monetary compensation. Instead of receiving direct financial remuneration, women are often compensated with a quantity of the processed smooth soil, proportional to the number of bags they have handled at the grinding machine. This form of payment in kind reflects a broader issue of economic inequity, where women are relegated to receiving compensation that do not immediately address their financial needs. This practice not only limits their immediate purchasing power but also places them at a disadvantage when it comes to converting these goods into cash or other necessary resources. This system underscores the broader systemic challenges that women face in the mining industry, where their contributions are undervalued, and their economic gains are minimal compared to their male counterparts.

The aforementioned field results invigorated this study to recommend that, relevant authorities, such as gender-based non-governmental organizations (NGOs) in collaboration with the Ministry of Women, Children and ministry of women, children and social Protection (MOWACSP), should partner with micro-credit institutions to develop credit schemes that provide women and women's groups with micro-credits on flexible terms in mining districts. Access to credit can significantly enhance their well-being by enabling them to invest in mining activities.

Furthermore, gender-based NGOs and MOWACSP should work together to sensitize and encourage women to pursue higher-status jobs rather than limiting themselves to low-paid positions in the mines. This can be achieved by promoting the idea of women obtaining mining concessions and forming associations to share common interests and legalize their operations as formal miners. This approach has been successfully implemented in several sub-Saharan African countries, including Tanzania, Zambia, and South Africa. The District Assemblies, Ghana Education Service (GES), Minerals Commission, Environmental Protection Agency (EPA), and civil society organizations should raise awareness about the importance of keeping children away from artisanal and small-scale mining (ASM) sites, as these environments are not suitable for children. This initiative aligns with Articles 28(1) subsection (d) and 27(2) of the 1992 Constitution of the Republic of Ghana.

9.3.16 Creation of Job Opportunities

The study found that the unproductive nature of agriculture (36.4%) and unemployment (13.2%) were significant motivating factors driving able-bodied youth to engage in artisanal and

small-scale gold mining (ASGM) activities in the study area. To address these issues, the study calls for the creation of alternative livelihood programs through collaborative efforts between the Ministry of Employment and Labour Relations and the Ghana Enterprises Agency (GEA), formerly known as the National Board for Small Scale Industries (NBSSI).

These programs should focus on organizing and training unemployed youth in the study area in various skilled trades such as cloth weaving, dressmaking, hairdressing, tiling, welding, masonry, soap making, pomade making, and Plaster of Paris (POP) production, among others. The study further recommends that upon completing their training, these graduates should be provided with start-up capital to establish their own businesses. This support would enable them to become self-employed and, in turn, train more unemployed youth, creating a sustainable cycle of skill development and employment in the community.

9.3.17 Protection of children in ASGM

The Ministry of Women, Children, and Social Protection, in collaboration with the Ministry of Education (GES), District Assemblies (DAs), traditional authorities, and parents, should urgently implement measures to reduce or eliminate the involvement of children in mining. The study revealed that the engagement of school-age children in artisanal and small-scale gold mining (ASGM) is a major factor contributing to the high school dropout rate in the area. This trend has detrimental effects on the human capital of the region, leaving many children without the basic academic qualifications necessary for meaningful employment, thereby perpetuating their stay in the unsustainable mining sector. To address this issue, the chiefs and elders should enact by-laws that impose penalties or fines on parents whose children are found at mining sites during school days or weekends. This is crucial due to the physical dangers and moral risks associated with such exposure, which jeopardize the children's future prospects. The enforcement of these by-laws should be supported by the District Assemblies and the Ghana Education Service. Additionally, children in mining communities should receive educational support, including special scholarship packages, and the provision of school materials such as pencils, books, school bags, uniforms, and sandals. The lack of these essential items has been identified as a significant reason for children staying out of school. These measures align with Article 28(1) Subsection (d) of the Constitution, which mandates special protection for children against physical and moral hazards. Article 27(2) also stipulates that facilities should be provided for the care of school-age

children to support women in fulfilling their traditional roles in child-rearing and help them achieve their full potential.

9.3.18 Protection of the Shea Tree

As part of the study assessing the negative consequences of artisanal and small-scale gold mining (ASGM) on the physical environment, numerous concerns were raised regarding the loss of biodiversity, specifically the decline of shea trees in the study area. Field observations at several mining sites revealed widespread and indiscriminate felling of shea trees, especially in communities where surface mining is practiced, with no regard for environmental conservation. Given the shea tree's significant value chain, the study prioritized its protection and recommended several measures to address the issue. It is essential to encourage the establishment of shea tree plantations in mining areas and designate these areas as protected and conserved zones. The Forestry Commission in collaboration with the District Assemblies can play a pivotal role in this effort by forming "Friends of the Shea Tree" (FOST) volunteer groups within mining communities. These groups would focus on replanting and nurturing shea trees, using seedlings provided by the Forestry Commission, to replace those lost to ASGM activities. To ensure the sustainability of these initiatives, traditional authorities and assembly members should collaborate with the Forestry Commission to enact and enforce relevant by-laws. These regulations would support the conservation efforts and promote the long-term preservation of shea trees in mining areas.

9.3.19 Decentralization and Simplification of ASGM Licensing Procedures

The study revealed that all 40 miners interviewed were operating without a mining permit, highlighting the prevalence of unlicensed mining in the area. Several factors contribute to this issue, including miners' lack of awareness about the licensing process, their inability to afford the registration fees, and the cumbersome nature of the licensing procedure. To address these challenges, the study recommends that the Ministry of Lands and Natural Resources (MLNR), in collaboration with the Minerals Commission (MC), even though instituted an online ASGM license application process, decentralize the responsibilities for granting mining leases and small-scale mining licenses to the various mining districts and regions. Again, to make the licensing process more accessible, the government should consider subsidizing registration fees and

preventing other related costs, including ‘unapproved’ fees often charged by intermediaries (commonly known as "Goro Boys" process). Simplifying and streamlining the licensing procedures to be more user-friendly, less bureaucratic, and more affordable could significantly increase the number of miners who can obtain the necessary permits. This approach is expected to help formalize more mining operations, ensuring better regulation and management of the sector.

9.4 Contributions of the study to knowledge

The relationship between the activities of ASGM and rural livelihood diversifications within the Upper West Region in Ghana has been extensively explored in this research. This investigation is both current and has the potential to inform policy and practical applications. This research made enormous additions as far as the already available discourse on the nexus between environmental threats and rural livelihoods due ASGM. The study contributions are thus far elaborated into detail in the following paragraphs:

First and foremost, the study’s results based in Ghana has the capacity to greatly enhance dialogue on the effects of ASGM on the environment and rural livelihoods in Africa

Furthermore, it can offer valuable insights regarding the negative impacts ASGM on rural lives due to environmental dangers. This particular aspect has received limited attention in previous studies especially within the Upper West Region. The extensive and thorough empirical findings gathered during the study setting as well as its participants enable these potential contributions. I employed existing researches to illustrate the historical environmental consequences regarding ASGM and agriculture, and the manner in which economic situations and institutional reforms contribute to these consequences. The study analyzed the intricate and varied interrelationships between small- scale agriculture mining and ASGM in terms of essential resource capacities such as water, labour and land. In essence, I showed how these complex interdependencies lead to the economic well-being as far as both miners and non-miners in the three selected districts of the Upper West Region are concerned.

Again, the research has illuminated the impact of ASGM as far as expansion of rural livelihoods in the Upper West Region. Scholars have enhanced our comprehension of how individuals and households adapt to the socio-economic changes caused by mining by analyzing the different tactics taken by local communities in response to mining activity. This includes exploring how people diversify their sources of income.

In addition, the work makes significant advances to the realm of theory. Utilizing the frameworks of political ecology, classical theory of the informal sector, tragedy of the commons, and resource curse theory, this analysis examines the interconnection the effects of ASGM on the natural environment and rural livelihood diversification in three mining districts of the Upper West Region. This study offers a distinctive and inventive contribution, particularly in the context of broader conversations on natural resources and specifically within the realm of mining. I demonstrate the incorporation of these theories in order to conceptualize ASGM setting and rural livelihoods, and the relationships of power and hierarchies among various actors in the mining sector. The study employs the sustainable livelihood framework to examine the power relations among many stakeholders and regulatory institutions at various levels relations influence the mining industry and rural livelihoods, including agriculture. It also assesses availability and access to the five assets (Social, natural, human, physical, financial) as well as the coping strategies employed by the mining communities to mitigate the negative repercussions of ASGM on their livelihoods.

Next, the study contributes in scholarly knowledge by assessing the resilience of rural populations in the Upper West Region to endure and rebound from the consequences of ASGM operations, as well as their vulnerability to these impacts. By examining the factors that enhance or undermine the resilience of inhabitants of the study setting, the study has provided valuable perspectives for governments and local stakeholders. This data can be utilized to develop treatments that enhance the general well-being of populations that have been affected.

Besides, the research findings have highlighted challenges in the management and regulation of artisanal and gold mining on a small in the Upper West Region. This encompasses an assessment of the effectiveness of existing policies, the participation of local organizations, and the need for regulatory structures that align economic growth with the sustainability of the environment and society.

Following this, the investigation also uncovers the distinct characteristics and types of ASGM in the Upper West Region. The text delineates the rudimentary tools and financial ramifications of mining operations. These findings contribute to the comprehension of the intricacy of ASGM and establish a foundation for future research in comparable contexts, as well as insights for achieving sustainable development.

Quiet apart from the above, the research has immediate policy ramifications concerning ASGM in Ghana. This demonstrates the impact of mining activities on the environment and the potential dangers they represent to the rural livelihoods of inhabitants in the study area. The knowledge it gives is valuable for policymakers to create and enhance rules that achieve a balance between economic development and environmental sustainability. This is crucial for policy interventions that seek to optimize the economic advantages of mining while minimizing its adverse environmental effects.

Finally, this thesis not only sheds light on the multifaceted impacts of ASGM in the Upper West Region but also provides valuable insights into how ASGM can be leveraged to support the achievement of the seventeen (17) Sustainable Development Goals in the following ways:

The research reveals that ASGM plays a crucial role in poverty reduction (SDG 1) by providing essential income opportunities for local miners and their families. Field data indicates that many households rely on ASGM as their primary source of livelihood while others indirectly channel their income into agricultural activities, which helps them to improve their economic status and reduce poverty levels. In terms of hunger alleviation (SDG 2) and nutrition enhancement, the study shows that the increased income from ASGM enables some households to afford better food and nutrition, which is critical in the study area where food security can be a significant concern. The findings also highlight improvements in human health (SDG 3), as miners and non-miners benefit from increased income to afford better healthcare, though mining-related diseases and accidents that need addressing remain a significant issue. The environmental impacts of ASGM are thoroughly documented, providing insight into environmental sustainability (SDGs 13-14). The study identifies both detrimental effects, such as land degradation and water pollution, and positive practices where sustainable mining techniques are employed. This dual impact underscores the need for balancing economic benefits with environmental protection.

Regarding social development (SDG 5), the research uncovers the gender dynamics within ASGM communities, noting both the participation of women in mining and the social challenges they face, such as work schedule and reward disparities as ASGM operators. This contributes to a deeper understanding of gender roles and social equity in these contexts. Economic growth and decent work opportunities (SDG 8) are evidenced through the creation of both decent and indecent mining jobs and the improvement in local infrastructure driven by ASGM activities. In exploring

peace, justice, and governance (SDG 16), the study provides valuable insights into the ASGM governance structures and social stability in mining communities. It highlights both the contributions of ASGM to local economies and the conflicts that can arise from mining activities. Finally, the research underscores the importance of partnerships (SDG 17) in achieving these goals. The collaboration between miners, District Assemblies, and mining regulatory bodies has been critical in addressing the challenges and maximizing the benefits of ASGM. This cooperation is essential for ensuring that the positive impacts of ASGM are sustained and that any negative consequences are effectively managed.

9.5 Recommendations for Further Research

The study identified several knowledge gaps, making it imperative to recommend the following areas for further research.

First, while the current study provides insights into the socio-economic and environmental implications of artisanal and small-scale gold mining (ASGM) in the Upper West Region, there is a need for more in-depth analysis of the health impacts on local communities. Future research should focus on the long-term health consequences of exposure to mining-related pollutants, such as mercury and other heavy metals, on both miners and the broader population. This gap is crucial to address, as understanding the extent and nature of health risks can inform better health interventions and policies aimed at mitigating these impacts.

Finally, another area for further study is the effectiveness of community-based natural resource management strategies in mitigating the adverse effects of ASGM. The current study evaluates the roles and effectiveness of regulatory institutions, laws, and government policies, but it does not extensively examine how local communities themselves can contribute to sustainable mining practices thereby filling a gap in understanding the bottom-up approaches to sustainable mining and environmental conservation.

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APPENDICES

APPENDIX A: QUESTIONNAIRE FOR HOUSEHOLDS
SIMON DIEDONG DOMBO UNIVERSITY OF BUSINESS AND
INTEGRATED DEVELOPMENT STUDIES
FACULTY OF INTEGRATED DEVELOPMENT STUDIES
DEPARTMENT OF ENVIRONMENT AND RESOURCE STUDIES

This field questionnaire is strictly for the Ph.D field Survey of Moomin Seidu, a graduate student of Simon Diedong Dombo University of Business and Integrated Development Studies, Department of Environment and Resource Studies to seek your candid views on “**The Implications Of Environmental Threats Of Artisanal And Small-Scale Gold Mining (Galamsey) On Rural Livelihood Diversifications In The Upper West Region, Ghana**”. All responses will be treated with all confidentiality and will be used only for academic purposes. Your participation is highly appreciated. Please, fill or tick where appropriate.

QUESTIONNAIRE IDENTIFIERS

Questionnaire No..... **Date.....**

Name of community/village.....

SECTION A: BACKGROUND DATA OF RESPONDENTS

- 1) Age 1) 15 – 24 [] 2) 25 – 34 [] 3) 35– 44 [] 4) 45 – 54 [] 5) Above 55
- 2) Gender 1) Male [] 2) Female []
- 3) Religion 1) African Traditional Religion (ATR) [] 2) Islam [] 3) Christianity []
- 4) Marital status: (1) Married [] (2) Single [] (3) Divorced [] (4) Widowed
- 5) Educational Background: (1) No formal Education [] (2) JHS/Middle School []
(4) SHS/Voc/Tec [] (5) Tertiary []
- 6) Household Size 1) 1-4 2) 5-8 [] 3) 9-12 [] 4) 13+ []
- 7) Children of Household 1) 1-4 [] 2) 5-8 [] 3) 9+ []
- 8) Status of Membership in Community 1) Native [] 2) Migrant [] 3) Settler []
- 9) Employment status 1) Formal 2) Farming 3) artisanal mining 4) Trading 4) Other type of artisan

- 10) Ethnicity 1) Busanga [] 2) Dagaati [] 3) Moshi [] 4) Saamunuu [] 5) Sissala [] 6) Waala [] 7) Dagomba [] 8) Moshie [] 9) Other (Specify).....
- 11) Number of Years Stayed in Community 1) less than 1 year [] 2) 1-5 [] 3) [] 6-10 4) 11+ []
- 12) On what basis do you work as a miner? 1) full-time [] b. Part-time []
- 13) What motivates you to become a artisanal miner?.....
- 14) Employee type? 1) Owner [] 2) Worker []
- 15) What are your roles on site? 1) Blast man [] 2) Loco boys [] 3) Sponsor [] 4) smoother [] 5) Crusher [] 6) washer [] 7) Hole makers 8) cook 9) security man 10) Chiseller 11) Owner []
- 16) Is there an ASM union/society in this area? 1) Yes [] 2) No []
- 17) If yes, are you a member of such union/association? 1) Yes [] 2) No []
- 18) Are you offered any kind of support/service? 1) Yes [] 2) No []
- 19) What is the nature of the support? 1) Material [] 2) Cash [] 3) Training [] 4) Tools [] 5) Equipment [] 6) Market []

SECTION B: EFFECTS OF MINING ON HOUSEHOLD LIVELIHOOD INCOME, ASSETS AND ACTIVITIES

Employment and Income Sources

- 20) Is ASM your only source of livelihood? Yes [] No []
- 21) Do you have other source (s) of livelihood(s) apart from mining? 1) Yes [] 2) No []
- 22) If yes, what is/ are some of them? 1) Hunting [] 2) Crop farming [] 3) livestock rearing [] 4) fishing 5) trading [] 6) Teaching [] 7) Other Artisan [] 8) Other (specify)
- 23) Has mining affected **(Neg/Positive)** your/ any sources of livelihood in the community? 1) Yes [] 2) No []
- 24) If Yes, please name them.....
- 25) If yes, how has mining affected **(Neg/Positive)** such source(s) of livelihoods?.....
- 26) What is the best alternative livelihood to mining in your opinion? 1) Hunting [] 2) Crop farming [] 4) livestock rearing [] 5) fishing [] 6) trading [] 7) teaching 8) Other Artisan [] 9) other specify
- 27) How many hours do you work per day?

28) Which activity do you undertake at this mining site? 1) Mineral extraction (digging) [] 2) Mineral processing (separation, sorting and washing) [] 3). Providing goods and services [] 4. Buying gold [] 5) others (specify).....

29) What is your monthly income from other sources aside m (kindly list them)

Monthly Income in GH¢	Income Sources										
	Crop Farming	Pito Bre wing	Shea Butter Extrac tion	Animal rearing	Poultry keeping	Food vendi ng	Prov ision shop oper ation	Fishing	Teac hing	Other artisa ns	Other (Specify)
1) 100-500											
2)600-1,000											
3)1,100-1500											
4)1600-2000											
5) 2,100 and above											
6) Other (Specify)Gh¢...											

30) Would you say that mining has enhanced the livelihoods of your household in general? (Tick as appropriate) 1) Yes [] 2) No []

Expenditure and Income

31) By either agreeing or disagreeing indicate how you spend your income SCALE: 1=strongly disagree 2=Disagree 3=Agree 4=strongly agree

Expenditure indicators	1	2	3	4
Food				
Education				
Health				
Clothing				
Transport				
Remittance to relatives and friends				
Naming Ceremony				
Funeral				

32) What positive benefits have mining brought to your household livelihood? **Clue :**
Respondents can select more than one(1) answer

<i>Perceived Benefits</i>	Tick
Employment Opportunities	
Sustainable education system	
Health Centres	
Increased food security	
Enhanced Security	
Commuting transport	
Created markets for agricultural produce	
Construction of roads	
Increase in food vending	
Increase in pure water vending	
Increased incomes	
Buying of vehicles (farm implements, cars, motorbikes, etc.)	
Improved Housing	
Enhancement of the local economy	
Contribution to construction of community projects	

33) What negative attributes has mining brought to your household livelihood?

SCALE: 1=strongly disagree 2=Disagree 3=Agree 4=Strongly agree

Perceived Negative attributes of ASM				
Poverty				
Insecurity				
Destruction of farmlands				
Drug abuse/Alcoholism				
High cost of living				
Drift of farm labour to ASM				
High rate of School Dropout				
High Prevalence of mining related diseases				
conflicts/tensions				
High incidence of ASM induced death				
High incidence of ASM induced accidents				
Pollution of drinking water sources				
Prostitution				
High incidence of teenage pregnancy				
Loss of economic trees				
Loss of farmlands				
High incidence of accidents/injuries				

Assets

34) As a result of mining activities in this area, I bought the following assets *SCALE: 1=Strongly disagree 2=Disagree 3=Agree 4=Strongly agree*

Asset	1	2	3	4
Farming tools				
Land				
Mining tools				
House				
A car				
Livestock				
farm inputs (Fertilizer, pesticides)				
Capital for farm labour				
Motorbike				
Bicycle				

35) As a result of mining activities in this area, I have lost livelihood assets *SCALE: 1=strongly disagree 2=Disagree 3=Agree 4=strongly agree*

Asset	1	2	3	4
Farming tools				
Land				
Mining tools				
House				
A car				
Livestock				
Economic Trees				
Water				
Motorbike				
Bicycle				

36) Do you own any tools and or equipment that would help you to be more productive in your occupation (*tick appropriately*) 1) Yes [] 2) No []

37) Has mining helped you to improve your livelihood resources purchase of farming tools, and
1) Yes [] 2) No []

Livelihood Activities

38) Mining operations have added value to the livelihood with the following activities:

Livelihood	Yes (1)	No (2)
Crop Farming		
Hunting		
Pito Brewing		

Shea Butter Extraction		
Animal rearing		
Poultry keeping		
Food vending		
Fishing		
Provision shop operation		
Teaching		
Other artisans		

39) Mining activities have robbed residents of their livelihood activities such as:

Livelihood	Yes (1)	No (2)
Crop Farming		
Hunting		
Pito Brewing		
Shea Butter Extraction		
Animal rearing		
Poultry keeping		
Food vending		
Fishing		
Provision shop operation		
Teaching		
Other artisans		

SECTION C: ASM EFFECTS ON THE PHYSICAL ENVIRONMENT AND POSSIBLE WAYS OF MITIGATION

40) Which mining method do you use in mining? 1) Open pit ☐ 2) Surface mining ☐ 3) Underground/Tunnelling ☐ 4) Dig and Wash 5) Dig and Spread ☐ (Tuyere) 6) Others specify.....

41) How did you acquire the land used in mining activities? 1) Lease ☐ 2) Inheritance ☐ 3) Family land ☐ 4) Borrow ☐ 5) Others (Specify).....

42) How was the land before your mining activities? 1) Forest ☐ 2) Farming land ☐ 3) Vegetation ☐ 4) bare land ☐ 5) Others (Specify).....

43) What is the nature of the land now as a result of the mining activities? 1) Forest ☐ 2) Used for farming ☐ 3) Vegetation ☐ 4) Degraded ☐ 5) Others.....

44) Are you aware of the negative consequences of your mining activity on the physical environment? 1) Yes ☐ 2) No ☐

- 45) If yes, what are some of the effects? **(Please Tick all that apply)** 1) Land degradation []
 Water pollution [] 2) Land pollution [] 3) air pollution [] 4) noise pollution [] 5) loss of
 vegetative cover [] 6) Loss on biodiversity (Loss of plants and animals) Other (Specify).....
- 46) What in your opinion is the predominant cause of your answer(s) above?.....
- 47) Use of chemical [] 2) Use of equipment [] 3) Clearing the land [] 4) digging trench [] 5)
 others (specify).....
- 48) Do you use excavator for your mining activity? 1) Yes [] 2) No []
- 49) If Yes, for what purpose? 1) Clearing of site [] 2) Digging pits [] 3) Others (Specify).....If
 No, Why.....
- 50) 17. What chemical(s) do you use in processing or extracting gold (Amalgamation)? (Please
 Tick all that apply) 1) Mercury [] 2) Cyanide [] 3) Arsenic [] 3) cadmium [] 4) Other,
 (specify).....
- 51) 18. Do you know of any adverse effects of the chemical (s) you use for mining on the natural
 environment? 1) Yes [] 2) No []
- 52) If yes, what are some of the effects?
- 53) What equipment/tools/ materials do you use in mining gold?
- 54) What efforts or measures are put in place by you (miner) to address the adverse effects of
 your mining activities on the environment?.....
- 55) What role is government/DA/CBOs/traditional rulers playing to address the adverse effects
 of mining activities on the environment?.....
- 56) In your opinion what strategies can be put in place to achieve sustainable mining in the area?
- 57) What are the environmental effects of ASGM on the natural environment? 1) Loss of
 vegetative cover [] 2). Land degradation [] 3). Air pollution [] 4) Noise pollution [] 5)
 Impact on water resources [] 6) Loss and threat to animal biodiversity [] 7) Loss and threat
 to plant biodiversity Yes [] No [] If Yes, how?
- 58) What measures do you put in place to reduce the risk of damage to the land or reclaim
 disturbed land? 1) Cover pits [] 2) Cover pit and plant trees [] 3) Leave it [] 4) Others
 (Specify).....
- 59) How do you dispose the waste you generate during mining? 1) Dig and bury it [] 2) Leave
 them on Site [] 3) Dump it on other lands [] 4) Dump them into rivers bodies.

- 60) What impact does it have on your farmlands? 1) Degrades land ☐ 2) Reduce Crop yield ☐
 3) Reduce land availability ☐ 4) Others (Specify).....

SECTION D: SOCIO-ECONOMIC IMPLICATIONS OF ASGM

- 61) Were you working before you became a Artisanal small scale miner? 1) Yes ☐ 2) No ☐
 62) If No, Why?.....
 63) If yes, 1) What type job were you doing?.....
 64) Were you earning as compared to mining?.....
 65) How is your standard of living now as a miner as compared to your previous work? 1) Better ☐ 2) worse ☐ 3) The same ☐
 66) Do you have other workers working under you? 1) Yes ☐ 2) No ☐
 67) If yes, how many workers do you have?.....
 68) Do you pay any tax (es) for mining? 1) Yes ☐ 2) No ☐
 69) Are there other people apart from your spouse and children who depend on you for living?
 1) Yes ☐ 2) No ☐
 70) If yes, how many people?
 71) What are the major social problems associated to mining in your opinion? 1) Prostitution ☐
 2) Drug Abuse ☐ 3) Fighting ☐ 4) Killing ☐ 5) Armed Robbery ☐ 6) Teenage Pregnancy ☐
 72) Has mining led to any form of resettlement? 1) Yes ☐ 2) No ☐
 73) If yes, which form (s)?
 74) What is the rate of sanitation in your area? 1) Very Good ☐ 2) Good ☐ 3) bad ☐ 4) very bad ☐
 75) What can you say is the main sanitation problem? 1) Improper disposal of mining tailings (Waste) ☐ 2) Improper disposal of human waste (Excreta) ☐ 3) Improper disposal of liquid waste from mining ☐ 4) Others (Specify).....
 76) Are the above sanitation problems caused by ASM activities? 1) Yes 0 2) No 0
 77) What methods are used to dispose the following mine waste?
 a) Solid Waste
 b) Liquid Waste.....
 78) What do you think can be done to improve the sanitation situation in the community?
 79) Do you use PPEs/ protective gears when mining? 1) Yes ☐ 2) No ☐

- 80) Are you aware of your exposure to artisanal mining hazards/accidents/casualties? 1) Yes 2) No []
- 81) If yes what are some of the hazards?
- 82) Do you have toilet in your house? 1) Yes [] 2) No []
- 83) If No where do you defecate?.....
- 84) If yes, what is the type of toilet? 1) KVIP toilet [] 2) Pit latrine [] 3) local improvised toilet [] 4) Others (Specify).....
- 85) What are the dominant diseases you often suffer from? 1) Malaria [] 2) Skin disease [] 3) Asthma [] 4) Acute Respiratory Infection [] 5) Tuberculosis [] g) Other (specify).....
- 86) Do you think the above diseases are as a result of ASM activities?
- 87) Where do you seek for treatment? 1) Hospital [] 2) Clinic [] 3) Drug Stores [] 4) Own first aid [] 5) Herbal centre [] 4) Others (specify) .**(Tick as many all that apply)**
- 88) How the distance from your area to the nearest health facility? 1) Far [] 2) very far [] 4) Near [] 5) Very near []
- 89) What is the distance between your area and the nearest health facility?.....
- 90) What is your source of water? 1) Pipe borne [] 2) river [] 3) Stream [] 4) borehole [] 5) Well [] 6) Rain water [] 7) Others(Specify).....
- 91) How the distance from your area to the nearest health facility? 1) Far [] 2) very far [] 4) Near [] 5) Very near []
- 92) What is the distance between your area and the nearest health facility?.....
- 93) What is the distance of your source of water to a mining activity?
- 94) What can be done to improve the health situation in the community?.....

SECTION F: THE ROLE OF REGULATORY INSTITUTIONS, LAWS AND GOVERNMENT POLICIES IN THE MINING SECTOR IN GHANA

- 95) Are you aware of any laws or regulations mining? 1) Yes [] 2) No []
- 96) If yes, are these laws effective? 1) Yes [] 2) No []
- 97) If Yes, state some of them?.....
- 98) Are you aware there are mandated agencies/institutions responsible for monitoring small-scale mining activities? 1) Yes [] 2) No []
- 99) If yes, what are some of these agencies?.....

- 100) How is your relationship with these agencies? 1) Very Cordial [] 2) cordial [] 3) unfriendly [] 3) Very Unfriendly
- 101) Have you ever complained/ reported to any of such agencies? 1) Yes [] 2) No []
- 102) If yes, were you satisfied? 1)Yes [] 2)No []
- 103) If no, what alternative action did you take?
- 104) Are your ASM activities been monitored by Minerals Commission and Environmental Protection Agency? 1) Yes [] 2) No []
- 105) If yes, how frequent? 1) Monthly [] 1) Quarterly 2) Biannual 3) Yearly [] 4) other specify
- 106) Does EPA conduct Environmental Impact Assessment to your mining activity? 1) Yes [] 2) No []
- 107) If yes, how often? 1) Monthly [] 1) Quarterly 2) Biannual 3) Yearly [] 4) other specify
- 108) Do you know the agency responsible for issuing small-scale mining licences? 1) Yes [] 2) No []
- 109) Do you have a licence? 1) Yes [] 2) No []
- 110) Do you know that you need a licence to mine? 1) Yes [] 2) No []
- 111) If yes, why don't you have a licence? 1) Cumbersome procedure [] 2)High Administrative Cost [] 3)Don't Know where to acquire one [] 4) Don't Know []
- 112) What do you think are/is the best solutions to solve the problems above?.....
- 113) Which of the following do you think is/are the main causes of illegal mining 1) corruption on the part of government officials [] 2) non-enforcement of laws [] 3) the complex and cumbersome licensing procedure []
- 114) What is your perception about government's use of alternative livelihood programs in place of mining.....
- 115) What alternative livelihoods do you think the government should introduce in place of Artisanal mining?
- 116) Do you think Government's use of brutality or force to solve the problem of Artisanal mining is the best? 1) Yes [] 2) No []
- 117) If yes, why?.....
- 118) If *no*, *what* do you think should have been the best approach for government?.....
- 119) Do you have any question to ask me/have any suggestion to say for me?.....

APPENDIX B: QUESTIONNAIRE FOR MINERS

PART A: BACKGROUND DATA OF RESPONDENT

1. Age: 1) 15-30 [] 2) 31-46 [] 3) 47-62 [] 4) 63+ []
2. Gender: 1) Male [] 2) Female []
3. Marital status: (1) Married [] (2) Single [] (3) Divorced [] (4) Widow [] (5) Widower []
4. Educational Background: 1) No Education [] 2) JHS/Middle School [] 3) SHS/Voc/Tec [] 4) Tertiary
5. Ethnicity.....
6. Major Occupation: a) Farming b) Mining c) Trading d) Others.....
7. Number of people in household.....
8. Monthly Income in Ghana Cedis.....

PART B: SMALL-SCALE MINING OPERATIONS

9. What motivates you to do mining?.....
10. How did you acquire land for your mining activities? (1) From family [] (2) From Chiefs [] (3) From mining companies [] (4) inheritance (4) others (Specify)
11. (Do you sometimes pay royalties and taxes? (1) Yes [] (2) [] b) If yes, how much?.....
12. Do you have a valid mining license? (1) Yes [] (2) No []
13. If No, Why? 1) Not aware [] 2) Insufficient fund [] 3) Cumbersome procedure [] 4) don't know where to acquire it [] 5) others.....
14. What is the source of capital for your mining operations? (1) Individual contributions [] (2) Family contribution (3) Loan [] (4) Foreign investment [] (5) others (Specify)...
15. Which mining method do you use in mining? 1) Open pit [] 2) Surface mining [] 3) Alluvial method [] 4) Others specify.....
16. How was the land before your mining activities? 1) Forest [] 2) farming land [] 3) Vegetation [] 4) Fallow land [] 5) Others (Specify).....
17. 14. What is the nature of the land now as a result of the mining activities? 1) Forest [] 2) Used for farming [] 3) Vegetation [] 4) Degraded [] 5) Others.....
18. In your opinion, do you think your activities pose a great danger to the land? 1) Yes [] 2) No []

19. What measures do you put in place to reduce the risk of damage to the land or reclaim disturbed land? 1) Cover pits [] 2) Cover pit and plant trees [] 3) Leaves it [] 4) Others (Specify).....
20. How do you dispose the waste you generate during mining? 1) Dig and bury it [] 2) Leave them on Site [] 3) Dump it on other lands [] 4) Dump them into rivers bodies.
21. What impact does it have on your farmlands? 1) Degrades land [] 2) Reduce Crop yield [] 3) Reduce land availability [] 4) Others (Specify).....
22. What are the main minerals produced? 1) Gold [] 2) Diamond 3) Manganese 4) Bauxite [] 5) Others (Specify).....
23. Have you ever been treated for work related medical conditions? (1)Yes [] (2) No []
24. b) If “Yes”, please provide details.....
25. What are your main duties in the mining operations?.....
26. Have you ever been arrested by the police? (1)Yes [] (2) No []
27. If yes, what happened after the arrest?.....
28. What chemicals do you use for mining? 1) Mercury [] 2) Cyanide [] 3) Others ...
29. Has small-scale mining improved your socio-economic live? (1) Yes [] (2) No [] b) If yes, in what ways?.....
30. Are your activities been monitored by Minerals Commission and Environmental Protection Agency? 1) Yes [] 2) No []
31. If yes to question 29, how frequent?.....
32. If no to question 11, Why?.....

APPENDIX C: INTERVIEW GUIDE FOR ENVIRONMENTAL PROTECTION AGENCY (EPA)

Date..... **Position**.....

- 1) What is the mandate of your agency as per the laws of Ghana?
- 2) What role(s) does EPA play in the activities of Artisanal and small scale Gold mining in the Upper West Region?
- 3) How periodic do you normally monitor the activities of artisanal and small scale gold mining activities?
- 4) What predominant method(s) do small-scale miners use to mine minerals?

- 5) What are the effects of these methods of gold extraction on the natural environment?
- 6) What can miners do to address the adverse effects of small-scale mining on the environment?
- 7) Kindly Explain your answer in question (6) above.....
- 8) What are the regulations governing artisanal and small scale gold mining activities?
- 9) How is the response of ASGM operators to your regulations?
- 10) To what extent has EPA been able to enforce such regulation with regards to Artisanal and Small Scale Gold Mining?.....
- 11) What are some of the challenges faced by EPA in the enforcement of such with regards to Artisanal and Small Scale Gold Mining?.....
- 12) In your opinion, what do you think can be done to facilitate the enforcement of your regulatory rules roles?.....
- 13) Could you please describe EPA's collaboration with other agencies like District Assemblies, Minerals Commission in the execution of your duty?.
- 14) . Are there collaborative strategies between you and other stakeholders to protect the environment from ASGM activities?.....
- 15) What kind of collaborative strategies do you have with these stakeholders?.....
- 16) What can you say is/are the effects of small-scale mining on smallholder farming and other livelihoods?

APPENDIX D: INTERVIEW GUIDE FOR MINERALS COMMISSION (WA DISTRICT)

Date..... Position of Officer in EPA.....

1. What is the mandate of your agency as per the laws of Ghana?
2. What predominant method(s) do artisanal and small-scale gold miners use to mine minerals?
3. What are the effects of these methods of gold extraction and use of chemicals on the natural environment?
4. What efforts or measures are put in place by the commission to address the adverse effects of small- scale mining activities on the environment?
5. What measures exist to regulate or prevent the activities of illegal small scale mining in the Upper West Region?.
6. How effective are these measures enforced to achieve their aims
7. How often is the awareness of the artisanal and small scale gold miners craved to ensure compliance?

8. How is the response of artisanal and small scale gold miners to regulations from Minerals Commission?
9. In your opinion what can you say are the effects of artisanal and small-scale gold mining on farming?
10. Where mining operators are not complying what others measures are adapted to make them comply?
11. What Amount is involved in an individual or group applying for small scale Mining Licenses?
12. Could you please describe the processes involved in acquiring a small scale mining license?
13. Could you please state the mining law(s) where such processes are spelt out?
14. In your opinion what do you think are some of the reasons preventing illegal miners from acquiring mining licenses?
15. What measures are put in place to ensure that all small-scale miners are licensed?
16. What are some of the challenges faced by Mineral commission in the enforcement of such with regards to Artisanal and Small Scale Gold Mining?
17. In your opinion, what do you think can be done to facilitate the enforcement of your regulatory rules roles?
18. In your opinion, what can you say as regards minerals Commission's collaboration with other agencies like District Assemblies, EPA and forestry commission in the execution of your duty?
19. Are there collaborative strategies between you and other stakeholders to protect the environment from ASGM activities?
20. What kind of collaborative strategies do you have with these stakeholders?
21. What can be done to enhance artisanal and small-scale gold mining in the Upper West Region?

APPENDIX E: IN-DEPTH INTERVIEW GUIDE FOR DISTRICT ASSEMBLIES

Date.....Position of officer

1. Are you aware of artisanal and small scale gold mining in your district?
2. Has any mining community or group in the District made any effort to acquire a community mining license?
3. If yes, kindly name such communities/mining groups/mining company.....
4. Do you have a District Small Scale Mining Committee and what are/is their role in the management of mining activities in the District?If no Why?.....

5. If yes, how effect is it in the governance of mining activities in the District?
6. In your opinion what can you say are/is the effects of Artisanal and Small Scale gold mining on rural livelihoods in mining communities?
7. What do you think are/is the adverse or positive implications of Artisanal and Small Scale gold mining on agricultural activities?
8. What in your opinion is/are the socio-economic consequences of artisanal and small scale mining activities on the following?
9. What can you say is the effect of artisanal and small scale gold mining on the development of mining communities?
10. What role(s) does the District play in the activities of Artisanal and small scale Gold mining in the Upper West Region?
11. What is the current state of artisanal and small scale gold mining activities in the District?
12. Who are the major collaborators or stakeholders of the artisanal and small scale gold mining in your district and what are their roles?
13. Have you encountered any problems/ differences among the major stakeholders? Yes or No
14. If yes, what is/are the problems?
15. In your opinion what do you think is the effect of Artisanal and small scale gold mining on the physical environment?
16. What measures are put in place to curb the negative consequences of artisanal and small scale gold mining in the district?
17. What measures exist to regulate or prevent the activities of artisanal mining?.....
18. How effective are these measures enforced to achieve their aims? Explain your answer
19. To what extend has the District been able to enforce such regulation with regards to Artisanal and Small Scale Gold Mining?.....
20. What are some of the challenges faced by the District in the enforcement rules with regards to Artisanal and small scale gold mining in the District?
21. In your opinion, what do you think can be done to facilitate the enforcement of your regulatory roles?.....
22. In your opinion, what can you say about your collaboration with other agencies, institutions or stakeholders in the regulation of mining activities in the District?

APPENDIX F: INTERVIEW GUIDE DISTRICT MOFA OFFICE

Date.....Position of Officer

1. What are the crops cultivated in your District?
2. Can you estimate the yield of crops per acre in various years in your District? Please Use MOFA achievable Standards against the Actual yields for the past 10 years
3. Are you aware of the artisanal and small scale mining?
4. What are the challenges facing small-holder farmers in your district?
5. How would you describe crop harvest for previous and current farming seasons in your district?
6. Would you say mining activities in the district has a negative implication on food crop production farmers? Explain your answer
7. What would you say are the environmental consequences of artisanal and small scale gold mining in your district?
8. In your opinion what do you think are the implications of artisanal and small scale gold mining on livelihood diversification of farmers
9. What efforts are being made by the District MOFA at solving the Challenges farmers faced through mining activities?
10. What NGOs exist in your District to offer assistance to farmers?
11. In your opinion What is do you think are the implications of artisanal and small scale gold mining of mining activities on rural lands livelihoods?.....

APPENDIX G: INTERVIEW GUIDE FOR HEALTH PROFESIONALS

Date.....Name of community.....Position

1. Please is the status of your health facility?
2. Are you aware of mining activities going on in the community? Yes/No
3. Please Yes/No kindly explain to what extend you know about.....
4. As a health professional, what is your candid opinion on the effects of mining activities on the health of the following? a) The miner b)The Community
5. What common diseases/conditions are reported at your health facility?.....
6. If yes, would you say those diseases are as a result of mining activities?

7. Can you mention the kinds of mining/galamsey related accidents ever recorded by your facility?
8. Have you ever or been organizing sensitization or outreach programs with regards to the effects of mining on community members health? Yes/No
9. If Yes, how periodic? Weekly, Monthly, Quarterly, and Half-yearly or annually?
10. What strategies would you advice galamsey workers to put in place in order to prevent or reduce mining related diseases or accidents?.....
11. Do you think your facility has the resources and equipment to handle mining related Diseases or accidents?.....
12. If No, what do you think should be done by government to make your facility more resourceful to be able to deal with galamsey related diseases or accidents? Clue: Equipment, machines, personnel, instrument, drugs, infrastructure etc

APPENDIX H: FOCUS GROUP DISCUSSION GUIDE

Date..... Name of Mining Community.....

- 1) When did mining starts in this community?
- 2) Which mining method do you use in mining?
- 3) Have you received any training in mining before your mining activity?
- 4) What motivates you to become a artisanal miner?.
- 5) Is ASGM your only source of livelihood?
- 6) Do you have other source (s) of livelihood(s) apart from mining?
- 7) If yes, what is/ are some of them?
- 8) Has mining affected **(Neg/Positive)** your sources of livelihood in the community?
- 9) If Yes, please name them
- 10) If yes, how has mining affected **(Neg/Positive)** such source(s) of livelihoods?.
- 11) How much do you earn from ASGM Activities in a month (Gh□)?
- 12) Would you say that mining has enhanced the livelihoods of your household in general?
- 13) Could you please list some of trees lost through ASGM
- 14) List some of the water sources affected as a result of ASM
- 15) List some of the livestock lost through ASM
- 16) How many acres of arable land were lost due to mining activities?
- 17) How will you describe the relationship between miners and the local community?

- 18) What do you think are the negative consequences of small scale gold mining on the natural environment?
- 19) What regulations/programs are there to address or manage the negative effects of mining in the community?
- 20) What are the agreements (including land access) between miners and the local/indigenous people?
- 21) What in your opinion is/are the socio-economic consequences of artisanal and small scale mining activities on the following?
- 22) What is the sanitation situation in your community?
- 23) What can you say is/are the main sanitation problem?
- 24) Are the above sanitation problems caused by ASM activities?
- 25) What do you think can be done to improve the sanitation situation in the community?
- 26) Do you use PPEs/ protective gears when mining?
- 27) Are you aware of your exposure to artisanal mining hazards/accidents/casualties?
- 28) If yes what are some of the hazards?
- 29) What are the dominant diseases you often suffer from in your community?
- 30) Do you think the above diseases are as a result of ASM activities?
- 31) Where do you seek for treatment?
- 32) How the distance from your area to the nearest health facility?
- 33) What is/are your source of water?
- 34) How is the distance of your source of water to a mining activity?
- 35) What can be done to improve the health situation in the community?
- 36) Are you aware of any laws or regulations mining? If yes, state some of them?
- 37) If yes, are these laws effective?
- 38) Are you aware there are mandated agencies/institutions responsible for monitoring small-scale mining activities? If yes, what are some of these agencies?
- 39) How is the nature of your relationship with these agencies?
- 40) Are your ASM activities been monitored by Minerals Commission and Environmental Protection Agency? If yes, how frequent?
- 41) Does EPA conduct Environmental Impact Assessment to your mining activity? If yes, how often?

- 42) What is/are the role(s) of traditional leaders play on issues relating to small-scale mining in your community?
- 43) Do you know the agency responsible for issuing small-scale mining licenses?
- 44) Do you have a license?
- 45) Do you know that you need a license to mine?
- 46) If yes, why don't you have a license?
- 47) What do you think are/is the best solutions to solve the problems above?
- 48) What is your perception about government's use of alternative livelihood programs in place of mining?
- 49) What alternative livelihoods do you think the government should introduce in place of Artisanal mining?
- 50) Do you think Government's use of brutality or force to solve the problem of Artisanal mining is the best? Explain your answer
- 51) How do the community benefit from the operations of small-scale mining?
- 52) Has farmers whose farmlands were taken over by miners been compensated?
- 53) Is the compensation enough to match the farmland lost?
- 54) Do you have any question to ask to me/have anything to say?

APPENDIX I: INFORMED CONSENT FORM
SIMON DIEDONG DOMBO UNIVERSITY OF BUSINESS AND
INTEGRATED DEVELOPMENT STUDIES

Background and Purpose: My name is Moomin Seidu, a PhD candidate with student Identification number: **PG0004121** from Simon Diedong Dombo University of Business and Integrated Development Studies pursuing a programme on Environment and Resource Management. As part of the requirement for acquiring my Doctor of Philosophy (PhD) degree, I am conducting a research on the topic **“The Implications of Environmental Threats of Artisanal and Small-Scale Gold Mining (Galamsey) On Rural Livelihood Diversifications in the Upper West Region, Ghana”**.

Your Participation: Your participation in this project is completely voluntary. Moreover, your participation in this study will consist of an interview lasting approximately 45 to 60 minutes. You will generally be asked questions about artisanal and small-scale mining, its socio-economic implications, its livelihood implication and environmental effects on mining communities at large.

You have the right to withdraw from the study at any point in time by notifying the researcher. There is no penalty to this. All your personal data will be anonymized even after your discontinuation.

Why Participate in this project: This is purely for academic purpose and your participation would help gather information to undoubtedly boost the hitherto research literature base on artisanal and small scale gold mining and its effects on the physical environment as well as how it is shaping the livelihood architecture of miner and the community at large.

Confidentiality: All information would be treated confidentially. The interview will be recorded and notes would also be taken in the course of the interview. Kindly note that your name will not be recorded, and the recordings and field notes would both be kept safe. Any digital information will be password protected. I will use pseudonyms to report findings in a way that fully anonymizes you. The researcher will not share any individual responses with others other than the academic research supervisor.

By signing this consent form you acknowledge that you have thoroughly read and perfectly understood the information above and that you are aware that you have the right to withdraw from the study at any point in time.

Participant/Respondent

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

I, **Moomin Seidu**, herewith confirm that the above participant has been fully informed about the study and has given consent to participate as indicated above.

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

APPENDIX J: INTRODUCTORY LETTER

**SIMON DIEDONG DOMBO UNIVERSITY OF BUSINESS AND INTEGRATED
DEVELOPMENT STUDIES (SDD-UBIDS)**
Faculty of Integrated Development Studies
Department of Environment and Resource Studies

Email: ykadiri@uds.edu.gh

Phone Number: 0547918465



P. O. Box 64
Wa Campus
Ghana, West Africa
www.ubids.edu.gh
20th February, 2023.

To Whom It May Concern

Dear Sir/Madam

LETTER OF INTRODUCTION

This is to certify that **Mr. Seidu Moomin** with index number **PG0004121** is a level 900 student of the Department of Environment and Resource Studies, Faculty of Integrated Development Studies. He is a student of PhD Environment and Resource Management.

He is currently working on his thesis as a partial fulfilment of the requirement for the award of PhD Environment and Resource Management. The title of his PhD thesis is **"THE NEXUS OF ECOLOGICAL THREATS AND RURAL LIVELIHOOD DIVERSIFICATIONS: THE PERSPECTIVE OF ARTISANAL AND SMALL SCALE GOLD MINING, UPPER WEST REGION"**.

He needs data from your outfit in order to enable him complete work on his thesis. Necessary courtesies may be extended to him.

Thank you.

Yours Faithfully


Abdul-Kadri Yahaya (PhD)

(HoD, Environment and Resource Studies)

DEPARTMENT OF ENVIRONMENT &
RESOURCE STUDIES
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