Understanding policy and governance strategies for sustainable development of the artisanal and small-scale gold mining and gold sourcing industry: Insights from Ghana

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Doctor of Philosophy

University of York

Politics and International Relations

April 2024

Abstract

Artisanal and small-scale gold mining (ASGM) is characterised by low capital, labour-intensive mineral extraction and processing, with potential contributions to development. However, the sector predominantly operates informally, limiting its potential benefits and sustainability. Despite studies on ASGM's environmental and socio-economic impacts, understanding of the policies and governance strategies for effective formalisation that spur sustainable development of ASGM is lacking. Focussing on Ghana, this thesis aims to enhance understanding of sustainable ASGM in newly engaged agricultural communities, through objectives that: i) identify and analyse livelihood trajectories associated with ASGM to inform policies supporting rural livelihoods; ii) investigate ASGM's impact on natural and physical capital and its interactions with agriculture to promote co-existence; and iii) assess the legal framework and policy coherence for sustainable ASGM governance. Fieldwork in Atiwa West District and Koforidua comprising environmental surveys, transect walks, questionnaires, focus groups, and stakeholder interviews revealed three livelihood trajectories linked to ASGM's rise—consolidation, fluctuation, and marginalisation. While ASGM benefited some farmers, it harmed others due to competition for land, labour, and water, caused by its informal operations. ASGM interacted with agriculture, providing short-term income but long-term community-level costs such as land degradation. Linkages were lacking at the institutional level for joined-up governance. Document reviews showed a broad legal framework, yet ASGM governance lacks decentralisation and policy coherence, hindering intersectoral coordination. Findings overall emphasise the need for targeted policies linking rural livelihoods, agriculture, and mining, and highlight the need for collaboration between formal and informal institutions. Cross-sectoral planning and stakeholder engagement are crucial for sustainable ASGM development, necessitating coordinated governance, integrating ASGM into broader development policies while promoting legal and responsible operations.

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List of Acronyms

ASM	Artisanal and Small-scale Mining
ASGM	Artisanal and Small-scale Gold Mining
SLA	Sustainable Livelihoods Approach
CMS	Community Mining Scheme
Kuli-kuli	Artisanal mining of residual gold from previously mined sites
Kwee-kwee	Artisanal mining with metal detectors
MOFA	Ministry of Food and Agriculture
COCOBOD	Ghana Cocoa Board
MC	Minerals Commission
LC	Lands Commission
MLNR	Ministry of Lands and Natural Resources
EPA	Environmental Protection Agency
WRC	Water Resources Commission
DCE	District Chief Executive
GSS	Ghana Statistical Service
GDP	Gross Domestic Product
SAPs	Structural Adjustment Programmes
DfID	Department for International Development
UNDP	United Nations Development Program
UNDESA	United Nations Department of Economic and Social Affairs
OECD	Organisation for Economic Co-operation and Development
IMF	International Monetary Fund
USDOS	United States of America Department of State
UNECA	United Nations Economic Commission for Africa
UNEP	United Nations Environment Program

Acknowledgements

I would like to thank my supervisors Prof. Lindsay C. Stringer and Prof. Henrice Altink for their advice, unwavering support and encouragement during my candidacy. Their guidance has been invaluable, shaping both my academic and professional journey in profound ways. Working alongside them has been a privilege I deeply cherish.

I would also like to acknowledge the financial support for my fieldwork by the University of York which made this research possible.

Many thanks also to the people who assisted during my fieldwork in Ghana. I truly appreciate the involvement of all individuals and organisations who supported my research in various ways such as participation in questionnaires, interviews, and meetings.

Finally, many thanks to my family for their support during this journey.

Declaration

I declare that this thesis is a presentation of my original work and I am the sole author. To my knowledge, this work has not previously been presented for an award of a degree or other qualification at this, or any other, university. All sources used are acknowledged as references.

I was responsible for developing the idea, articulating the theoretical framing, designing the methodology, carrying out all data collection and analysis, and writing and revising the manuscript. Lindsay Stringer, Henrice Altink provided feedback and advice on the research design, contributed to the writing of the manuscripts by revising, and gave final approval for publication.

Chapter 4 of this thesis has been published as:
Adranyi, E., Stringer, L. C., & Altink, H. (2023). The impacts of artisanal and small-scale gold mining on rural livelihood trajectories: Insights from Ghana. *The Extractive Industries and Society*, 14, 101273. https://doi.org/10.1016/J.EXIS.2023.101273

Chapter 5 of this thesis has been published as:
Adranyi E, Stringer LC, Altink H (2024) Joined-up governance for more complementary interactions between expanding artisanal small-scale gold mining and agriculture: Insights from Ghana. *PLoS ONE* 19(4): e0298392. https://doi.org/10.1371/journal.pone.0298392

Chapter 6 of this thesis has been published as:
Adranyi, E., Stringer, L. C., & Altink, H. (2024). Artisanal and small-scale gold mining governance and cross-sectoral policy coherence in Ghana. *Resources Policy,* 96, 105235, ISSN 0301-4207, https://doi.org/10.1016/j.resourpol.2024.105235.

Chapter 1. Introduction

1.1 Background

A livelihood comprises the capabilities, assets (including both material and social resources) and activities required for a means of living (Chambers and Conway, 1992). Artisanal and small-scale mining (ASM) is widely recognised as an important source of livelihood in mineral-rich countries in the Global South, providing opportunities for ordinary people to benefit from natural resources and offering wealth-generation prospects for entrepreneurs (Hilson and Hu, 2022). The ASM sector is complex and lacks a universally accepted definition, with interpretations varying across regions and countries (Zvarivadza, 2018). These definitions depend on a country's macroeconomic situation, geological context, mining history, and legal framework (Hentschel et al., 2002). Generally, "artisanal mining" is considered more rudimentary and uses relatively simple methods for the exploration, extraction, and processing of small mineral deposits (Hilson and Maconachie, 2020a; Scammacca et al., 2021). "Small-scale mining" is seen as more mechanised and sophisticated (Ferring et al., 2016; Fritz et al., 2016) or as a slightly larger undertaking (Seccatore et al., 2014).

The ASM sector is characterised by low capital investment, labour-intensive operations, and diverse actors that include low-income informal individual miners, families or groups, seeking to make a living or supplement a subsistence livelihood, as well as small-scale formal commercial mining activities that can produce minerals in a responsible way respecting local laws (Barry, 1996; Eduful et al., 2020; Hentschel et al., 2002; IGF, 2018). Most ASM activities are, however, conducted informally, with 80–90% of workers globally operating in informal settings (World Bank, 2020). Informal ASM refers to small-scale, unregistered operations that lack formal licenses but often have a social license to operate. This is in contrast with illegal ASM, which violates laws or regulations, such as operating in protected areas or trespassing on active or decommissioned mining sites (Chen, 2007; Singo and Seguin, 2018). While the distinction between informal and illegal ASM can be blurred due to registration and permitting requirements, recognising these differences is essential for crafting effective ASM policies.

ASM significantly supports rural economies by employing many poor individuals and creating downstream jobs. Despite low individual output, the large workforce contributes substantially to national production. It forms the world's largest mining workforce. The World Bank (2020) estimated that in 2019, at least 44.75 million people across 80 countries worldwide were engaged in ASM, up from 13 million estimated by the International Labour Organisation in 1999. In sub-Saharan Africa (SSA) alone, 10 million people work directly in ASM and 60 million more rely on it indirectly for their livelihoods (World Bank, 2020). For countries such as Mali (Teschner, 2014), Sierra Leone (Maconachie and Binns, 2007), Tanzania (Fisher et al., 2009), the Democratic Republic of Congo (Geenen, 2012), and Zimbabwe (Mkodzongi and Spiegel, 2019) the sector has become a vital livelihood strategy, particularly as traditional sectors like agriculture face increasing pressures. Ghana, the focus of this thesis, hosts one of the largest and most dynamic ASM economies in SSA (Hilson et al., 2022), supporting approximately 1 million people directly and 4.5 million indirectly. However, estimates suggest that over 85% of ASM workers in Ghana operate beyond the scope of state regulation (Abdulai, 2017; Boafo et al., 2019; Kumah, 2022). ASM's expansion in Ghana and SSA more widely is largely attributed to the liberal economic reforms of the 1990s, which spurred widespread unemployment and poverty, driving many into ASM as a means of survival (Hilson and Potter, 2005). While these policies promoted large-scale mining development, they largely ignored ASM so it developed organically (Fisher, 2007). Additionally, high international mineral prices have attracted wealth-seekers to the sector (Maconachie, 2011). Over time, ASM in SSA has evolved from subsistence-level operations to a diverse mix of formal and informal activities with varying levels of mechanisation (Owusu et al., 2019).

Within the ASM sector, artisanal and small-scale gold mining (ASGM) is prominent (Scammacca et al., 2021), and globally directly employs over 20 million miners who generate approximately 20% of total annual gold production (IGF, 2018; World Bank, 2020) valued at $31.5 - 37.8 billion each year (PlanetGOLD, 2020). Extensive evidence has been advanced in support of the great potential ASGM holds in contributing to broad-based development goals, including poverty reduction, rural development, diversification of government revenue and global economic growth through mineral trade (Dreschler, 2002; Hilson and Osei, 2014; World Bank, 2020). In Ghana, ASGM is the largest ASM sub-sector, contributing 43% of the country's

4.8 million ounces of gold production in 2018 (Adu-Baffour et al., 2021). This thesis focusses on Ghana's ASGM sector. A full justification for selecting Ghana as a case study is in Chapter 3.

Notwithstanding the socio-economic benefits derived from ASGM, the sector is heavily overshadowed by its environmental, social and economic problems, largely linked to its predominant informal and illegal nature (Kumah, 2022), which pose challenges not only for miners and their communities but also for governments seeking sustainable development (Hilson et al., 2017; Hilson and Maconachie, 2020a). Environmental issues include widespread land degradation, chemical contamination, and water pollution (Bansah et al., 2018). Social problems entail unsafe and hazardous working conditions, the emergence of unsanitary settlements, disruptions to traditional livelihoods such as agriculture, and tensions between miners and landowners (Banchirigah, 2008; Boadi et al., 2016), while economic problems include a lack of technical and financial support for miners (Siwale & Siwale, 2017; World Bank, 2020), market and support service challenges, exploitative gold buying schemes, corruption, and illicit financial flows (Kalokoh and Kochtcheeva, 2022).

1.2 Rationale

In the ASM literature, extensive studies have been undertaken regarding the socio-economic and environmental impacts of ASM, while research concerning its informality and formalisation challenges is limited, particularly when it comes to exploring the sector's potential sustainability. Scholars have only recently begun to delve into ASM informality. Noteworthy studies include Geenen's (2012) studies in the DR Congo, Hilson et al.'s (2019) research in Niger, Siegel and Veiga's (2009) work in Uganda, Salo et al.'s (2016) study in Peru, and Verbrugge's (2015) research in the Philippines.

The role of ASGM in rural livelihoods is complex, producing both negative and positive impacts. The informal nature of ASGM provides miners with easy entry into the industry, and where the informal economy dominates, informal ASGM aligns seamlessly with the socio-economic landscape, making mining operations accessible and familiar to participants. Informality eliminates the need for complicated training, allowing miners to engage in ASGM without facing significant barriers, while it thrives in remote areas with limited infrastructure,

making it a practical and viable option for many (Tschakert, 2009). Informal ASGM, however, faces numerous challenges. Miners often have lower levels of education and higher rates of illiteracy, limiting their access to resources and opportunities for capacity building. Wages in informal ASGM are generally low, contributing to widespread poverty among miners and their families, while working conditions are typically poor, with miners enduring long hours, inadequate safety measures, and exposure to hazardous environments. Informal ASGM operations also lack social protection, labour rights, and mechanisms to address workplace grievances (ILO, 2018). Despite the challenges, the informal and illegal ASGM sector continues to thrive which means that there are many critical questions that remain insufficiently understood and its making regulation and policy implementation particularly complex (Hilson and Hilson, 2015).

The ASGM sector is highly diverse, comprising self-employed miners, casual labourers, and other informal workers, who have varying capabilities, which can impact livelihood trajectories. Informal ASGM intersects with other critical livelihoods, such as agriculture, creating both complementary benefits and potential conflicts. For instance, while ASGM offers an alternative source of income, its environmental impacts such as land degradation can undermine agricultural productivity. To ensure that ASGM's operations intersect with other livelihoods positively and do not occur at the expense of other sectors would, among other things require coherent policies. Yet it remains unknown whether existing policies for ASGM are coherent with those of other affected sectors.

Ensuring formal governance of ASGM to operate as a sustainable livelihood, in which it impacts positively on other livelihoods on a long-term basis is essential. This, however, require a detailed understanding of the sector's informality. This thesis addresses the broader themes of understanding why the ASGM sector remains persistently informal and, in some cases, illegal, examining how these conditions have arisen, and the governance and formalisation challenges they pose to the sector's sustainable development. Through a focus on livelihood trajectories, the interactions between ASGM and agriculture and formalisation and policy coherence, this study provides fresh insights. Advancing understanding in these issue areas is essential for unpacking the sector's complexities and to address its currently unsustainable development trajectory. The persistent informality signals the absence of laws or failure of existing legal frameworks to effectively address the diverse needs of ASGM operators,

associated stakeholders, and connected institutions, all of whom must embrace sustainable practices for ASGM's success. This thesis, overall, seeks to promote the sustainable development of the ASGM sector by examining three interconnected pathways: improved livelihoods, enhanced formalisation efforts, and strengthened policy coherence/linkages. In doing so, it identifies strategies within these pathways to address the sector's challenges, and to show that improvements in these areas offer potential to jointly contribute to achieving sustainable development of ASGM.

The 1987 Brundtland Commission (WCED, 1987, p.41) defined sustainable development as "…development that meets the needs of the present without compromising the ability of future generations to meet their own needs." This concept, which integrates environmental, economic, and social considerations, has been widely adopted, including in the mining sector. However, its application to mining remains strongly contested. Critics highlight that the extraction of finite resources and the significant environmental and social impacts of mining inherently conflict with sustainability principles (Parameswaran, 2016; Whitmore, 2006). Once depleted, non-renewable resources cannot be replaced, raising questions about the long-term sustainability of mining.

Despite these concerns, a growing body of literature suggests that mining can align with sustainable development if managed responsibly. Jenkins and Yakovleva (2006) emphasise that sustainable development in mining, large-scale and ASM, should focus on reinvesting mining profits into local development to support economic sustainability, prioritising environmental protection by minimising the impacts of exploitation and rehabilitating mined land, and promoting social cohesion through stakeholder engagement, transparency, and mitigation of cultural and social disruptions (Jenkins and Yakovleva, 2006). This perspective, often referred to as sustainable mining or responsible mining, seeks to minimise its negative social, economic and environmental impacts, while maximising the positive impacts, with scholars proposing various strategies and indicators to, in particular, ensure sustainable development in large-scale mining (Bilham, 2021; Broad, 2014; Childs, 2014, 2008; Goodland, 2012; G. Hilson, 2002; Hilson, 2008; Mudd, 2020; Sauer and Hiete, 2020; Tost et al., 2018).

In large-scale mining, sustainable practices have gained traction since the 1998-2002 Global Mining Initiative, led by the chief executives of some top mining companies. This effort

evolved into the International Council on Mining and Metals and produced the Mining, Minerals, and Sustainable Development report, which assessed sustainability in mining (Gorman and Dzombak, 2018). Since then, numerous initiatives like the Extractive Industries Transparency Initiative (EITI), launched in 2003; the World Gold Council's Responsible Gold Mining Principles, in 2019, and the International Council on Mining and Metals' Mining Principles in 2003, have driven sustainability efforts, helping large-scale mining companies to align with international sustainability standards alongside national regulations (Aznar-Sánchez et al., 2019).

However, the ASM sector has struggled to achieve similar progress. Its informality, as well as limited regulation, oversight, and resources, have been identified as significant barriers to adopting sustainable practices (Achina-Obeng and Aram, 2022). Unlike large-scale operations, ASM often lacks access to funding, technology, and global sustainability frameworks, while economic pressures push many miners to prioritise short-term gains over long-term sustainability. The central sustainability challenge for the ASM sector is to demonstrate that it can contribute to the well-being of the current generation without compromising the potential of future generations to enjoy a better quality of life (Azapagic, 2004). This thesis posits that achieving this balance requires a nuanced approach that addresses the specific governance and policy needs of ASM, while actively mitigating its environmental, social and economic concerns.

Sustainable ASGM in this thesis thus refers to practices, policies, and initiatives aimed at ensuring that ASGM activities contribute positively to economic development, social well-being, and environmental protection in a manner that can be maintained over the long term. To design and implement sustainable practices effectively, requires thorough understanding of the challenges that hinder the sustainable development of the ASGM sector, so that sustainable practices can be identified and successfully applied. Sustainable ASGM should be viewed and approached as a multifaceted development challenge, requiring the commitment of, and inputs from, a range of institutional actors, to be addressed effectively.

Formalising ASGM operations is often presented by scholars, donors and international organisations, and policymakers as a solution to the issues of informality and illegality and the associated environmental, socio-economic problems and demands ASGM's integration into

the formal economy through legal recognition, regulation, and support (McQuilken and Hilson, 2016). Scholars have argued that formalisation can help improve the governance and regulation of ASGM activities (Hilson et al., 2019; Salo et al., 2016) and that at the very least, the sector must be embodied in a "standardised legal framework, which is registered in, and governed by, a central state system" (Geenen, 2012, p.1). The United Nations (UN) and the World Bank have pushed for ASM formalisation in SSA over the past three decades. They have primarily focused on the challenges individual miners face, especially the difficulties in obtaining the necessary permits to operate legally, as key reasons for advocating formalisation (Davidson, 1993; Hilson et al., 2017; ILO, 1999; Maconachie and Hilson, 2011; Martinez et al., 2021), and many governments in SSA since the 1990s have taken steps to legalise and regulate their ASM sectors (Collins and Lawson, 2014). However, regulating the ASGM sector has proven challenging for most governments in SSA and the majority of ASGM operations in the region continue to run informally and illegally, and with little regard for sustainability (Achina-Obeng and Aram, 2022). Examples of widespread informal ASGM, despite relevant legal frameworks, can be found in Ghana (Hilson and Hilson, 2015), Uganda (Siegel and Veiga, 2009), Zambia (Siwale and Siwale, 2017), Philippines (Verbrugge, 2015), and Peru (Martinez et al., 2021). Current formalisation steps do not adequately address the complex socio-economic and political issues underpinning the sector.

Informality is often tied to broader livelihood dynamics, as many individuals engage in ASGM to address immediate economic needs or as a response to limited formal employment opportunities. These livelihood choices highlight the interplay between informal mining and existing socio-economic structures in local communities. While scholars have shown that engagement in ASGM occurs for myriad reasons and for different lengths of time (Siegel and Veiga, 2009; Verbrugge and Besmanos, 2016), an understanding of the divergent livelihood trajectories, i.e., the directions that livelihoods follow over time (Bagchi et al., 1998), linked to ASGM emergence and its intersection with existing drivers in local communities is lacking. Yet, undertaking livelihood trajectory studies connected to ASGM can identify diversity of livelihood pathways, revealing how individuals move between livelihoods or integrate multiple sources of income, and unpack the drivers of people's engagement in it. It would also reveal any inequalities, highlighting disparities in income, resource access, or social mobility across different groups. The first objective in this research analyses the divergent livelihood

trajectories that develop when ASGM emerges in communities, with a view to exploring governance strategies that can be implemented to enable divergent livelihoods to flourish. A nuanced understanding of livelihood trajectories is central to devising workable policies that address the diverse needs of the ASGM workforce. Such an approach recognises the heterogeneity of livelihood trajectory groups and serves as a crucial pathway to formalisation (see Chapter 4). Livelihood trajectories are further reviewed in Chapter 2. By examining how informal livelihoods like ASGM can transition to regulated, sustainable practices, these policies can promote compliance with regulations and support the implementation of ASGM as a sustainable livelihood activity. Formal governance of ASGM is necessary to transform the sector into a sustainable livelihood option and to address its associated socio-economic and environmental issues (Siegel and Veiga, 2009; Zvarivadza, 2018).

Furthermore, agriculture is the main source of income in Ghana and in many parts of SSA. The relationship between ASGM and agriculture can be complex, and studies have shown both positive and negative dynamics between them (Boadi et al., 2016; Pijpers, 2014). While ASGM can degrade farmlands, it can also generate positive relationships with agriculture, as noted in case studies from Sierra Leone (Maconachie and Binns, 2007) Malawi (Kamlongera, 2011), Mali and Ghana (Hilson and Garforth, 2012) and Zimbabwe (Mkodzongi and Spiegel, 2019), where smallholder farmers were able to shift between farming and mining and use mining income to support agriculture and enhance productivity. The literature on ASGM-agriculture relationships, however, has largely focussed on describing these negative or positive relations as observed in field studies. Studies have not systematically explored institutional linkages between ASGM and agricultural sectors that influence ASGM-agriculture interactions on the ground. The underlying factors or conditions that influence observed linkages between ASGM and agriculture remain unclear and knowledge of ASGM governance strategies that can ensure a more lasting, supportive relationship between ASGM and agriculture is currently lacking. This study, via its second objective, seeks to address this gap and gain an understanding of ASGM-agriculture interactions across household, community, and institutional levels. This information is then used to explore governance strategies and policies that can enable a more mutually supportive relationship and sustainable, workable co-existence of ASGM and smallholder agriculture. Objective 2 is largely addressed using the Sustainable Livelihood Approach (see Chapter 2), considering that sustainable ASGM should

be based on an analysis of the contextual factors of people's lives (i.e. the key socio-economic, demographic, and political context); their access to and stocks of financial, physical, human, social and natural assets, and their ability to employ these for productive use; the institutions, policies and organisations that shape household access to assets; and the problems and priorities people themselves identify, and the strategies they employ to meet these priorities (see Chapters 4 and 5).

ASGM activities are deeply influenced by local socio-cultural processes, policies, laws, political interests, and power structures. These factors lead to competition for land and property access, creating complex bureaucratic systems that miners must navigate. The intricate socio-economic and political landscape of the sector can hinder sustainable ASGM if not carefully addressed. A nuanced understanding of grassroots ASM operators, policymakers, governance structures, laws, and institutions is essential to develop tailored policies and strategies that provide the necessary support for a more sustainable ASGM sector, in which ASGM operations prosper while also realising positive impacts on other rural livelihood activities. Generic formalisation frameworks can lead to exclusion and inequality within ASM, benefiting only those miners who have the capital and mobility to meet the high thresholds of legalisation. This can also criminalise the poor for their inability to conform to such formalisation requirements. This study adds to this discourse by exploring the effectiveness of Ghana's ASGM legal frameworks in addressing the complexities of the sector along its value chain, from land acquisition to mining and post-mining operations, including a focus on policy linkages that allow for the integration of grassroots and other stakeholder perspectives. Objective 3 examines Ghana's legal framework governing ASGM activities and assesses policy coherence between the ASGM sector and other sectors that are critically affected by ASGM operations (Chapter 6). Given the many difficulties associated with informal ASM, this thesis argues for the need to rethink formalisation as not just a legal or regulatory process that simply seeks to enable miners to obtain the necessary permits to operate legally, but as an inclusive strategy that addresses the environmental, social and economic factors driving informality, and thereby minimising negative impacts and maximising benefits to promote sustainable ASGM. Doing this is key to understanding the challenges of sustainable ASGM in these contexts and for forging new sustainable pathways.

Bringing all these aspects together, this thesis makes an important contribution to the understanding of the complexities of informal ASGM and the associated ASGM's sustainable development challenges, particularly in Ghana's agricultural areas. The analysis focuses on livelihood trajectories associated with the rise of ASGM, ASGM's interactions with agriculture at multiple scales (household, community, and institutional levels), and the examination of the legal framework along the ASGM value chain - land acquisition, mineral extraction, processing, land reclamation, and mineral trading - as well as the coherence of intersectoral policies related to ASGM governance. Through this approach the thesis seeks to deepen understanding of factors that influence the dynamics of ASGM's development and its impacts on rural livelihoods, and to identify governance and formalisation mechanisms that can support sustainable ASGM and its integration in overall sustainable development efforts.

1.3 Research aim and objectives

1.3.1 Aim

The aim of the research is to deepen the understanding of the challenges posed by ASGM, particularly the informal ASGM sector, in order to identify policies and governance strategies that offer potential to improve the sustainability of ASGM.

1.3.2 Objectives

The research aim is achieved through pursuit of the following objectives and questions:

Objective 1: Identify and analyse livelihood trajectories linked to ASGM in new frontier communities, with a view to informing policy interventions that support the development of sustainable rural livelihoods. To accomplish this, the research asks:

1.1 What household livelihood portfolios existed prior to and after the rise of ASGM, and what key factors have influenced changes in livelihood activities?
1.2 What are the impacts of ASGM emergence on livelihoods?
1.3 What opportunities and barriers have evolved for different livelihood trajectory groups since ASGM emergence and how do these interact to shape overall livelihood trajectories?
These are addressed in Chapter 4.

Objective 2: Investigate ASGM's impact on natural and physical livelihood capitals and interactions with agriculture, in order to understand the policy implications for positive co-existence of sustainable agriculture and ASGM. To achieve this, the research poses the following questions:

2.1 How have agricultural lands, water resources and local infrastructure been altered through ASGM activities and what agriculture-ASGM interactions occur at the household, community, and institutional levels?
2.2 What individual and societal drivers have shaped the interactions between ASGM and agriculture and brought about changes in the natural and physical livelihood capitals?
2.3 What are the policy implications of the agriculture-ASGM interactions?
These are addressed in Chapter 5.

Objective 3: Examine Ghana's current legal and regulatory framework and analyse intersectoral policy coherence concerning ASGM governance, with a particular focus on formalisation. The study asks:

3.1 Do existing laws and regulations on ASGM formalisation address the main activities along the sector's value chain?
3.2 To what extent is mining policy coherent with policies of other mining-sensitive sectors regarding sustainable ASGM?
3.3 What challenges impact policy coherence between the mining sector and the other mining-sensitive sectors, thereby affecting ASGM formalisation outcomes?
These are addressed in Chapter 6.

1.4 Structure of thesis

Following this Introduction (Chapter 1), Chapter 2 provides an overview of the ASM and ASGM sector globally and in SSA. It sets out current debates on informality and formalisation in ASM and the applicability of sustainable development to the ASM sector. The sustainable livelihoods approach (SLA) is presented as a core framework utilised in the research. The chapter considers its strengths and novelty in exploring ASGM livelihoods, but also addresses the SLA's limitations through the incorporation of the concept of livelihood trajectories. Chapter 2 furthermore presents broad debates regarding ASGM's impacts on livelihoods and

agriculture and points out the relevant gaps in the literature. It presents governance and formalisation challenges and reveals the importance of the applicability of policy coherence in the ASGM sector.

Chapter 3 provides a broad overview of the study area, the research design, the qualitative and quantitative data collection methods and the sampling techniques used. It also addresses issues related to positionality, risks, ethics, and limitations. Chapter 4 presents the empirical findings on ASGM impacts on livelihood trajectories. Chapter 5 shows findings on ASGM interactions with agriculture across household, community, and institutional levels, highlighting the differences in the relationships across the levels and underlying factors that influence the different relationships. Chapter 6 reveals insights from the examination of Ghana's legal framework on ASGM and the level of coherence in policies between the ASGM sector and other sectors that ASGM impacts considerably (land, agriculture, environment, water, and development), considering its impacts for formalisation.

Chapter 7 provides a broad discussion of the thesis highlighting its contribution to existing scholarship and presents strategies that can be undertaken to make ASGM more sustainable. It also mentions future research that can be carried out regarding sustainable ASGM. Chapter 8 summarises the key contributions to knowledge made by this thesis and draws them together in conclusion, reiterating the links between the objectives.

Chapter 2. Literature review

As outlined in Chapter 1, this thesis explores ASGM from a governance perspective. In doing so, it investigates different pathways to sustainability in ASGM through a focus on livelihoods, policy coherence and formalisation through improved governance.

This chapter situates the research within the existing literature on ASM and on ASGM and highlight the gaps in knowledge that it tries to fill through the use of the conceptual frameworks of Sustainable Livelihoods Approach and livelihood trajectories, formalisation/informality, as well as policy coherence. It provides a contextual understanding of the sector and introduces the key debates to which this thesis intends to add clarity.

2.1 Characterisation of ASGM

2.1.1 ASGM characteristics, operational dynamics and underlying factors

Artisanal and small-scale gold miners usually exploit marginal ore deposits, which are not profitable for large-scale mining. Miners often exploit alluvial mineral deposits found in sediments in or near watercourses or former watercourses through a process called placer mining. Alluvial deposits consist of gold pieces, washed away from the lode by the force of water. They are easier to discover than hard-rock deposits, and do not require complex and expensive surveys (Nyame and Grant, 2014). Placer mining, which is the practice of separating heavily eroded minerals like gold from sand or gravel, can be undertaken without mechanisation, through e.g. panning for gold in streams or rivers. However, most artisanal miners use some form of mechanisation and aim to buy mechanised equipment when they can afford it to mine larger quantities of deposits with minimum effort and in less time (Bansah et al., 2018). For example, in Ghana and Peru, use of mechanised equipment is common and includes water pumps, dredgers, detectors, bulldozers, and excavators (Damonte et al., 2013; Kumah, 2022). Miners that exploit hard rock and primary material deposits must dig narrow tunnels along the gold seam to reach deposits, blast them with explosives, and then use machines to crush the assembled ore (Bansah et al., 2016). Irrespective of the way gold is extracted, miners often clean it with mercury or cyanide. The

unregulated and heavy use of these chemicals in ASGM has led to several environmental and health problems including pollution of waterways that serve as drinking sources for communities (Clifford, 2017). Despite these impacts, such mining still plays a key role in many rural livelihoods globally.

Discussion on the precise role of the ASM in rural livelihoods has been dominated by a 'need versus a greed' debate. Some authors argue that people undertake small-scale mining because of its 'get-rich-quick' attributes and contend that it is greed rather than poverty that draw people to the sector (Hinton, 2005; Hirons, 2014); others have argued that people venture into ASM due to poverty. A lack of viable alternative livelihoods can push miners into ASGM and other artisanal mining areas, and miners often operate under poor working conditions, exposing themselves to other associated risks (Banchirigah, 2008; Fisher et al., 2009; Hilson and McQuilken, 2014). More recently, scholars have further examined the nuances of the ASM sector and challenged the idea that all small-scale mining operatives are living in lasting poverty. Although many individuals and households continue to undertake small-scale mining of gold and other minerals out of necessity, the sector has also grown in complexity, providing a strong opportunity for capital accumulation (Hilson and Hu, 2022; Tschakert, 2016; Verbrugge, 2015). Recent studies therefore reveal that both poverty and the desire for wealth accumulation are influential factors, affecting why people turn to mining (Hilson and Hu, 2022).

Increasingly more sophisticated machinery and complex divisions of labour are developing in ASGM (Owusu et al., 2019; Tschakert, 2009). In the Philippines, for instance, ASGM began with rudimentary tools but the sector is now heavily mechanised, leading to the emergence of a dominant group of ASGM entrepreneurs and financiers, driven to mining by a desire for capital accumulation and who operate alongside poverty-driven individuals (Verbrugge and Besmanos, 2016). Similar observations have been made for Zimbabwe (Mkodzongi and Spiegel, 2019), Ghana (Crawford and Botchwey, 2017; Tschakert, 2016), and Tanzania (Fisher, 2008).

As such, ASGM can create a range of jobs and livelihood opportunities for both unskilled and semi-skilled workers, as well as economic opportunities for many more downstream industries, and has been demonstrated to contribute to rural poverty reduction (Bryceson et

al., 2014; Hilson and Osei, 2014; Verbrugge, 2016). Downstream employment spurred by ASGM includes service roles, such as taxi drivers, cooks, and clothing merchants; semi-skilled labouring opportunities, including machine operators and repairmen; and roles for skilled and educated groups, notably bookkeepers, accountants, and technicians (Bloch and Owusu, 2012; Teschner, 2014). The pronounced differentiation, however, can provide impetus for labour exploitation by elite groups, as observed by Verbrugge and Besmanos (2016) in the Philippines. It can also lead to other social challenges in ASGM communities such as unsafe working conditions. Poverty is likely to remain a fundamental driver for the consistent shift of workers into ASGM, but a simplistic focus on poverty alone risks masking the divergent reasons underpinning ASGM operations and fails to unearth the socially segmented nature of diversification into the sector (Verbrugge, 2016), as well as limiting understanding of the divergent livelihood trajectories that are followed. This knowledge gap is addressed in Chapter 4.

2.1.2 The Growth of ASGM in sub-Saharan Africa

Expansion of ASGM in SSA has been fuelled by broader economic changes, most notably the economic reforms promoted by the World Bank and International Monetary Fund (IMF) under the Structural Adjustment Programmes (SAPs) to address the alarming economic declines of the late 1960s and the early 1970s. SAPs were initiated across SSA in the late-1970s and the early-1980s and came with various conditions, amongst others, the privatisation of state assets, trade liberalisation, and the revaluation of currencies. Institutional frameworks were therefore characterised by the concept of free trade, free markets, and strong private property rights. By the late 1980s and the early 1990s, most SSA countries had implemented SAPs as a condition for aid. The implementation of SAPs led to the downsizing of industries, cuts in public spending, privatisation, closure of many state-owned enterprises (SOEs), and increasing unemployment. Hilson and Potter (2005) estimated that 278,000 jobs were lost in Ghana between 1985 and 1991. In line with the SAPs, reforms were undertaken within the mining sector to boost investor confidence and attract foreign investment. In Ghana, this included development of the Minerals and Mining law in 1986. These reforms caused large-scale mining to grow substantially, boosted by investment from foreign companies, especially during the 1990s. However, these reforms led to, amongst

others, the reorganisation and transition of large-scale mining from underground labour-intensive operations to capital-intensive surface operations, resulting in labour retrenchment. Increased large-scale mining operations have also impacted access to mineral lands by local people. Many people made unemployed by the SAPs were not absorbed into the large-scale mining sector, and instead turned to artisanal mining of gold and other minerals (Akabzaa and Darimani, 2001; Banchirigah, 2008, 2006; Hilson, 2004; Yankson and Gough, 2019).

The implementation of SAPs had a substantial negative impact on the economies of SSA countries as they failed to stimulate economic expansion and development (Bawa and Ateku, 2020). Countries faced numerous economic crises, with no safety nets for the most vulnerable people, and smallholder farmers found it particularly difficult to make a living (Haselip and Hilson, 2005). The grim economic situation positioned ASGM and its downstream industries as a solution to severe poverty and joblessness. Many people shifted into ASGM, perceiving it as a livelihood activity that could help them rise out of poverty and build economically sustainable lives. Existing scholarship on ASGM then sees the SAPs as the main explanatory factor for ASGM expansion in an organic and informal manner, with little carefully crafted regulatory structure to manage its activities.

Alongside the SAPs, scholars have also attributed ASGM expansion in SSA to the declining fortunes linked to agriculture (Afriyie et al., 2016a; Bryceson et al., 2014; Hilson and Garforth, 2012). This argument is primarily concerned with livelihood diversification. Bryceson et al. (2014) note that since the late 1970s, contracting global markets for African smallholder agricultural exports have triggered large-scale de-agrarianisation. Many Africans employed in agriculture have sought employment in other sectors to support their survival. Yet Hilson and Garforth (2012) have argued, in the cases of Mali and Ghana, that ASGM does not entirely replace smallholder farming, as the term 'de-agrarianisation' implies but that instead ASGM coexists with subsistence farming. Mkodzongi and Spiegel (2019) have made the same argument in the case of Zimbabwe.

Existing literature similarly highlights that the rise in gold prices, particularly since the early 2000s, has led to a sharp growth in ASGM operations in the Global South, and with it, increases in the number of people employed in the sector (Hilson and Garforth, 2012; Hilson and Hu, 2022). Between 2000 and 2023, the price of gold in the international market

increased seven-fold (US$8,982.92/kg on 6 January 2000 to US$65,150.30/kg on December 6, 2023), principally due to global demand (World Gold Council, 2023a). ASGM expansion is closely associated with increased mechanisation and intensification (Okoh and Hilson, 2011; Owusu-Nimo et al., 2018), and migration. As gold deposits can become quickly exhausted due to increased ASGM activities to meet growing demands, miners are constantly on the lookout for new deposits, including across national borders which increases involvement of other nationals in ASGM (Hausermann et al., 2018; Nyame and Grant, 2014). For instance, there are reports of migrants from Western Africa and further afield, who work in Ghana's ASGM sector, even though foreigners are legally prohibited from working in the sector (Adu-Baffour et al., 2021; Tschakert, 2016). This foreign presence, facilitated by a lack of law enforcement, can disrupt social relations in mining communities by influencing local politics and traditional norms, altering labour dynamics and economic disparities, and impacting infrastructure and other local resources. These disruptions can increase the risk of tensions and conflicts among various livelihood groups.

Despite its growing economic importance, ASGM generally occupies a peripheral position in the economic development agenda of SSA. The sector has yet to make a significant mark by featuring prominently in poverty alleviation strategies. Some scholars link this to a poor understanding of the sector's role in SSA's liberalised economies and the effects of inappropriate policy ideas and generalisations about the sector's activities (Hilson and Maconachie, 2020b). Consequently, ASGM is largely unregulated and subjected to relatively inadequate monitoring and regulation by state authorities. The persistent informality of the sector increases risks of environmental degradation, social conflict and labour rights abuses, corruption, and criminal activity. Mining operatives can remain trapped in vicious cycles of vulnerability and insecurity. Consequently, there is urgent need for further studies on ASGM operations and their impacts on livelihoods to inform the formulation and implementation of appropriate governance strategies that promote more sustainable ASGM. As mentioned, there has been debate over the applicability of sustainable development to the ASGM sector (Hilson and Maconachie, 2020b), and scholars differ in their perspectives on the most appropriate governance mechanisms to promote sustainable ASGM. The next section highlights sustainable mining challenges in the ASGM sector.

2.2 Sustainable mining challenges in ASGM

Sustainable mining entails the integration of environmental, social, and economic considerations into all stages of the mining lifecycle and value chain, from exploration and extraction to closure and post-closure (Bilham, 2021). Sustainable mining seeks to minimise the negative impacts of mining activities on the environment, communities, and workers, while maximising the benefits for present and future generations. Achieving sustainable mining, however, is largely contingent upon combined efforts from governmental agencies, the operators themselves, and other connected stakeholders including international bodies.

The ASGM sector faces numerous social, economic, and environmental challenges, making it difficult to operate sustainably. Some stakeholders view ASGM as an undesirable activity to be eliminated or at least discouraged due to the significant social and environmental threat it poses. Nonetheless, ceasing ASGM operations is impractical and potentially unproductive, considering its extensive scope in terms of employment and the resources it generates (Ayuk et al., 2020). Rather, the focus should be on identifying and meeting the context-specific governance needs of ASGM that can improve ASGM structures and livelihoods and address other environmental and social impacts (Hilson et al., 2016). The literature underscores the significance of ASGM for livelihoods but stresses the need for sustainable practices to address its negative environmental, social and economic impacts (Baffour-Kyei et al., 2021). Experts, governments, and donors globally consider that formalising the sector is essential to improve governance (Geenen, 2012; Hilson et al., 2019) and perhaps a crucial step toward making ASGM a sustainable livelihood and mitigating its associated problems.

However, the literature on ASGM in Ghana and beyond has largely focused on socio-environmental impacts (Achina-Obeng and Aram, 2022; Damonte et al., 2013; Dondeyne et al., 2009; Famiyeh et al., 2020; Owusu et al., 2019), health hazards (Donkor et al., 2006; Kwaansa-Ansah et al., 2010), and some regulatory challenges (Geenen, 2012; Hilson et al., 2019), often overlooking the potential for sustainable practices within the sector.

Few studies have examined the combined socio-economic and environmental impacts of ASGM, with examples from Ghana (Bansah et al., 2018; Obiri et al., 2016; Ofosu et al., 2020), Congo (Ingram et al., 2011), and Tanzania (Kitula, 2006). These analyses predominantly highlight challenges such as resource conflicts, depletion, health risks, and community displacement. However, there has been limited emphasis on the livelihood implications of these practices or on interventions that could promote sustainable mining. Studies that explore how ASGM could be structured to not only mitigate its negative impacts but also improve the livelihoods in mining communities are limited. Understanding how to integrate sustainable practices into ASGM could contribute to poverty alleviation, community development, and environmental conservation. Yet, the discourse remains fragmented, underscoring the need for more comprehensive research focusing on understanding strategies to enhance livelihoods, foster formalisation and regulatory compliance, and ensure environmentally responsible ASGM practices

This thesis asserts that sustainable ASGM should involve a thorough evaluation of sustainability issues not only during the mining operation phase but throughout the entire ASGM value chain. By adopting this holistic approach, we can identify and address critical gaps in a logical and systematic manner, thereby avoiding reactionary, short-term and unsustainable solutions. This comprehensive evaluation is crucial to ensuring that interventions are well-informed and effective, promoting long-term environmental stewardship, social equity, and economic viability within the ASGM sector.

In Ghana, ASGM operations have received increased attention from international bodies and government agencies over recent years, but the sector remains largely informal and faces diverse sustainability challenges (Amankwah and Anim-Sackey, 2003; Bansah et al., 2018; G. Hilson, 2002). Informal practices which often manifest as gold rush activities, as currently being practised, are less likely to shape sustainable ASGM because miners' income is unlikely to be invested in other economic undertakings locally (Kumah, 2022). Further investigation into Ghana's governance measures to mitigate the negative effects of ASGM and to help the industry develop more sustainably is necessary.

Given that the pathways to a sustainable future will also depend on the provision of mined resources, it makes the relationship between mining and sustainability a complex one

(Bilham, 2021). The mining industry is deeply linked to global supply chains. Sustainable ASGM holds the potential to create a positive ripple effect throughout numerous industries and communities, encouraging a better balance between development and preservation (Zvarivadza, 2018). However, governance approaches to ensure sustainable ASGM are limited, and contributions to the literature on governance strategies that can enable sustainable ASGM is important. To effectively engage and implement sustainable practices, it is essential to thoroughly grasp the challenges that impede sustainable ASGM. With this understanding informed strategies for sustainable practices can be recognised and effectively applied. The challenges in achieving the sustainable ASGM is explored by analysing livelihood trajectories associated with ASGM (Chapter 4), the intersections between ASGM and agriculture, and the underlying factors shaping these dynamics (see Chapter 5). Additionally, the legal framework along ASGM value chain and policy coherence across sectors pertaining to ASGM governance is examined, with a view to informing policies and governance strategies that foster sustainable ASGM (Chapter 6). Based on the findings in Chapters 4, 5 and 6 guiding interventions aimed at supporting sustainable rural livelihoods, facilitating harmonious coexistence between agriculture and ASGM, and enabling ASGM are drawn out in Chapter 7. Given the complex array of challenges within ASGM, the study is conducted using a conceptual framework that integrates Sustainable Livelihoods Analysis (SLA) and livelihood trajectories. It also incorporates the concept of formalisation examined across the ASGM value chain, and policy coherence with investigations conducted across multiple sectors. Literature on the concepts of sustainable livelihoods approach and livelihood trajectories are drawn out in Sections 2.5 and 2.6 respectively. Before then Section 2.3 delves more into the similarities and differences between informal, and illegal ASM and Section 2.4 reviews formalisation efforts and challenges towards sustainable ASGM.

2.3 ASM informality and illegality

Most ASM miners operate without the necessary legal permits, placing them within the informal economy. However, in many regions ASM workers are required to secure licenses to operate legitimately. Unlicensed and licensed operators often interact, compete for the same resources, and aspire to access the same support services, underscoring the interconnectedness of formal and informal sectors in ASM. Miners who operate without licenses are often referred to either as informal or illegal miners, due to the informal sector often associated with illegality. Although informality and illegality are closely related and often used interchangeably, there are contextual distinctions that need understanding to develop appropriate policies for the sector (Pein, 2022). Figure 2.1 shows the differences and connections among formal, informal and illegal ASM activities.

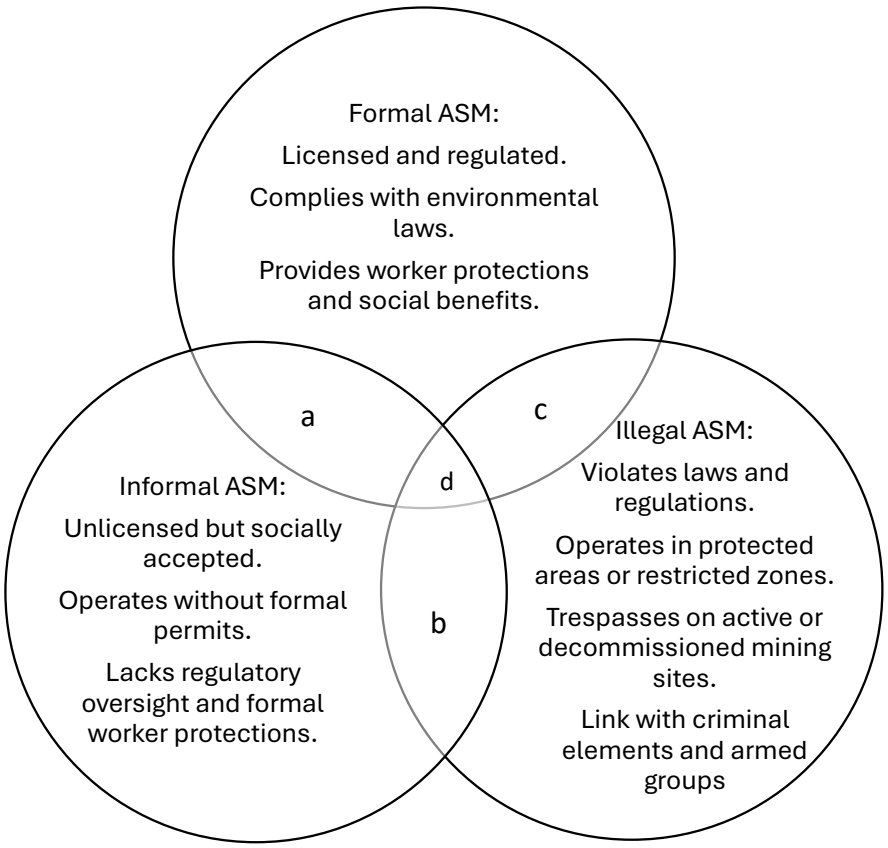

Fig. 2.1 Differences and connections among formal, informal and illegal ASM.

Legend

a: Connections between Formal and Informal ASM:
Both contribute to livelihoods and local economies.
In some cases, informal ASM can transition to formal status with appropriate support and regulation.

b: Connections between Informal and Illegal ASM:
Both often involve unlicensed operations.
Lack compliance with regulatory frameworks.

c: Connection between Formal and Illegal ASM:
Overlaps can occur if regulatory breaches happen within otherwise formal operations.

d: Connection shared by all three:
Reliance on ASM as an economic activity and a source of income for communities.

There are two main types of informal mining. First, mining that takes places outside an '*applicable* legal framework' (Buxton, 2013). This occurs when regulations and policies do not specifically address artisanal mining (Marshall and Veiga, 2017). For example, Ghana's Minerals and Mining Act 2006 only recognises small-scale mining. As a result, artisanal miners operate in a space without regulations that specifically address their activities, potentially rendering their ASM operations illegal.

The second main type of informal mining is mining *outside* of an existing 'appropriate legal framework' (Buxton, 2013). Here, miners operate without complying with existing regulations mostly because they find the legal obligations too onerous. Consequently, mining operators are unable to obtain legal authorisation for their activities and instead operate without the necessary permits. Without this required legal authorisation, their mining operations are unequivocally illegal (Buxton, 2013). For instance, the Democratic Republic of Congo's Mining Code, 2018 requires authorisation for mining activities, but many ASM operators do not obtain the necessary permits, making their operations illegal (Buxton, 2013; Geenen et al., 2021).

The overlap between informal and illegal mining is evident when miners contravene the legal framework, thus committing a crime. However, questions arise about the legitimacy of operating outside a framework that does not adequately address ASM activities. In some cases, a lack of political will to create appropriate frameworks for legalising ASM results in continued informal and illegal operations (Abdulai, 2017). The informal status of the ASM sector often persists due to a lack of political will, which can be driven by issues such as money laundering, tax evasion, corruption, and other illegal activities. This unregulated space allows governments to avoid scrutiny, perpetuating informality and illegality in the sector. In SSA, some governments avoid acknowledging and supporting ASM activities, keeping them in the informal and illegal realms (Hilson et al., 2019).

Overall, informal mining generally refers to ASM activities outside the legal framework, where miners lack required permits but often have a social license or legitimacy to operate, granted by local communities, and may also receive tacit government acceptance (IGF, 2018). While informal mining operates without legal access to land or minerals, it is not necessarily tied to criminal activity (Singo and Seguin, 2018). Illegal mining, in contrast, often involves the extraction of minerals without the proper permits or licenses in protected areas like national parks, forest reserves or water bodies, and on concessions owned by others, including active or decommissioned sites operated by large-scale mining companies, and may include organised criminal elements or links to armed groups, as seen in South Africa (Singo and Seguin, 2018). Formal miners may also engage in illegal mining activities if they breach the terms and conditions outlined in their licenses and permits.

There are instances in SSA where small-scale miners operate within a legal framework, complying with legal conditions, obtaining necessary permits, paying taxes, and adhering to environmental and social regulations, as can be found for instance in South Africa (Pein, 2022). However, informality remains a defining feature of the ASM sector. In this thesis, the term 'informal' refers to miners operating outside the legal framework. Teschner (2012) observed that in Ghana's ASGM sector, registered and unregistered actors operate similarly, with formal and informal supply chains deeply intertwined, highlighting that legal and illegal actors should not be equated with formal and informal economic activities. While this finding was not discussed within the context of sustainable ASGM, understanding the dynamics of informal ASGM including its underlying factors is necessary to promote sustainable ASGM. Through a focus on livelihood trajectories, the interactions between mining and agriculture and policy coherence in informal ASGM, this study provides fresh insights, crucial for developing effective policies for sustainable ASGM.

2.4 Formalisation efforts and governance mechanisms for sustainable ASGM

2.4.1 Calls and motivations for ASGM formalisation

Since the mid-1990s, formalisation has gained much support in SSA from donors, multilateral agencies, and governments as a key intervention to check illicit activity and curb related social and environmental ills in the ASGM sector (Hilson et al., 2022, 2017). The African Union developed the African Mining Vision (AMV) policy framework in February 2009. It aims to promote continental harmonisation of the mining framework, including the ASGM sector, to ensure equitable and transparent exploitation of Africa's mineral wealth. It aspires to create sustainable and well-governed mining sectors that are safe, foster broad-based sustainable socioeconomic development, and which are environmentally friendly and socially responsible. These goals have also been advocated by many scholars (Hilson et al., 2017; Hilson and Hilson, 2015; Martinez et al., 2023). Despite these aspirations, the objectives of the AMV have not been achieved yet. ASGM predominantly retains its informal nature, and efforts to formalise it at both country and regional levels in SSA and elsewhere remains elusive.

Over the past four decades, several perspectives on informality have emerged, many of which provide insights into the rapid growth and composition of ASM in SSA (Hilson and Hilson, 2015). Most of these perspectives can be categorised into three dominant schools of thought regarding the nature and composition of the informal sector: *Dualist, Structuralist, and Legalist* (Chen, 2016; De Soto, 2000). Each school offers unique, often contrasting views on why informal economies emerge. Notably, all these narratives are relevant to understanding informal ASM in SSA (Hilson and Hilson, 2015).

The Dualist School posits that the informal sector comprises marginal activities that provide income and a safety net for the poor. This perspective sees informal economies as distinct, operating in their own space, emphasising its incompatibility with modern capitalist norms with few, if any, linkages to the formal sector (Chen, 2007). The growth of ASM in SSA is largely poverty-driven, aligning with the Dualist view that informal activities arise to support individuals during times of economic hardship. According to Dualists, the informal sector

operates separately from the formal economy, driven by broader economic changes and an imbalance between employment growth and population growth (Chen, 2016; Hilson and Hilson, 2015).

The Structuralist School, emerging in the 1970s and 1980s, views the informal economy as subordinate to the formal economy but intrinsically linked and interdependent. Proponents argue that the informal sector exists due to the structure of the capitalist world economy, where firms in the formal sector reduce labour costs and increase competitiveness by exploiting informal labour (Chen, 2016, 2007). This school explains the enabling conditions for the informality of ASM in SSA. Governments in the region have prioritised the growth of large-scale, capital-intensive mining, only moving to formalise ASM after establishing a policy framework for large-scale operations (Hilson et al., 2022).

The Legalist School, notably associated with De Soto's (2000) work on the 'extralegal' economy, has become the dominant perspective. It emphasises the relationship between the formal regulatory framework and the informal economy (Davidson, 1993). Legalists argue that the informal sector comprises plucky micro-entrepreneurs who operate informally to avoid the cumbersome and costly procedures of formal registration (De Soto, 2000). According to this view, a hostile legal system forces individuals to create their own informal norms and operate outside the legal framework (Chen, 2016). Legalists contend that poor people in developing countries possess assets lacking legal representation due to their existence in the informal sector. This absence of legally acknowledged property rights restricts their ability to generate additional value and denies economic freedom to many. They believe empowering the poor would be possible if informally held assets were converted into formal assets, emphasising the acquisition of legal title as the all-important key that, by itself, can lead to economic growth and poverty reduction (De Soto, 2000). This approach, which promotes private property rights and deregulation, has gained traction among major international organisations like the World Bank and International Monetary Fund (Bromley, 2009). However, a major weakness of the legalist view is its reliance on legal title as the sole key to unlocking access to a pre-existing, fully functional free-market system. It overlooks that access free-market system is also influenced by robust state and market institutions (Siwale and Siwale, 2017). Some scholars criticise this kind of formalisation, asserting that having a land title does not guarantee access to credit. They argue that lenders consider factors

beyond land title, such as the borrower's ability to repay, associated risks, and project feasibility (Musembi, 2007; Williamson, 2015).

Although most scholars agree upon the need for formalisation, their perspectives differ over its meaning and the most appropriate processes to achieve formalisation (Spiegel, 2015). Essentially, views on formalisation can be categorised as either 'narrow' or 'broad' (Siwale and Siwale, 2017, p.192). The 'narrow' view is associated with the legalist school. In the context of ASM, formalisation efforts have largely followed the legalist view (Siwale and Siwale, 2017), with many countries drafting or adapting mining laws to recognise ASM and enforce mineral and tenure rights. This has led to various forms of legalisation or formalisation, whereby mining leases and environmental permits are issued (Salo et al., 2016). Proponents argue that mining licenses create mutual benefits for governments, miners, and the environment, where miners gain rights to land and minerals, enabling them to use their assets as collateral in credit markets, while their registration as legal entities require them to adhere to regulations, such as environmental protection and tax compliance (Siegel and Veiga, 2009). However, the prevalence of informal ASM in Ghana and SSA indicates that legal titles alone do not guarantee accountability, and effective formalisation for sustainable ASGM requires more than just legal documentation and property rights. A deeper understanding of local contexts and dynamics is essential. The 'narrow' view, while providing an essential foundation through legal recognition, risks oversimplifying the challenges miners face by neglecting systemic issues like weak institutions and limited market access.

Scholars who adopt a 'broader' understanding of formalisation concentrate on the process of registering, organising, tracking, and supporting the ASM sector (Heemskerk, 2002; Siegel and Veiga, 2009). Formalisation in this sense is understood as an effective intervention strategy, where the focus is not simply on the presence of legislation but on its activation and enforcement by authorities. This provides a more comprehensive view with title acquisition as an initial step, paving the way for ASM development (Siegel and Veiga, 2009; Siwale and Siwale, 2017). This study adopts this 'broad' view, taking a range of stakeholders into account other than the miners themselves. This approach aligns more effectively with sustainable

ASGM because it considers legal recognition and addresses the broader socio-economic and environmental factors and structural challenges critical to the sector's sustainability.

2.4.2 Challenges to ASGM formalisation

ASGM formalisation efforts are widespread in SSA and elsewhere, with Mongolia leading efforts in the Asia-Pacific, while Peru boasts the highest number of licensed miners in Latin America (Martinez et al., 2023). ASGM formalisation faces challenges in SSA, primarily due to inadequate laws and policies that governments fail to address, which often can lead to uneven distribution of benefits, reinforcing existing inequalities and power dynamics, particularly when licensing costs and bureaucratic hurdles are prohibitive for the poorest miners (Hilson, 2020). In Ghana, for instance, despite the government's efforts to legalise and regulate the ASGM sector, informal mining remains widespread (Kumah, 2022; Teschner, 2012). Similarly, in Zimbabwe, formalisation policies have primarily benefited politically connected elites, reinforcing patronage systems and excluding the majority of ASGM miners (Mkodzongi and Spiegel, 2019). In Uganda, even ASM operators who have secured titles and basic tools struggle to obtain loans, underscoring the financial barriers that persist despite formalisation efforts (Siegel and Veiga, 2009).

Numerous factors contribute to the frequent failure of formalisation policies in the ASGM sector in Ghana and SSA more widely. These include the destructive influence of partisan politics and polarisation (Abdulai, 2017), pervasive corruption (Crawford and Botchwey, 2017), the entrenched rent-seeking behaviour of government officials, which undermines trust between miners and state authorities (Hentschel et al., 2002; Hilson et al., 2021), the lack of capacity to enforce existing laws, and the prioritisation of large-scale mining expansion (Tschakert, 2016; Van Bockstael, 2014). Despite various explanations offered by scholars (Fold et al., 2014; Hilson and Potter, 2005; Kumah, 2022; Verbrugge, 2015), the persistent shortcomings of these policies are rooted in complex and interrelated factors, revealing deep systemic issues rather than isolated challenges. The disjointed approach to policymaking, characterised by fragmented efforts that fail to address the interconnected challenges of the ASGM sector, is often unable to address the systemic barriers to sustainable ASGM. While policy coherence framework in ASGM formalisation has the potential to address challenges associated with disjointed policymaking, this concept has not been investigated in the ASM

literature, a requiring a closer examination. Policy coherence is reviewed further in Section 2.4.5.

2.4.3 Context of ASM formalisation efforts in Ghana and prevailing challenges

The formalisation of Ghana's ASM sector, initiated in 1989, marked a significant milestone in SSA. Supported by international donors, including bilateral agencies, the World Bank, and the UN, this effort led to the passing of critical legislation in 1989 such as the Small-Scale Gold Mining Law, Mercury Law, and the Precious Minerals and Marketing Corporation Law. This legal framework aimed to integrate ASM into the formal economy, making Ghana the first country in the region to fully legalise its ASM sector.

In 1991, the Ghanaian government, with support from the German Technical Cooperation Agency (GTZ), launched the Small-Scale Mining Project (SSMP) to further institutionalise ASM formalisation. This project involved four key government institutions: 1) The Minerals Commission, where a Small-Scale Mining Unit was established to manage ASM licensing; 2) The Precious Minerals and Marketing Corporation (PMMC), responsible for purchasing gold and diamonds from small-scale miners; 3) The Mines Department, tasked with overseeing industry health and safety; and 4) The Geological Survey Department, authorised to prospect and demarcate mineral-rich land for the sector (Barry, 1996; Hilson and Potter, 2005). To streamline the licensing process, the government established eight district centres in key mining regions, staffed by officers from the Minerals Commission and Mines Department: Tarkwa, Enchi, Bibiani (Western Region), Akim Oda, Kibi (Eastern Region), Assin Fosu, Dunkwa (Central Region), and Konongo (Ashanti Region). These centres were intended to provide essential support services, including a finance scheme, such as the US$87,000 seed money from then GTZ, and equipment rentals to encourage the growth of the small-scale mining sector (Hilson et al., 2022).

Despite these efforts, formalising ASM in Ghana has faced significant challenges, raising critical questions about the sustainability and inclusivity of these initiatives (Kumah, 2022). A major issue has been the reliance on external funding and the centralisation of decision-making within specific governmental institutions. This approach has shaped the sector's trajectory and sustainability, with these key institutions often prioritising large-scale mining

over ASM (Hilson et al., 2022; Teschner, 2012). Consequently, while Ghana has secured hundreds of millions of dollars in annual revenue from mining, the ASM sector has been marginalised.

The Minerals Commission, responsible for assessing license applications for both large-scale and small-scale mining, exemplifies this bias towards large-scale mining. Its mandate includes to build relationships with investors and promote large-scale mining projects, and thus has facilitated extensive land allocation for large-scale mineral extraction, encouraged by favourable government incentives (Hilson and Potter, 2005). This bias, coupled with the failure of the Small-Scale Mining Project to integrate with Ghana's broader economic goals, undermined its effectiveness and ultimately derailed subsequent donor-led efforts to formalise ASM in the country. The Small-Scale Mining Project in less than a decade after its establishment, was barely recognisable (Hilson et al., 2022).

The establishment of district centres and support services, while necessary, has not fully addressed the underlying challenges faced by small-scale miners, such as access to technology, fair market prices, and environmental concerns. The ongoing evaluation of these efforts is essential to ensure that the ASM sector can contribute meaningfully to Ghana's economic development while safeguarding the rights and livelihoods of the miners involved.

Ineffective management of ASM by the Minerals Commission poses a significant formalisation challenge, as its executives are key contacts for funders. As a semi-autonomous unit, it is a preferred partner for most donors, including the World Bank. The Precious Minerals and Marketing Corporation's dual approach of purchasing gold from both licensed and unregistered miners has further complicated formalisation efforts. While this practice aimed to reduce gold smuggling, it has inadvertently allowed illegal mining activities to persist. Additionally, the then Mines Department, essential to the daily operations of the district centres, was barely functional. The restructuring of key government institutions following the enactment of the Minerals and Mining Act 2006 (Act 703) included the absorption of the Mines Department into the Minerals Commission, transforming it into the Inspectorate Division of the Minerals Commission. However, the centralisation of licensing decisions in Accra has reduced the influence of district officers, who could otherwise facilitate the registration process for ASM operators (Hilson et al., 2022).

Geological knowledge is crucial for effective ASM formalisation strategies, so the Geological Survey Department was expected to play a vital role in the Small-Scale Mining Project. However, it has often been sidelined, partly because it has not been a semi-autonomous entity like the Minerals Commission. Funds for prospecting and designating areas have been inconsistent, inadequate, and typically passed through the Commission before reaching the Geological Survey Department. The outlook improved with the establishment of the Ghana Geological Survey Authority under the Ghana Geological Survey Authority Act 2016 (Act 928), as a semi-autonomous entity. Despite this, it remains severely under-resourced (Hilson et al., 2022).

The complex bureaucratic licensing process, compounded by the introduction of environmental permits in 2001 and water use permits in 2009, has further discouraged many miners from pursuing formal licenses. The involvement of the Environmental Protection Agency (EPA) and the Water Resources Commission in the licensing process, backed by the respective Environmental Assessment Regulations, 1999 (LI 1652), and Water Use Regulations, 2001 (LI 1692), while necessary to address environmental concerns, has added layers of complexity, making formalisation even more challenging.

Despite ongoing donor support, including significant investments from the World Bank and UN, formalising ASM in Ghana remains challenging. The sector's persistent informality underscores the need for a more decentralised and integrated approach to address systemic issues and bureaucratic complexities to support a sustainable ASGM sector. These challenges reflect broader difficulties across SSA, where about 80% of ASM operations remain unlicensed despite over three decades of donor pressure (Hilson et al., 2019; IGF, 2018). Research in various SSA countries, including Zimbabwe (Spiegel, 2015), Liberia (Van Bockstael, 2014), Niger (Hilson et al., 2019), and Senegal (Persaud et al., 2017), identifies common barriers such as complex bureaucracies, high permit costs, and inaccessibility to mineral-rich land. These trends highlight a disconnect between policymakers and donors' perceptions and the realities faced by ASM operators. The informality of ASM in SSA is not merely a byproduct of economic desperation but also a result of deliberate policy choices and structural barriers.

The Ghanaian government views informal ASGM (commonly termed galamsey) as a serious threat to the environment and resources. Over the years, the government has implemented a series of operations aimed at curbing informal ASGM, arresting offenders, and deterring

illegal activities. One of the key initiatives was the establishment of the Inter-Ministerial Task Force Against Illegal Mining in 2013, which included the Ministry of Lands and Natural Resources, the Ministry of Defence, and the Ministry of Interior. From March 2017 to December 2018, the government imposed a temporary ban on both formal and informal ASGM activities. During this period, "Operation Vanguard" was launched in July 2017—a Military-Police Joint Task Force supervised by an inter-ministerial committee—to combat illegal mining operations. Later, "Operation Halt II," launched in April 2021 and relaunched in October 2022, involved personnel from the Ghana Armed Forces with the objective of removing all individuals and mining equipment from water bodies and forest reserves (Adu-Baffour et al., 2021; Eduful et al., 2020). The Ghanaian government also introduced the Community Mining Scheme (CMS) in 2019, aimed at decentralising ASGM operations and to reduce bureaucratic hurdles (Hilson et al., 2022).

Despite these efforts, informal ASGM continues to be widespread, with allegations of political actors' involvement further complicating the situation. Given the abundance of gold resources in Ghana and the high international gold prices, many individuals are willing to go to great lengths to extract these resources. As a result, the government's strategy of simply attempting to stop or combat illegal mining is likely to face significant challenges. At the same time, the ASGM sector in Ghana is undergoing a significant transformation. Once defined by the use of basic tools like spades, pickaxes, and chisels, the sector is now increasingly mechanised, blurring the lines between artisanal and small-scale mining. This shift is driven by an influx of urban and international investors attracted by high gold prices and profit potential, enabling substantial capital mobilisation into the sector. Today's ASGM sector is complex and sophisticated, deeply integrated into national and global networks with intricate, often unregulated, gold sourcing mechanisms. This evolution raises important questions about whether Ghana's existing legal framework and formalisation processes are equipped to address the sector's changing realities.

To be effective, the legal framework must cover the entire ASGM value chain, including from land acquisition and mining to processing, site reclamation, gold sourcing, and export. Without comprehensive reform, the sector risks remaining in a legal grey area, exacerbating regulatory gaps, environmental degradation, and the entrenchment of unregulated gold flows, which undermine both local economies and the global gold market. Given these

challenges, it is crucial to undertake a thorough review of Ghana's legal framework for ASGM. This review must be holistic, addressing not only traditional artisanal practices but also the emerging trends in mechanisation and investment that are reshaping the sector. Doing so can help policymakers develop strategies to create a regulatory environment conducive to the sustainable, equitable, and transparent management of gold resources, benefiting both the nation and the communities involved in ASGM. Chapter 6 of this thesis explores Ghana's legal framework along the ASGM value chain, identifying bottlenecks, and proposing strategies for a more sustainable sector.

2.4.4 Mechanisms to enhance governance efforts in ASGM

Scholars have proposed various solutions to address governance and formalisation challenges in the ASGM sector. These solutions include: enhancing technological dissemination and forming partnerships with researchers, consultants, and governmental agencies to improve prospecting, monitoring, regulation, and environmental auditing activities (Hilson, 2002); reducing hurdles involved in formalisation through approving sub-contracts to miner associations to allow artisanal miners to coexist with mineral title owners; increasing on-the-ground presence to provide education, training, and capital investment for adopting cleaner processing techniques in ASGM (Veiga and Marshall, 2019); and developing a framework to bridge the gap between informal ASM operators and government officials, facilitating dialogue, providing decentralised licensing platforms, supporting sector services, stimulating innovation, and holding stakeholders accountable (Hilson, 2020a). Sustainable ASGM should provide ongoing support to formalised miners to prevent the risk of reverting to informal practices. This support, as highlighted by Martinez et al. (2023) and Siegel and Veiga (2009), may include capacity building, access to financial resources, and market opportunities. However, current formalisation programmes are deemed unsustainable (Martinez et al., 2023).

The ASGM sector requires further understanding of interventions for sustainable ASGM that can enable better governance, enforcement, and implementation of laws and integration of key stakeholders for more sustainable ASGM development. This is dependent on appropriate public policies and regulations that address the complex aspects of ASGM activities concurrently and comprehensively. There is consequently a growing recognition among ASM

scholars of the need for more nuanced analysis of the vital role that institutions play in facilitating formalisation of the sector's activities (Martinez et al., 2023; Spiegel, 2012; Tschakert, 2016).

Objective three in this thesis responds to the growing need to understand complexities regarding institutions and governance of the ASM sector by examining Ghana's laws and regulations concerning ASGM's value chain, and the policy coherence between the mining sector and other critical sectors impacted by ASGM: land, agriculture, environment, water, and development. Findings are presented in Chapter 6. The study underscores that understanding the roles and challenges of government institutions in creating an enabling environment is key to comprehending why the governance process to ensure sustainable ASGM has faltered in many gold producing countries. As a country with complex legal frameworks and political stability, Ghana provides an important case study to provide useful and fresh insights into governance challenges to sustainable ASGM and development. Ghana's ASGM sector has received extensive attention in the literature, but the focus has tended to be on the impact of its activities on the environment, its socio-economic contribution, and its growing connection to livelihoods, except for few instances where governance was the focus (Adu-Baffour et al., 2021; Osei-Kojo et al., 2016). The next section reviews the literature on policy coherence.

2.4.5 Policy coherence

The concept of policy coherence refers to "an attribute of policy that systematically reduces conflicts and promotes synergies between and within different policy areas to achieve the outcomes associated with jointly agreed policy objectives" (Nilsson et al., 2012, p.396). Synergies here, also called 'win-win', refer to strengthening positive effects between objectives set under two or more policy areas. A key assumption underlying much policy coherence work is that ineffective, inequitable, and unsustainable development interventions are, in part, the consequence of fragmented, siloed, and therefore incoherent institutional and policy design (Nilsson and Weitz, 2019; OECD, 2016). Coherent policies are believed to enhance efficiency, reducing competition for the same budgets and resources (Akhtar-Schuster et al., 2011). Policy coherence is popular among development agencies, including the Organisation for Economic Co-operation and Development (OECD), which recognise the

need to make policies more attuned to development policy objectives, prompted by evidence of the negative effects of incoherent policy choices in developing countries (Brand et al., 2021). Policy coherence emphasises the need for improved coordination among sectoral departments and policy instruments to ensure that they support rather than undermine each other. The goal is to make coherence a central policy objective, requiring integration across national governments and various public decision-making sectors (Zeigermann, 2018).

Given the increased focus on sustainable development worldwide, there is a growing effort to develop or amend sectoral policies. However, questions arise whether these policies are coherent amongst themselves or whether they are contradictory and create significant trade-offs. For instance, Antwi-Agyei et al. (2017) assessed policy coherence between climate change adaptation, mitigation and development action in Ghana and found incoherence between sectoral policies due to weak institutional capacity that hindered coordinated policy action. Despite the recognised importance of integrating the ASGM sector into broader development frameworks (Martinez et al., 2023), research on policy coherence in the extractive industries sector, and particularly regarding ASGM, is lacking. Studies have shown that supportive policies in one sector can be rendered inefficient by unsupportive policies, instruments, and practices in others (Huttunen et al., 2014). Therefore, it is essential to determine whether different but related policies share common goals or if they contradict each other. Lack of policy coherence can be a significant obstacle to attaining sustainable ASGM, considering that ASGM activities intersect with various policy domains, including environmental protection, agriculture, and economic development. With better policy coordination and coherence, the ASGM sector can reduce duplication, fragmentation, and efficiently utilise limited resources to achieve common objectives. The investigation of policy coherence in the ASGM sector is undertaken (see Chapter 6) to fulfil objective 3 of this thesis.

Some scholars critique policy coherence for its managerial approach, challenging the apolitical view that policy incoherence stems solely from flawed institutional and policy design and that once correctly adjusted, can lead to a coherent state of development (Yunita et al., 2022). They contend this approach may prioritise administrative and procedural solutions over deeper political and structural issues (Brand et al., 2021; Yunita et al., 2022). Given the cross-sectoral nature of ASGM activities, which involve both state and non-state institutions,

understanding its policy coherence challenges requires considering not only administrative but also political and institutional factors. To address this, the study adopts a nuanced perspective that examines the political, social, and institutional dynamics shaping policy coherence in the ASGM sector. Additionally, policy coherence has been criticised for its lack of context sensitivity with policies and interventions that promote coherence often based on generalised frameworks or guidelines (Keijzer et al., 2024), as such this study emphasises local contexts, including the unique cultures of emerging ASGM communities, and the challenges faced by diverse stakeholders in Ghana's ASGM sector. Policy coherence initiatives may encounter inherent tensions and trade-offs between competing policy objectives (Yunita et al., 2022) and this study argues for stakeholder engagement to carefully negotiate such trade-offs. The approach for procedural and structural adjustments for policy coherence, should therefore occur within the context of acknowledging and addressing vested interests, power dynamics and politics involved in policy decision-making processes which are necessary requirements to ensuring sustainable ASGM.

Policy coherence studies have traditionally focused on either procedural aspects, such as policy-making processes (Kivimaa and Mickwitz, 2009; OECD, 2002), or on policy outputs (Harahap et al., 2017; Nilsson et al., 2012; Ranabhat et al., 2018). The latter approach examines policy objectives, instruments, and implementation practices (Nilsson et al., 2012). This thesis aligns with the latter perspective, where it examines policy coherence from both horizontal (across sectors) and vertical (across government levels) perspectives, focusing on policy objectives, measures, and their implementation mechanisms and challenges (see Chapter 6). This approach can help identify areas of potential conflict, synergy, and highlight gaps that may hinder governance processes for sustainable ASGM.

2.5 Conceptual frameworks for assessing ASGM as a livelihood activity

2.5.1 Sustainable livelihoods approach

The concept of livelihoods originated in the 1980s as a response to the era of single-sector, top-down development interventions and assessments, which generated disappointing results in devising effective policies to alleviate poverty. A livelihood comprises the capabilities, assets (including both material and social resources), and activities required for a means of living (Chambers and Conway, 1992). A livelihood is more than the daily transactions of market exchanges and household chores. It entails the management of social relationships, affirmation of personal significance and group identity, and the interrelations that exist. The Sustainable Livelihoods Approach (SLA) was developed in the 1990s (Scoones, 1998) and provides a people-centred, bottom-up and place-based approach that offers valuable insights into the activities that people engage in to make a living, and the assets – both material and social – that enable those activities (de Haan, 2017; Scoones, 2009, 1998). Originally developed to assess poverty, the SLA is premised on the assumption that people compose complex and dynamic livelihood portfolios under the influence of socio-economic, political, and climatic uncertainties and variabilities (Ellis, 2000).

2.5.2 Sustainable Livelihoods Framework

SLAs often use an instrument referred to as the Sustainable Livelihood Framework (SLF) (Fig 2.2), which visualises the main influencing factors affecting livelihoods. It links inputs (capitals or assets) and outputs (livelihood strategies), which are, in turn, connected to livelihood outcomes; that is, what people gain from what they do, manifesting from livelihood strategies. Assets are tangible and intangible resources that households draw upon to make a living (Bebbington, 1999) and are categorised as natural (e.g., land, minerals, and water), social (i.e., networks and associations), financial (including access to financial support, credit, savings or investments, and markets), physical (e.g., house, tools, and infrastructure), and human capital (e.g., skills, health, and education) (Scoones, 1998). The mix of assets and activities a household selects denotes the livelihood strategy (e.g., subsistence production, artisanal mining, off-farm waged labour) (Scoones, 1998). In pursuing livelihood strategies,

both access to assets and the use to which they can be put are mediated by transforming structures and processes (laws, policies, and institutions). Livelihoods are also affected by external factors, i.e., changing natural environment and complex social, economic, and political contexts, also called the 'vulnerability context,' comprising ''seasonality," ''trends'' and ''shocks'' (Allison and Ellis, 2001; Chambers and Conway, 1992; Ellis, 1999; Scoones, 1998). Scoones (1998, p.5) states that "…a livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base".

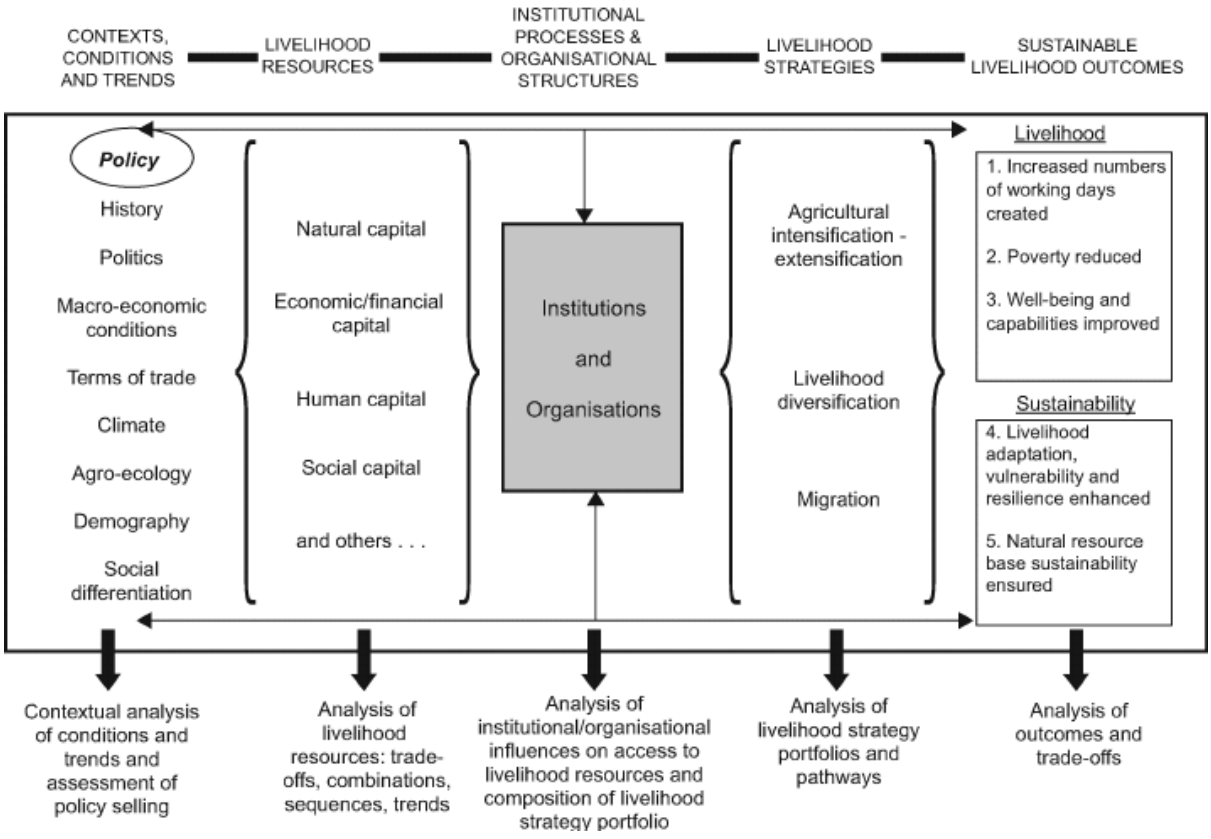

Fig. 2.2 The Sustainable Livelihoods Framework. Source: Scoones (1998, p.4).

A livelihood strategy can therefore be viewed as a dynamic negotiation process, involving the agency of households or individuals and the structural constraints of development, particularly in terms of their spatial context (Bebbington, 1999). This is pertinent to this thesis because both ASGM and other rural livelihood activities like agriculture entail negotiations over the utilisation of the same physical space. In essence, households must navigate their choices within the spatial dimensions of their environment, balancing their aspirations and capabilities with the opportunities and limitations imposed by the surrounding context.

The SLA reveals that the ability to make use of assets (entitlements) is delimited through formal and informal resource-regulation institutions, including social differentiation (biases such as indigeneity, gender, class, and caste) (Bebbington, 1999; Leach et al., 1999; Scoones, 1998). This is relevant to this thesis because in ASGM-affected communities, the ability of households to utilise assets can be influenced by institutional factors such as legal frameworks, customary practices, and social norms governing resource access. Social differentiation can further shape resource distribution and opportunities. For instance, marginalised groups may encounter barriers to land access and mining permits, limiting their participation in ASGM and its benefits. Furthermore, the impact of ASGM on agriculture and livelihoods, including land use changes and environmental degradation, can also be influenced by these institutional and social factors, leading to varying effects on different social groups. Understanding these dynamics is crucial for assessing the broader implications of ASGM on agriculture and rural livelihoods and devising more sustainable ASGM.

Most ASGM communities in Ghana exhibit relatively low levels of development, with households engaged in a range of primarily natural-resource-based livelihoods, relying heavily on the goods and services provided by the resources. The rapid growth of ASGM can severely impact forests, farmlands, waterways, and the livelihoods of ASGM communities. This can cause significant divergence in the livelihood opportunities available to households within these communities. The use of the SLA offers a broad framework for holistic investigation into ASGM's impact on livelihoods and its interactions with agriculture, which can provide valuable insights into the vulnerabilities and opportunities experienced by households and various livelihood groups. However, in this thesis the SLA was not solely used due to its associated criticisms. Popularised by the UK Department for International Development (DfID), the United Nations Development Program (UNDP) and NGOs such as CARE and Oxfam in the late-1990s, the SLA is deemed a valuable conceptual and programming framework for achieving poverty reduction in a sustainable manner within communities (Carney, 1998).

In the ASM context, the SLA gained traction as a demographic research tool following the 1999 launch of the UNDP's pilot study, "Focusing on Artisanal Mining Communities in sub-Saharan Africa". This project, conducted in Ethiopia, Ghana, Tanzania, and Mali, marked a pivotal moment in the application of SLA to ASM. Building on the UNDP's initiatives, DFID

commissioned a livelihoods and poverty reduction study in Ghana and Tanzania in the early 2000s. This study aimed to assess the economic contributions of ASM at the micro-level, explore the challenges faced by these communities, and develop policy initiatives to enhance their security and quality of life (CDS, 2004; Ofei-Aboagye et al., 2004). Similarly, the United Nations Department of Economic and Social Affairs (UNDESA) employed the SLA in its Support Service for Policy and Programme Development (SPPD Project RAF/99/023) studies, conducted between 2000 and 2003 in Ghana, Mali, Ethiopia, and Guinea. This project focused on crafting policies to promote sustainable livelihoods within the broader ASM community. It aimed to deepen the understanding of poverty in artisanal mining communities, evaluate the role of SLA in poverty eradication, and produce policy options and best practices for government, international non-governmental organisations, and civil society to implement at various levels (UNDESA, 2003). The World Bank also recognised the potential of the SLA, using it as the foundation for its baseline study, "Program for Improvements to the Profiling of Artisanal and Small-Scale Mining Activities in Africa and the Implementation of Baseline Surveys (47100)". This study, based on a review of 23 baseline studies across 15 African countries conducted between 1987 and 2002 (Noetstaller et al., 2004) sought to enhance the profiling of ASM activities and improve the effectiveness of baseline surveys.

Although these projects led to the growing recognition of SLA as a promising framework for examining ASM-related poverty reduction and sustainable development within these regions (CDS, 2004), these studies did not catalyse its widespread adoption in understanding ASM livelihoods. Despite the potential utility of the SLA to offer a detailed and more rounded understanding of livelihood opportunities and challenges linked to ASM activities, these various development agencies' projects largely centred on examining the impacts of ASM, emphasising economic data and highlighting the economic impacts (Scoones, 2009). There was little exploration or understanding of the underlying social, cultural, environmental and political factors that together with economic aspects shape ASGM activities. These projects also did not focus on exploring these factors across scale.

A critical observation about the ASM sector is its vast diversity, which varies between and within countries, types of minerals, extraction and processing methods, marketing arrangements, political economies, and socio-economic structures. This diversity necessitates

context-specific strategies to reduce vulnerability and improve livelihoods for ASM workers at both the national and local levels. Effective policy interventions must address not only the 'what' but also the 'how,' requiring a thorough analysis of the political economy, institutional environment, and the micro-realities faced by those in the sector. Only then can locally owned and sustainable policies be developed. The SLA is a valuable tool for assessing these dynamics, as it focuses on the livelihoods of the poor and seeks to connect local realities with policy-making processes (Brocklesby and Fisher, 2003; Ofei-Aboagye et al., 2004). The SLA offers a holistic perspective on poverty, considering factors such as lack of assets, poor access to services, institutional shortcomings, and vulnerability (Ashley and Carney, 1999). It also examines how government and private sector structures influence livelihood strategies aimed at achieving better outcomes, such as higher income and reduced vulnerability.

However, the SLA has not been extensively applied in the ASM academic literature. It has not gained significant traction within scholarly debates to analyse and understand ASM livelihood activities. This can be attributed to a shift in focus in the past decades by donors and international organisations toward the environmental impacts of ASM, including mercury contamination, along with the sector's challenges being increasingly viewed through the lens of formalisation. This shift in priorities has steered the ASM academic literature toward impact assessments and governance, diverging from the livelihood-centric perspective of the SLA. This has left a notable gap in research. This thesis seeks to address this gap by applying the SLA to examine opportunities and challenges associated with ASGM, its impacts on other livelihoods, and the diverse factors across scale that drive and shape these dynamics and ASM informality (see Chapters 4 and 5). Understanding these dimensions is crucial for developing policies that promote ASGM formalisation for sustainable ASGM. The thesis thus highlights the usefulness of SLA application in ASM studies.

2.5.3 Criticisms of the sustainable livelihood approach

Despite its utility and widespread use beyond ASM, the SLA has been criticised for prioritising the economic aspects of decision-making, given the more direct applicability of economic data to quantitative analysis and distribution of findings (de Haan, 2012; Scoones, 2009). Hence, the tendency has been to sideline the "complex processes requiring in-depth qualitative understandings of power, politics, and institutions" (Scoones, 2009, p.178).

Limitations of the livelihood approach include: failure to address power relations; temporal limitation, as it only captures a snapshot analysis of livelihood activities at a specified time, neglecting historical legacies and long-term trends that shape livelihood strategies and outcomes; too narrow a focus on the local scale and thus may not adequately account for the impact of wider global processes on livelihood activities; and a lack of consideration of networks and linkages, thus overlooking the interrelation between different levels of governance and networks, which can influence livelihood opportunities (de Haan and Zoomers, 2005; Scoones, 2009). This study addresses aspects of the shortcomings of the SLA by utilising the concept of livelihood trajectories; that is, considering the directions that livelihoods follow over time (Bagchi et al., 1998; Sallu et al., 2010). Applying an integrated SLA and livelihood trajectory approach to a study of ASGM's rise in Ghana addresses the limitations considering the broad and dynamic social, political, economic, and environmental processes that have shaped the current livelihood context of households.

2.5.4 Livelihood trajectories

A livelihood trajectory is defined as "…the consequences of the changing way in which individuals construct a livelihood over time" (Bagchi et al. 1998: p.457). Trajectories rarely exhibit one-off decisions and are more often a culmination of actions with greater or lesser strategic intent (van Dijk, 2011). The livelihood trajectory approach allows exploration of the life histories of individual households regarding how present conditions have emerged and evolved over time and for whom, as well as the strategic behaviour that underpins their changing livelihoods (de Haan and Zoomers, 2005). Livelihood trajectories help to understand the differential and potentially unequal effects of new livelihood strategies and to determine people's capacity for action and decision making (Orchard et al., 2016; Trung Thanh et al., 2021), providing valuable insights necessary for understanding the prospects, constraints, and potential windows of opportunity for future development (Trung Thanh et al., 2021).

For example, households in ASGM communities may engage in multiple livelihood activities and strategies simultaneously – strategically or unplanned – in response to intertwined present and future needs and aspirations shaped by wider social, cultural, political, and economic factors operating at multiple scales. Relational aspects can impose demands, expectations, desires, and duties that mediate opportunities, and the nature and trajectory

of livelihood activities (van Dijk, 2011). De Haan and Zoomers (2005) indicate the broader socio-political patterns of livelihood activities, acknowledging that livelihoods emerge not as rational responses to future certainties, but as incremental outcomes of behaviour embedded in a historical repertoire of possibilities through influence of other actors and structural constraints (Trung Thanh et al., 2021).

The concept of livelihood trajectories has been broadly applied across various sectors, such as agriculture (Sallu et al., 2010; Volpato and King, 2019), fisheries (Mellado et al., 2019; Trung Thanh et al., 2021), and mangrove ecosystem services (Orchard et al., 2016). Although ASM communities are complex with environmental, socioeconomic, and institutional dynamics playing crucial roles in shaping livelihood outcomes, the application of livelihood trajectories in the ASM sector is limited, with recent contributions primarily from Hilson and Hu (2022) and Hilson and Maconachie (2020).

While ASGM is often promoted as a means to create jobs and enhance the livelihoods of rural communities, the notion that one activity, like ASGM, can directly shape the course of livelihood trajectories is overly simplistic. Livelihood outcomes in ASM communities are highly contingent on various factors, including household capabilities, local ecological conditions, and broader political and economic contexts. These factors interact in complex ways, meaning that the impact of ASGM on livelihoods is neither uniform nor predictable. While some households may experience positive outcomes from engaging in ASGM, others may find themselves more vulnerable due to environmental degradation, entrenched cultural norms or fluctuating gold prices. Understanding the temporal dimension of livelihood trajectories is therefore essential. Rather than viewing livelihoods as static snapshots, it is crucial to consider how they evolve over time and across different contexts. This perspective allows for a more nuanced understanding of the sustainability of ASGM practices and their long-term impact on rural development. Research should, therefore, focus on the heterogeneous and context-dependent nature of these trajectories, considering how different drivers of change interact with each other over various timescales, such as over the next decade or across a lifetime.

Understanding the relationships between drivers of change and livelihood trajectories in ASM communities is essential for policies aimed at promoting sustainable ASGM. Without a deeper analysis of how these trajectories are shaped by local and external factors, policies may fail

to address the underlying causes of vulnerability and inequality. Consequently, a critical evaluation of the livelihood trajectory approaches adopted by local people is needed, drawing on an empirically grounded analysis to ensure that ASM sustainability policies are both effective and equitable.

This thesis posits that the development of ASGM in communities may have uneven distributional impacts with some people experiencing positive and others negative changes in their livelihoods. As such, local equity may be undermined or existing inequalities may worsen upon the arrival of ASGM. The use of the livelihood trajectory approach in this study, alongside the SLA, enables close examination of the dynamic links between ASGM and other rural livelihoods across multiple scales – households and community (see Chapter 4).

2.6 The impacts of ASGM on livelihoods

The literature reveals that the impact of ASGM on livelihoods in mining communities is complicated. ASGM is regarded as an important rural source of livelihood which presents the ability to quickly accumulate assets (usually financial and physical capitals) and support families, presenting better income opportunities than other rural livelihood options, such as subsistence farming, at least over the short term (Pedersen et al., 2021). ASGM also has the capacity to complement other livelihood strategies, primarily small-scale agriculture and pastoralism, as many farmers can work in mines during agricultural off-seasons and income from ASGM can be invested in agricultural inputs such as fertilisers (Banchirigah and Hilson, 2010a). It can also enable establishment of other non-farm livelihoods that are not mining-related e.g. trading and food vending (Hilson, 2016a).

Despite the socio-economic incentives and the multiple livelihood opportunities linked to ASGM, its informal nature characterised by the influx of migrant miners and environmentally unfriendly approaches, also means that it has high tendencies to adversely impact other livelihoods e.g. trade, farming, wood carving, weaving, hunting, fishing, fruits, picking of nuts and herbs and many more in ASGM host communities and beyond. However, existing literature presents a snapshot assessment of the impacts of ASGM on livelihoods (Arthur et al., 2016; Baffour-Kyei et al., 2021; Banchirigah, 2008; Ontoyin and Agyemang, 2014; Osumanu, 2020). There is lack of clarity on the temporal dimension of ASGM's impact, and

little understanding of social-economic, political and environmental factors that are embedded in history, influencing individuals and households' capabilities to tap into ASGM opportunities or deal with associated barriers. It remains unclear how ASGM impacts different livelihoods groups in communities and how underlying factors shape livelihood trajectories. Objective one of this thesis addresses this gap by using an integrated SLA and livelihood trajectories framework to explore ASGM's impact on livelihood trajectories. The findings are presented in Chapter 4.

2.6.1 Perspectives on ASGM and smallholder farming relationships

ASGM often intersects with agriculture given that ASGM mostly occurs in rural areas where agriculture is prevalent. Existing scholarship has outlined that ASGM has a complex relationship with agriculture. ASGM can have complementary relationships with agriculture, whereby it can provide farmers with opportunities to diversify into ASGM or its related support services (Chigumira, 2018; Hilson, 2016a; Hilson and Garforth, 2012; Kamlongera, 2011; Maconachie, 2011; Mkodzongi and Spiegel, 2019; Okoh and Hilson, 2011). In this instance, farmers can shift into ASGM using income from existing agriculture and can similarly invest ASGM earnings into farming and agribusiness to revive or boost productivity. The influx of migrant workers into ASGM communities also provide a market for farmers because of increased demand for food crops.

The relationships between ASGM and agriculture can also, however, be competitive. This competition arises from the shared demand for resources such as land, water, and labour, potentially leading to increased farm invasion and degradation of land and water resources due to the environmental externalities associated with ASGM activities (ACET, 2017; Ferring et al., 2016; Hausermann et al., 2018; Snapir et al., 2017). Farmland and existing farms can be lost to ASGM operations in areas where the two activities overlap, disrupting food systems and trade networks and displacing farmers through outright dispossession of farmland, with or without compensation.

Existing studies on the interaction between ASGM and agriculture have primarily focused on describing the benefits or drawbacks experienced by miners and farmers. Studies have not undertaken a comprehensive examination of the relationship between ASGM and agriculture

across multiple levels. Consequently, there is presently insufficient understanding of the diverse factors that underpin and influence the complementary or competitive nature of this relationship. For instance, it is unclear whether any demonstrated complementary relationships result from intentionally designed conditions or simply have emerged organically and informally. Similarly, it remains uncertain whether the benefits from complementary relationships outweigh the costs associated with competitive ones within communities, or vice versa.

Given the expanding scope of ASGM and its growing connections with agriculture, it is imperative to examine their relationship in a comprehensive manner. Understanding the various circumstances that drive both complementary and competitive dynamics is essential. This approach can facilitate exploration of governance schemes that can reorient stakeholders and ultimately promote a more mutually beneficial coexistence between these two livelihoods. As a result, this thesis addresses these research gaps by utilising SLA to conducting a detailed examination of the interactions between ASGM and agriculture in Ghana, which is presented in Chapter 5. This investigation spanned various scales, including household, community, and institutional levels, and involved multiple stakeholders beyond miners and farmers.

Chapter 3. Research design and methodology

3.1 Overview

This chapter provides a broad overview and justification of Ghana and Atiwa West District as the study area. It explains the research design, including the qualitative and quantitative data collection methods, sampling techniques and data analysis methods used. It also addresses issues related to positionality, risks, ethics, and limitations.

3.2 Ghana - the study area

Ghana is in West Africa, close to the equator at latitude 11.50N and 4.50S and longitude 3.50W and 1.30E (Environmental Protection Agency, 2020) and is divided into 16 administrative regions. With a total land area of 238,535 km^2, the country has a tropical climate, generally warm with variable temperatures, and is strongly influenced by the West African monsoon winds, which determine the two main seasons: dry and wet. Table 3.1 shows the country's six major agro-ecological zones, determined by climatic conditions and soil types, that enable considerable variety in food crops production. Agriculture is the largest employer in Ghana, accounting for 36.1% of the workforce (Ghana Statistical Service, 2016), and is vital to the country's economy, contributing 17.3% of GDP, US$ 66.98 billion, in 2019 (Ghana Statistical Service, 2020). However, gold mining is a significant industry in the country. Ghana is the largest gold producer in Africa, producing 127 tonnes of gold in 2022, from both large-scale and small-scale mining (World Gold Council, 2023b).

Table 3.1 Agro-ecological zones of Ghana (north to south)

Zone	Rainfall (mm)	Production system	Area (km^2)
Sudan savannah	800-1200 (unimodal)	Sorghum, millet, groundnut, tomato, cattle, small ruminants	2,200 (0.9%)
Guinea savannah	800-1200 (unimodal)	Sorghum, millet, maize, groundnut, cattle, small ruminants	147,900 (61.9%)
Transitional zone	1,100-1,400 (bi-modal)	Maize, cassava, yam, cashew, small ruminants	8,400 (3.5%)
Semi-deciduous forest	1,200-1,600 (bi-modal)	Cocoa, oil palm, cassava, maize, plantain, small ruminants	66,000 (27.8%)
Rain forest	800-2,800 (bi-modal)	Cassava, yam, plantain, small ruminants	9,500 (4.0%)
Coastal savannah	600-1,200 (bi-modal)	Maize, cassava, vegetables sweet potatoes	4,500 (1.9%)

Source: adapted from (Antwi-Agyei et al., 2012; Choudhary and D'Alessandro, 2015).

Figure 3.1 shows gold deposits discovered so far across the country, broadly divided into six belts. As a developing country faced with many challenges (Table 3.2), such as poor access to markets and low farm produce prices, ASGM is regarded as a convenient livelihood activity with the prospect of improving people's lives, particularly for those in rural areas. ASGM has been practised in Ghana for centuries, supporting households and contributing to the identities and cultures of communities and tribes as land access has traditionally been granted by chiefs and family or clan heads.

Table 3.2 Overview of Ghana's development indicators

Social		Economic		Environment	
Poverty headcount ratio at $2.15 a day (2017 PPP) (% of population)	25.2 (2016)	GDP (US$)	73.77 billion (2022)	Forest area (% of land area)	35.1 (2021)
Life expectancy at birth, total (years)	64	GDP per capita (US$)	2,203.6 (2022)	Access to electricity (% of population)	86.3 (2021)
Population, total	33,475,870 (2022)	GDP growth (annual %)	3.1 (2022)	People using safely managed sanitation services (% of population)	16 (2022)
Population growth (annual %)	1.9	Unemployment, total (% of total labour force (modelled ILO estimate)	3.9 (2022)	Electricity production from renewable sources, excluding hydroelectric (% of total)	0.0 (2015)
Net migration	-11,253 (2021)	Inflation, consumer prices (annual %)	31.3 (2022)	CO2 emissions (metric tons per capita)	0.6 (2020)
Human Capital Index (scale 0-1)	0.5 (2020)	Foreign direct investment, net inflows (% of GDP)	2.0 (2022)	n/a	n/a

Source: adapted from the World Bank, 2022 (World Bank, 2022).

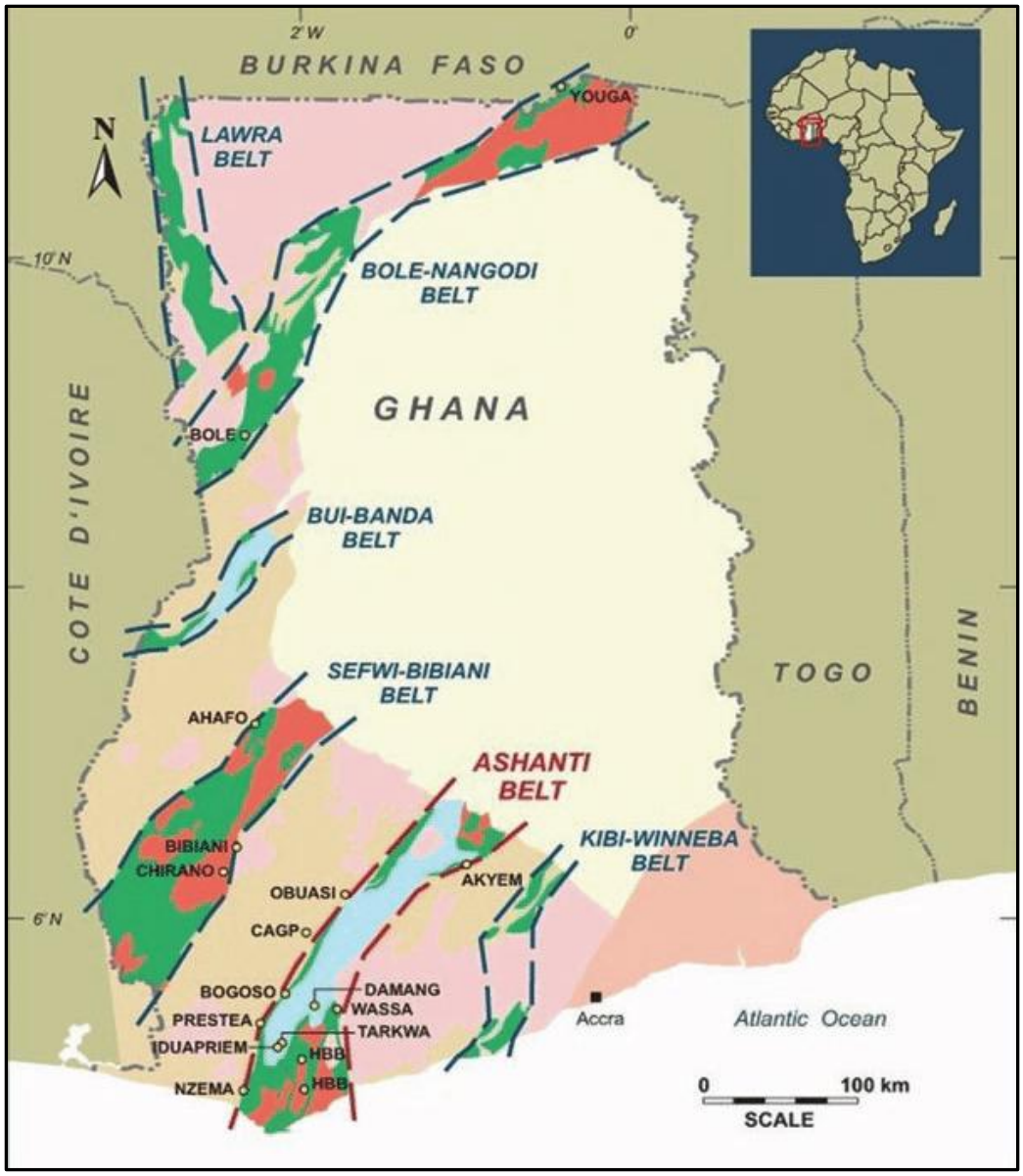

Fig. 3.1 Distribution of known gold deposits in Ghana. Source: Mafongoya et al. (2019).

Ghana was selected for this study due to the rapid expansion of ASGM activities over the past few decades. ASGM's contribution to Ghana's annual gold production grew dramatically from under 5% (17,023 ounces) in 1990 to nearly 40% (1.6 million ounces) in 2016, with significant shifts in the sector, characterised by increased migration, mechanisation, and intensification of mining practices (Owusu et al., 2019). This remarkable growth makes Ghana a compelling case for examining the dynamics and implications of ASGM.

Despite its significant economic contribution, the rising prevalence of ASGM in Ghana poses substantial environmental and social challenges (Bansah et al., 2016). The activities of miners intersect with other livelihoods, particularly in agricultural areas, and presents numerous

risks, including disruption of household incomes, community cultural dynamics and tensions between resident farmers and migrant miners due to crop destruction or land and water degradation (Boateng et al., 2014; Cocoa Post, 2020). Such challenges highlight the sector's complex interaction with local livelihoods and its broader societal impact. Although ASGM was legalised in Ghana in 1989, requiring miners to obtain licenses and permits, the existence of both formal and informal operations complicates governance. Informal mining, in particular, thrives alongside formal efforts, influenced by Ghana's complex land tenure system (Frimpong Boamah et al., 2020). Approximately 80% of land in Ghana falls under customary tenure, controlled by chiefs and family heads, which introduces additional layers of negotiation and potential conflict for miners seeking access to land (Ghebru and Lambrecht, 2017).

The expansion of ASGM in Ghana involves multiple stakeholders, including the state, traditional authorities, miners, farmers, and non-state actors, each with distinct roles and interests (Owusu et al., 2019). This diversity creates governance challenges, particularly in balancing the sector's profitability with its environmental and social impacts, while promoting coexistence with other livelihoods. Ghana therefore provides a unique opportunity to explore these governance issues and identify strategies for sustainable mining practices. Moreover, Ghana's status as a major gold producer with a diverse ASGM workforce offers insights with broader applicability. Understanding Ghana's experience can help address similar challenges in other regions where ASM coexist with competing livelihoods. This makes Ghana both a relevant and strategic choice for investigating ASGM governance and sustainability.

3.2.1 Suitability of Atiwa West District as study site

Given this research considers how ASGM intersects with other livelihoods in newly emerging ASGM areas, I avoided selection of regions with long-established ASGM activities, such as the Ashanti and Western regions. These areas have already been extensively covered in academic literature, as indicated by searches on Scopus, ScienceDirect and Google Scholar. Instead, I concentrated on areas where new ASGM activities, using both traditional and sophisticated methods, were developing within agricultural settings, with anecdotally reported impacts on rural livelihoods. To identify such regions, because they have often not yet been widely studied, I analysed online newspaper debates as this provided the most detailed and up-to-

date information about newly emerging ASGM areas (Arthur, 2022; Boateng et al., 2014; Cocoa Post, 2020; Ministry of Lands and Natural Resources, 2022). This analysis led me to focus on the Atiwa enclave in the Eastern Region, as a key area of interest, where many ASGM activities were reported, mainly driven by the introduction of sophisticated methods and machinery, particularly in districts such as Atiwa East, Atiwa West, and Abuakwa North. Subsequent site selection was guided by additional criteria, including: the absence of active conflicts in the area; accessibility of communities; willingness of residents to participate in the study; safety of the research team; availability of secondary data; presence of potential local contacts; and logistical feasibility. In consultation with two district agricultural officers, Atiwa West District (Fig. 3.2) emerged as the most suitable study area based on these criteria. The officers also confirmed that vibrant ASGM activities, including the adoption of sophisticated techniques, began in this district in 2010. To ensure a broad representation of participants, three communities—Akwabuoso, Ekorso, and Pameng—were selected from three respective Area Councils: Kwabeng, Abomosu, and Akropong. This geographic distribution was intended to provide a comprehensive understanding of ASGM's impact across the district. I selected these communities based on the following shared characteristics: a community with vibrant ASGM activities due to its perceived importance to livelihood by many residents; diverse levels of in-migration of ASGM workers; presence of both manual and mechanised methods; varying levels of environmental degradation, such as deforestation, water contamination, and land degradation; and differing ASGM legal statuses (formal, informal). Each community also presented unique features justifying its selection. In Akwabuoso, agricultural officers noted with many migrant miners departing, providing an opportunity to study local miners' livelihood dynamics. In Ekorso, ASGM activities around the Birim river was widely impacting vegetable farm irrigation. In Pameng, the community bordered the Atiwa Range Forest Reserve, where Xtra Gold operated, with formal and informal ASGM miners engaged in a range of relationships for its off-reserve concession in Pameng. This approach ensured representativeness, with the communities reflecting broader ASGM sector trends while offering unique insights into the socio-cultural and political dynamics at the community level.

Additionally, a review of academic literature through the search of “artisanal and small-scale mining in Atiwa West, Ghana” and “artisanal and small-scale gold mining in Atiwa West, Ghana” on ScienceDirect, Scopus, Google Scholar and Web of Science confirmed that the

ASGM activities in Atiwa West had not received extensive scholarly attention, reinforcing the significance of focusing on this district for the study.

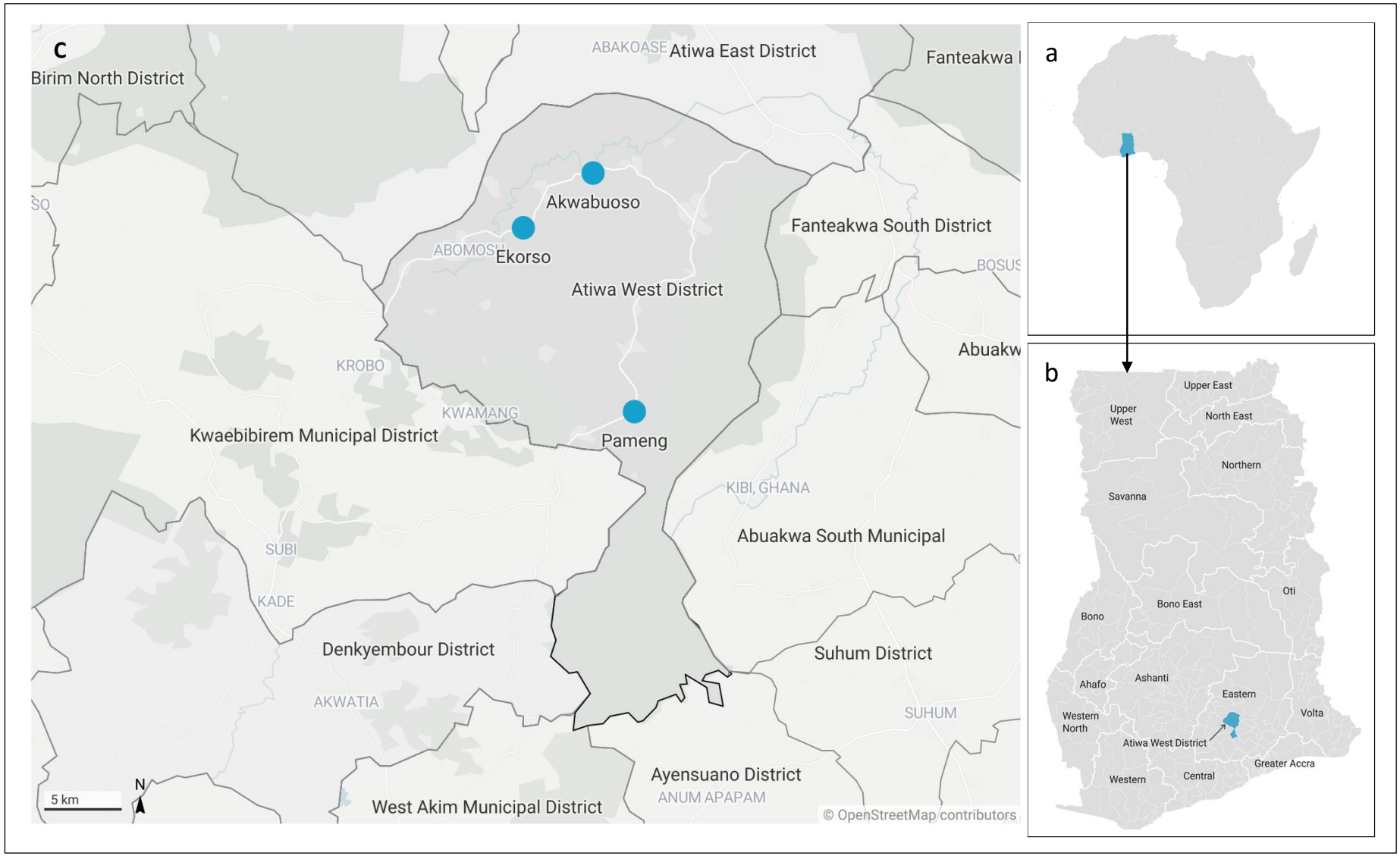

Fig. 3.2 a) Ghana in Africa; b) Atiwa West in Eastern region, Ghana; c) Study communities in Atiwa West, with adjoining districts. Source: Author's construct using Datawrapper

Atiwa West has historically relied on farming as its primary economic activity, supported by fertile soil and favourable climate (Table 3.3). These conditions are influenced by abundant vegetation cover, including the Atiwa Range Forest Reserve, a distinctive upland forest with high species diversity that is designated as a Globally Significant Biodiversity Area (Ron et al., 2010). Key subsistence crops include cassava, plantain, and maize, while major cash crops are cocoa and oil palm. Notably, the area produces the most cocoa annually in the Eastern Region (Codjoe et al., 2013).

Table 3.3 Key characteristics of Atiwa West District, Ghana

Characteristics	**Data**
Population	61,219
Land area	660.7 km^2
Economy	Agrarian (main), mining, trading, and sawmill
Agro-ecological zone	Semi-deciduous forest zone
Mean annual rainfall	1,250mm - 1,750mm
Rainfall patterns	Bi-modal (Major: Apr -July & Minor: Sept - Nov)
Temperature	Minimum of 26°C and maximum of 30°C
Relative humidity	65-75 % in the dry season; 75-80% in the rainy season

Source: Government reports, Atiwa West (Atiwa West District, 2021; Ghana Statistical Service, 2021).

Alongside farming, for generations, some locals intermittently attempted to extract alluvial gold from valleys using basic methods, though such efforts were in isolated instances (Ofosu-Mensah, 2017). However, with the knowledge that the Atiwa area is endowed with several mineral deposits such as gold, diamond, bauxite and kaolin, and that the gold deposits lie within the Kibi-Winneba Belt Area (Fig. 3.1) (Ron et al., 2010), the area has attracted interests from large-scale mining firms. For instance, in the 1980s and 1990s companies like WARDIG Plc, Sikaman Gold Resources, Ashanti Goldfields and EQ Resources attempted exploration and mining activities. Since the mid-2000s, more large-scale companies have made significant gold discoveries and are mining in the wider Atiwa enclave. These include Med Mining at Akyem Techiman, the Osino concession of Kibi Goldfields in the Fanteakwa South district and Newmont's Akyem operation in Birim North District (Ofosu-Mensah, 2017; Ron et al., 2010; Smith et al., 2012). Presently, Xtra-Gold Corporation of Canada holds five mining leases, including in Kwabeng, Pameng, Banso, Muoso, and Apapam, spread across Atiwa West, Atiwa East and Abuakwa South districts.

The discovery and widespread mining of gold by these large-scale companies have emboldened ASGM miners, leading to a surge in active ASGM activities in Atiwa West since 2010. This has been characterised by the use of large earthmoving equipment, and sophisticated methods greatly expanding operations and impacting rivers and farmlands. ASGM has since become a vital livelihood for many, intersecting with local economic activities in ways that can support and/or undermine local livelihoods and economies. For instance, the expansion of artisanal mining has in some instances led to conflicts between ASGM and large-scale mining leaseholders. As informal miners expand and sometimes encroach on legally held concessions, disputes have escalated, often leading to stand-offs, such as the one that happened between Kibi Goldfields Limited and local miners in Samaang, in the Fanteakwa South District of Atiwa (Fosu, 2011). These dynamics highlight the complexities of the ASM sector, where informal miners often operate outside legal frameworks, yet play an important role in local economies.

The Atiwa West District, therefore, offers a suitable study site, providing a valuable opportunity for a closer examination of the complexities of formal and informal ASGM practices, their interaction with rural livelihoods and linked socio-environmental consequences. It provides a useful case through which to explore ASGM's formalisation challenges due to the survival strategies of the many informal miners and the socio-economic realities faced by stakeholders and the local population, many of whom rely on both farming and mining for their livelihoods. While the specific socio-environmental and economic context in Atiwa West may differ from other regions in Ghana, the underlying challenges, such as livelihood interactions, environmental degradation, resource conflicts, and governance challenges, are reflective of broader patterns in the ASM sector globally. Studying these dynamics in Atiwa West provides a comprehensive lens through which to explore the intricacies of ASGM and gain valuable insights into how formalisation efforts might be designed to promote sustainable mining practices.

3.3 Research design and approach

The research design consists of a mixed methods research approach that integrates both quantitative and qualitative methods across multiple scales. Mixed methods enable the

collection and analysis of different kinds of data and integration of the findings to draw conclusions in a single study (Tashakkori and Creswell, 2007). The use of a multi-scale mixed methods research approach was selected due to the complex and interdisciplinary nature of the research questions.

Qualitative and quantitative methods have different epistemological and ontological backgrounds, but can be combined, allowing a deeper understanding through cross-validation of data (Bryman and Bell, 2007). Johnson and Onwuegbuzie (2004) suggest that philosophically, mixed methods research is the "third wave" or third research movement following a research tradition divided between quantitative purists adhering to positivist methodologies and qualitative purists favouring constructivist and interpretivist approaches. Recent advances in the philosophy of science have challenged the notion of a separate but equal status for these traditions, advocating instead for their integration. Therefore, the epistemological rationale for mixed-methods research dictates that the two paradigms (qualitative and quantitative) co-exist in a single study under a new paradigm based on the philosophy of pragmatism (O'Hanlon, 2018).

In a mixed-methods investigation, qualitative methods can be used to complement survey data, thereby proving crucial for triangulating and validating data (Robson, 2002). When the findings are corroborated across different approaches, greater confidence can be held in the resulting conclusion (Johnson and Onwuegbuzie, 2004). However, it is acknowledged that using a combination of both methods may add further uncertainty and conflicting results that need interpretation when answering research questions (Robson, 2002). Nevertheless, Johnson and Onwuegbuzie (2004) propose that conflicting findings present researchers with greater knowledge so that they can adapt their interpretations and conclusions accordingly. Johnson and Onwuegbuzie (2004) further assert that, in many cases, the goal of mixing is not to search for corroboration but rather to expand one's understanding.

However, the use of mixed methods faces many challenges and critiques. Advocates like Tashakkori and Creswell (2007) argue that this approach remains in a state of evolution and will continue to develop over time. Consequently, there are significant unresolved matters and unexplored facets that require a deeper understanding. Among these concerns are the methodologies for conducting mixed-methods studies, the philosophical foundations of

mixed methods, the junctures in the research process where paradigm blending occurs (such as in the formulation of research questions or during data collection), and the methodologies for executing it effectively (Tashakkori and Creswell, 2007).

Moreover, recognising that both qualitative and quantitative methods have their own set of limitations, Johnson and Onwuegbuzie (2004) proposed that understanding the strengths and weaknesses of each method empowers researchers to combine strategies for optimal outcomes in mixed methods studies. Consequently, researchers should collect multiple data using different strategies, approaches, and methodologies to ensure that the resultant combination capitalises on complementary strengths, while mitigating overlapping weaknesses (Johnson and Onwuegbuzie, 2004).

While quantitative methods excel at examining macro-scale phenomena, qualitative methods are adept at delving into micro-scale issues (Robson, 2002). Consequently, instead of seeking generalisations across large populations, qualitative studies aim to provide a nuanced understanding akin to a window or mirror that reflects the specific situation or phenomenon under scrutiny. Integrating both approaches can facilitate comprehensive exploration spanning multiple levels of social existence (Robson, 2002).

A drawback of quantitative methods is their tendency to reflect a researcher's pre-existing knowledge and perspective, potentially introducing bias (Robson, 2002). Conversely, qualitative methods, while aligned with participants' perspectives, also carry the risk of bias (Robson, 2002). For example, employing interviews enables researchers to delve into participants' experiences and perceptions, thus emphasising their viewpoints (Robson, 2002). However, qualitative interviews also allow respondents to highlight issues that the interviewer may not have anticipated in relation to the research questions, offering valuable insights into participants' perspectives (Bryman and Bell, 2007). Therefore, utilising a mixed-method approach in this thesis offered the most effective way to explore the research objectives and associated questions, encompassing diverse facets that contributed to addressing the research aim.

The multi-scale mixed methods research approach applied in this thesis involved extensive engagement with households, community groups, and stakeholders through consultative and

participatory methods to assess livelihoods dynamics. Stakeholders included farmers, miners, landowners, traditional leaders, and government officials. Data collection methods included household questionnaire surveys and focus group discussions. Additionally, transect walks and environmental surveys were conducted to determine the forms and status of lands and water bodies in mined areas. Furthermore, the research involved stakeholder interviews with practitioners and experts, along with a review of laws, policies, and public documents to assess the legal framework, policy coherence, and institutional capabilities pertaining to ASGM in Ghana. A comprehensive list of the objectives, research questions, and data collection methods is outlined in Fig. 3.3. The methods applied to address objectives one, two and three are presented and discussed further in Chapters 4, 5 and 6 respectively. By combining qualitative and quantitative methods, the study collected detailed insights while allowing for the broader generalisation of the findings.

Participatory methods in research empower local communities to contribute by sharing their knowledge and experiences, addressing local issues, and potentially fostering social change (Chambers, 1997). These methods involve collaboration between scientists and non-scientists, with researchers facilitating the process (Ballard and Belsky, 2010). Through the participatory methods used in this study, local people actively engaged in the research process, offering valuable insights into the complexities of ASGM activities and their impact on rural livelihoods. Despite potential time constraints and risks, the researcher moderated discussions to maintain relevance and minimise digressions.

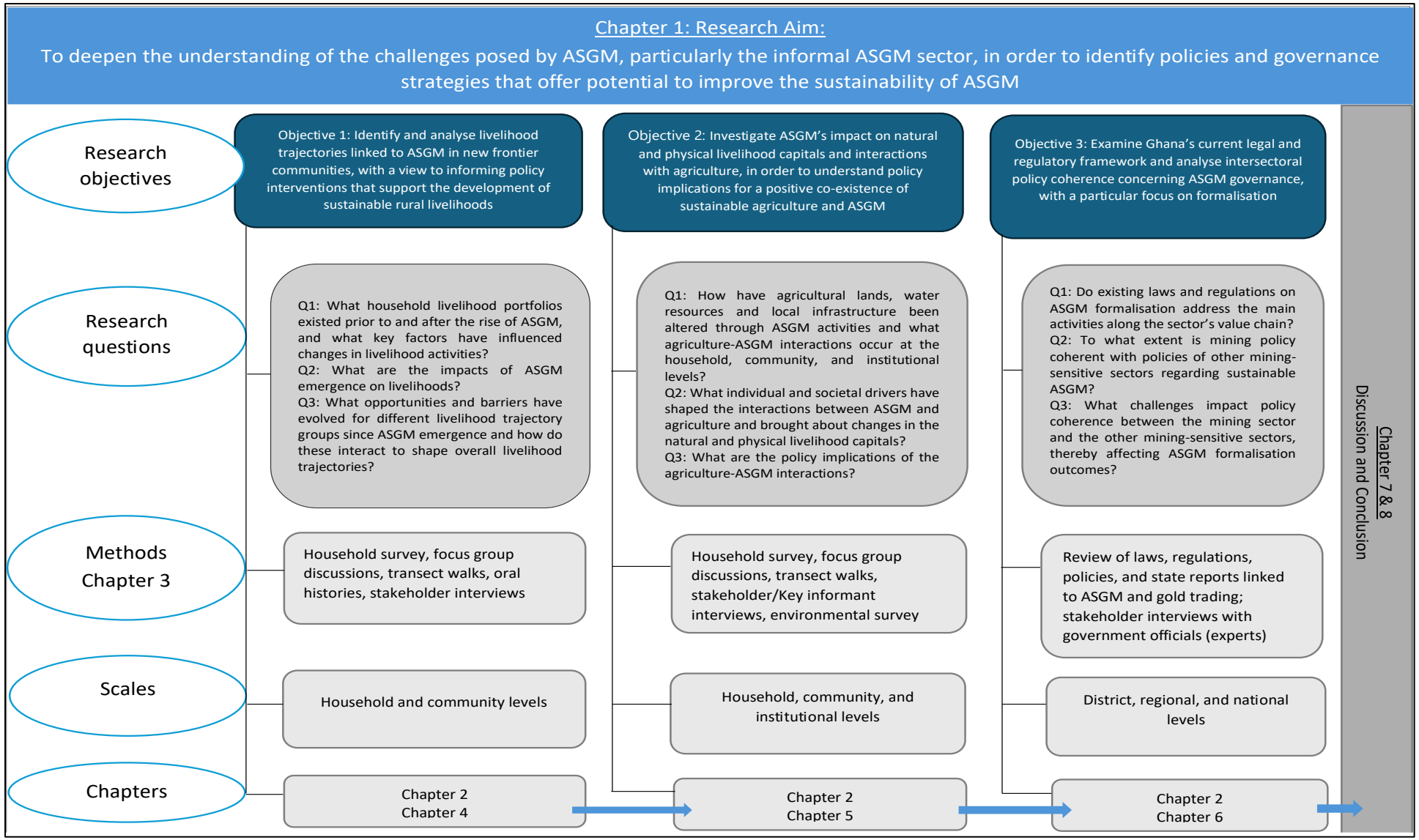

Fig. 3.3 Research design and links between different methods and research objectives

3.4 Fieldwork processes

Fieldwork in Ghana was undertaken from October to December 2021. This involved household surveys, focus group discussions, interviews transect walks, and environmental surveys in three selected farming communities experiencing newly emerging ASGM activities since 2010: Akwabuoso, Ekorso and Pameng in the Atiwa West District. Subsequently, interviews were conducted with government officials from selected agencies at multiple scales: district level – Atiwa West District Assembly, and Agricultural Department; regional level, Koforidua – Minerals Commission, Ministry of Food and Agriculture, Environmental Protection Agency, Lands Commission; and at national level, Accra – Minerals Commission. Details on the methodology are provided in Chapters 4, 5 and 6.

3.4.1 Selection of communities and reconnaissance visits

The methodology sections in Chapters 4 and 5 detail further how the communities and the sampling approaches were undertaken and how the sample sizes were selected. The researcher, with the assistance of agricultural extension officers, introduced the research to the chief farmer of each community, who then informed other leaders to agree on a date whereby the research team could make a reconnaissance visit and explain the aim and nature of the research.

3.4.2 Training of research assistants and pre-testing of questionnaire

Three research assistants – a graduate student and two extension officers – were selected and trained for a week to help conduct a questionnaire survey using Qualtrics on tablets, due to the large sample size of 360. They were chosen based on their technical expertise, including their communication abilities, writing skills, impartiality, and proficiency in English and the local language (Twi). The training covered an overview of the study's major themes, an examination of the questions, quality checks, appropriate translation of questions into the Twi language, and role-playing to become familiar with the questions and the Qualtrics platform. The research assistants were also trained on positionality (see Section 3.5) with a particular emphasis on objectivity and respect for local customs, and training on ethics (see Section 3.8).

The household survey questionnaire (Appendix A1) and the focus group discussions (FGDs) (Appendix A2) and interview question guides (Appendix A3) were pre-tested in Akwabuoso community during reconnaissance visits to evaluate the questionnaire's effectiveness and the Qualtrics software's usability. Following the pilot phase of the household survey, adjustments were made to the questionnaire by refining ambiguous questions and removing irrelevant ones. For instance, emphasis was placed on estimating land sizes in acres instead of hectares, recognising that some farmers were unfamiliar with the latter measurement unit. Similarly, a question regarding the type of accommodation based on roofing type was omitted upon observing that all houses had iron sheet roofs, and no thatch roofing was identified. Throughout the main fieldwork, the research team convened at the end of each day to review the day's activities and address any issues that arose.

3.5 Positionality

Positionality "refers to the stance or positioning of the researcher in relation to the social and political context of the study – the community, the organisation or participant group. The position adopted by a researcher affects every phase of the research process, from the way the question or problem is initially constructed, designed and conducted to how others are invited to participate, the ways in which knowledge is constructed and acted on and, finally, the ways in which outcomes are disseminated and published" (Rowe, 2014, p.2). Being aware of this is essential for conducting ethical and credible research.

In the context of place-based research, it is recommended that researchers minimise their influence on participants' views and interests, as well as on the reported outcomes of the study (Ritchie and Lewis, 2003). Rowe (2014) suggests that a researcher's positionality can be understood as either an insider or outsider concerning the study area and communities. In the case of the Atiwa West District, I found myself positioned both as an insider and outsider.

As a Ghanaian and a researcher trained in natural resources and environmental management who worked in the non-governmental sector for three years, I have a good understanding of critical issues communities in agricultural socio-ecological systems in Ghana face with their livelihoods. This is particularly true for the semi-deciduous forest zone, where I was involved in a number of projects on land governance, restoration and agricultural improvement efforts

using reforestation, soil suitability and agroforestry techniques as well as socio-economic baseline studies. This background and knowledge significantly informed my choice of research topic, the selection of the research area, the design of the research process and methodology, as well as the selection and recruitment of participants.

Having worked with NGOs in Ghana, I had connections with government officials responsible for management tasks, scientists conducting research, and NGOs involved in development projects within the broader study region. These networks assisted me in connecting with appropriate agencies to gather credible secondary data e.g. annual cocoa production. However, this “insider" position shaped my understanding of only certain well-known issues. For instance, secondary data from government reports initially directed my focus toward broader ASGM’s impact on environment and livelihood assets, rather than paying equal attention to pressing concerns like the social and cultural underpinnings of these livelihoods and linked social injustices (differentiated access to resources and livelihoods). This perspective shifted after my reconnaissance visits and interactions with community leaders. Based on these insights, I adjusted the interview questions and household surveys to broaden the research scope and deepen the study's objectives. I also adopted a mixed-methods approach that enabled me to collect both primary and secondary data, validating them for a more comprehensive interpretation of the findings.

At the outset, I considered myself an outsider to the study area because I was not part of the local community and had no previous local contacts there. Being based in the UK, I had not visited or conducted research in Atiwa West before. This outsider status brought unexpected challenges related to how I understood that the villagers structured their farming activities, including local farm days and off-farm days, and the constraints it posed to the research. First, I needed to establish rapport with community leaders and respected elders to facilitate introductions to village participants. This was a critical step to address any suspicions (particularly as the study relates to informal mining), promote transparency and ensure broader participation from community members because the local residents tend to be cautious and hesitant to share deeply with strangers. To enhance trust, I visited communities accompanied by district agricultural extension officers, who were locally known and assisted with the research. Their presence helped build credibility and fostered a more welcoming environment for the study. However, it was anticipated that the officers' presence may

introduce a bias where participants might tailor their responses to align with what they believe the officers wanted to hear, or rather, might make participants hesitant to share sensitive or critical views about issues bordering on the effectiveness of agricultural programmes (Tourangeau and Yan, 2007). To mitigate these potential biases, the participants, early on, were reassured of the confidentiality and anonymity of their responses and the researcher emphasised his independence from any institutional agendas (Bergen and Labonté, 2020). Additionally, agricultural extension officers' roles in the research process were carefully managed, ensuring they acted only as facilitators of access and not as participants in discussions including in FGDs. Their participation was limited to serving as research assistants for administering household surveys using predefined questionnaires, where they were given prior training to ensure their objectivity. This helped to reduce bias and the officers' potential influence on participant responses (Bergen and Labonté, 2020). Furthermore, the study applied a range of different methods, some of which did not involve the officers, such as oral interviews. Data collected during sessions where officers were present, such as FGDs, were cross-verified with that collected using other methods e.g., transect walks, environmental surveys and face-to-face interviews, to identify and address any inconsistencies arising from potential biased responses (See Section 3.7.2.4 on resolving any contradictions in data).

I was advised that farmers were often busy with their work and were generally only accessible for meetings or interviews on local taboo days, when they do not go to farm. This caused a rearrangement of data collection schedules. I was also advised about safety and accessibility issues in certain parts of the villages, prompting the need for local guides in such circumstances. Furthermore, in rural Ghana, men typically act as household heads and are the first to engage with guests, including for the household surveys. As such, there was a risk that the experiences of some groups could dominate the insights of the study. To mitigate this potential bias, I recruited a diverse range of participants from various parts of the study communities for FGDs, interviews, and transect walks.

I provided detailed briefings to the research assistants, emphasising the importance of maintaining an objective and neutral stance during interviews, while being mindful of socio-cultural norms. This aimed to standardise the approach and reduce subjective bias, which is crucial for ensuring data consistency. This included discussions on recognising their own

positionality, thus how their backgrounds, identities, and assumptions could influence their interactions with participants and the data collected. Strategies to mitigate these effects included role-playing interviews to practice neutrality, reviewing power dynamics in interviewer-participant relationships, and reinforcing the need to approach all interactions with cultural sensitivity and respect. While these measures aimed to minimise bias, I acknowledge that their positionality, as well as their perceived roles in the research, inevitably influenced the dynamics of the interviews and, consequently, the data collected. To restrict this influence, their participation was limited to undertaking household surveys with the structured questionnaires. Careful attention was given to appearance, attire, and approach when interacting with participants. Additionally, efforts were made to clearly communicate the purpose of the research throughout the data collection process.

Personal traits such as race, gender, and social identity played a role in shaping my relationships and communication with respondents. Having grown up in Ghana and being able to speak the local language (Twi), allowed me to understand the cultural context and social nuances during interviews. Being a male researcher enabled me to directly speak with the heads of households, who usually made the main decisions about economic activities and livelihood changes. To avoid breaching cultural norms and customs, interviews were conducted openly during the daytime and often in the presence of other household members, especially when interviewing women. During focus group discussions, seating arrangements were thoughtfully planned to ensure participants' comfort, and all meetings were held in communal spaces in the community centres.

I found that participants generally respected me and were willing to take part in the research activities, albeit with certain expectations. For example, they hoped that my research would help convey their concerns to management agencies, given their frustration with them reporting incidents without resulting in any local change. I was mindful of and respected these concerns. To avoid participants exaggerating the issues they faced, I clearly communicated the scientific objectives and potential long-term impacts of the research, without making promises about specific changes in the Atiwa area.

In this study, taking a development and environmental perspective as a researcher, the focus was on ASGM’s informality and its socio-economic and environmental impacts, while considering how formalisation and regulation could boost sustainability. This approach aligns

with global priorities, particularly those of UN and the World Bank, which work with government to address global socio-economic, environmental and regulatory issues in the sector. My research was based on the assumption that local ASGM practices reflect the effectiveness (or lack thereof) of existing laws and policies and that collecting personal stories and documenting the lived experiences of ASGM workers and community members can provide a deeper understanding of local practices, challenges, and norms, such as power structures within mining communities, which can help to reveal how broader systems and policies shape the sector.

While ASGM is a critical source of income, especially for the poor, addressing the environmental damage and social inequalities tied to it is equally important. Although I advocate in this thesis for regulating ASGM, it is essential that this does not marginalise miners or make formalisation seem burdensome or inaccessible. Given the complex dynamics of ASGM, the focus is to broaden understanding to enable us to find a balance between livelihood concerns and socio-environmental impacts, promoting a more sustainable approach to ASGM, through system-wide and policy-based approaches.

3.6 Approaches to data collection

3.6.1 Household questionnaire survey

Questionnaire surveys involve the collection of data at a single point in time from a sample selected from a defined population (Visser et al., 2002). Existing studies on ASGM have generally employed the use of surveys in their data collection (Baah-Ennumh et al., 2020; Obiri et al., 2016). A household questionnaire survey was chosen as the primary method for gathering large quantitative data, on which descriptive statistics and tests for statistically significant differences were undertaken. The survey was administered to a representative sample, using simple random sampling, allowing for generalisations to be made about the mining communities in the district. The household questionnaire survey adopted a semi-structured format to gather data on general household characteristics (e.g., age, gender, education), livelihood and income-generating activities, including local agricultural and ASGM practices, types of crops, and land tenure. The study adopted a common definition of a household used in Ghana as "a group of people who own the same productive resources, live together, and feed from the same pot" (Yaro, 2006, p.129). Informed by the SLA (Scoones,

1998) household assets (financial, human, natural, physical, and social) were assessed through the survey (see Appendix A1). Additionally, information on state and non-state interventions and other socio-economic characteristics, including wealth level, using local wealth-ranking indicators (Reed, 2005), were collected to ensure various social groups with different levels of wealth within each community were sampled.

Leading questions were avoided by designing concise, focused questions that did not guide the respondents towards specific responses, helping to reduce bias in responses (Linden and Sheehy, 2004). The household surveys (n=360) were conducted across the three study communities. In cases where the household head was unavailable, another adult household member was surveyed. The questionnaires were developed in English but administered in the local language (Twi) and were conducted face-to-face by the researcher and three trained research assistants. Surveys took place in respondents' homes and typically lasted between thirty to forty-five minutes. Consistency in translation was ensured through training and trial surveys to address any potential issues. The questionnaire was developed using the Qualtrics online platform (https://www.york.ac.uk/it-services/tools/qualtrics) and administered utilising tablets and smartphones equipped with the Qualtrics app.

A pilot questionnaire survey was carried out in October 2021 to test the clarity and flow of the questionnaire; to ensure that relevant questions were included to evaluate each area of interest; to evaluate the appropriateness of the language used (e.g., technical terms or areas that are ambiguous or difficult to understand). Based on the lessons learned from the pilot study, the survey was revised to enhance respondent comprehension and to provide a more comprehensive tool for data collection and analysis. These revisions were made to ensure both the validity and reliability of the final instrument (see Appendix A for a copy of the questionnaire).

3.6.1.1 Sampling method, sample size and margin of error

This research employed a probability sampling technique to determine the sample size, enabling the sample to be representative of the larger population and allowing for generalisations to be made (Visser et al., 2002). In determining an appropriate sample size that yields a representative sample, Israel (1992) suggests that several factors should be considered, including population size, sampling error, desired confidence level, degree of

variability, as well as time and cost constraints. The confidence level refers to the probability that the sample accurately reflects the attitudes of the population. Statistical guidelines recommend this level to be at least 95% (Howell, 2016). In this study the sample size for the survey was determined using a formula (see Israel, 1992; Qualtrics, 2022). Information provided by District Agricultural Officers indicated that ASGM was present in several communities and estimated that approximately one-third of the district's population was involved in ASGM activities. The total district population is 61,219, meaning that about 20,406 individuals were assumed to be affected (Ghana Statistical Service, GSS, 2021). With an average household size of approximately 4 individuals (GSS 2021, p. 83), this translates to a sample population of 5,102 households (20,406/4). The sample size for the study was determined to be 360 households based on a 95% statistical confidence level, with a 5% margin of error. Time and cost constraints were also considered so that the survey was implemented across three selected communities: Akwabuoso, Ekorso, and Pameng (Bryman and Bell, 2007; Qualtrics, 2022).

Simple random sampling (specifically systematic random sampling) was employed for the household survey. In each community, the researcher and the three research assistants convened at the centre of the community and then dispersed in four different directions (representing north, south, east, and west) to increase the chance of sampling diverse participants. To ensure randomness in the starting point, the researcher first numbered all the initial houses on each lane radiating from the community centre. Each data collector then randomly selected a starting house by drawing a number from a hat, corresponding to one of the numbered houses. From that randomly chosen starting point, they systematically visited every other house along the identified streets or lanes to administer the questionnaire.

3.6.2 Qualitative research design

Qualitative research considers depth and explanations in the responses of a small number of participants (Holloway and Todres, 2003; Robson, 2002) and in this study, the qualitative data were collected to allow in-depth understanding of a small number of subjective experiences. Qualitative data collection methods involved focus group discussions, transect walks, oral histories, and individual stakeholder interviews. These were conducted using a semi-structured, open-ended format, allowing for detailed insights from an insider’s perspective.

Semi-structured interviews were facilitated using an interview guide with a list of questions under specific themes (Appendices A2-A5) (Robson, 2002). These guiding questions were developed to draw out detailed experiences and perspectives at household and community levels as well as insights into selected organisations' activities.

With the participants' consent, interviews were recorded using digital audio recorders to ensure the discussions were captured accurately. Where recording was not feasible, e.g., due to background noise, detailed handwritten notes were taken.

3.6.2.1 Purposive sampling

Participants in the interviews and FGDs were carefully selected using a purposive sampling technique. Purposive sampling is a type of non-probability sampling in which the researcher selects cases/participants purposefully to ensure that the results are pertinent to the study objectives (Bryman, 2016). From the local through to the national levels, participants were chosen based on their experience and knowledge of ASGM as well as their links to mining, farming or connected livelihoods. At district, regional and national levels, participants included officials from government departments and agencies such as the Atiwa West District, the Ministry of Food and Agriculture and along with regulatory agencies including Minerals Commission, Lands Commission and Environmental Protection Agency (EPA). Officials were selected for interviews based on their ranks/roles, duties and their experiences. At the district level, officials familiar with rural livelihoods, mining, and agriculture were recruited to validate findings and provide deeper context. This group included District Assembly officials and members of both agricultural and traditional institutions, alongside individuals actively engaged in smallholder farming and mining. Specific selection criteria for interviewees are provided for the various qualitative methods. Purposive sampling for interviews was conducted broadly enough to achieve saturation, where no new information emerged (Bowen, 2008).

3.6.2.2 Focus group discussions

Focus group discussions (FGDs) were conducted during the validation phase to explore local insights that household surveys or environmental assessments did not capture. They aimed to explore the degree of consensus between households regarding livelihood patterns, agricultural and ASGM activities, and the role of formal and informal institutions in the community in a permissive, non-threatening environment (Saunders et al., 2009). The interaction between participants was a key feature, reflecting the social nature of knowledge rather than individual viewpoints (Bryman and Bell, 2007; Goss and Leinbach, 1996). However, one drawback of FGDs is the potential influence of group dynamics, which can make some participants hesitant to share their opinions, especially in the presence of dominant personalities (Darlington and Scott, 2003). To counter this, the researcher facilitated discussions in a manner that encouraged balanced participation and used ground rules to manage tensions and keep the conversation focused.

One focus group was held in each of the three communities, with group size of 10 participants (Hopkins, 2007), and each session lasted about one hour. Participants in the questionnaire surveys who demonstrated appreciable knowledge on rural livelihood dynamics of interest to this study's objectives, ASGM production and related environmental changes were selected. The environmental changes of interest were those impacting local livelihoods, including information on rainfall patterns, experiences of floods or droughts, and activities contributing to any deforestation and land degradation. To ensure diverse representation, participants were a mix of genders, ages and wealth levels.

The researcher moderated discussions by outlining topics, preparing prompts, and ensuring equal participation (Coldwell and Herbst, 2004). Probing questions were used to clarify responses. Topics covered included the identification of important resources categorised into key livelihood assets—natural, physical, social, financial, and human (Scoones, 1998). Discussions also explored changes in these assets before and after the emergence of informal ASGM, alongside the influence of external factors such as shifting policies and global market demands, and their impacts on livelihoods. For instance, social capital was analysed by investigating family systems, social networks, community-based associations, and NGOs that support members during challenging times (with key findings from these discussions

presented in Chapters 4 and 5). Figure 3.4 shows group gathering prior to a focus group session in Ekorso.

Fig 3.4 Introduction of the research to participants prior to a focus group discussion with community members, Ekorso, November 2021

3.6.2.3 Transect walks

Transect walks were conducted after the FGDs in each community and consisted of the research team walking once with three purposively sampled participants across the community via the community centre while observing, listening and questioning them (Kinyunyu and Swantz, 1996). These participants included the chief farmer (community's best farmer for the year as recognised by the District Assembly), a representative from the traditional authority, and a local cocoa farmer cum sourcing agent. Individuals selected were those with long-term residency in the community (two decades or more); have been involved in community activities, and/or decision-making processes, and had existing community-level roles or responsibility. In each of the communities, the above selected participants were

found to be active and could share deep socio-cultural insights concerning landforms and land use changes. This method created an informal setting putting participants at ease, promoting open communication and offering the researcher a first-hand view of critical features such as land use, landforms, vegetation, and other environmental conditions highlighted during FGDs. The transect walks thus provided valuable information on the local environment, as well as the availability of resources and the relationship between natural processes and human activities at each site. Importantly, they validated and supplemented the insights gained from the FGDs (Sallu et al., 2010). The walks also helped identify issues, opportunities, and solutions related to rural livelihoods. During the walks, data were recorded by hand on notepads, and additional information was captured through audio recordings and photographs, all of which were digitised as soon as possible afterwards.

3.6.2.4 Oral histories

Following the transect walks, oral histories were conducted with household heads to provide insights into the past events that have shaped their livelihood activities and their resultant livelihood trajectories. By gathering personal narratives through oral histories, the researcher sought to trace the events and decisions, as well as external factors including policies that influenced household livelihood trajectories over time. This approach allowed for a more nuanced understanding of why some households remain vulnerable or poor, while others progress (Bryman and Bell, 2007). Selection of individuals for participation in the oral interviews was conducted through purposive sampling, based on specific livelihood activities that interviewees engaged in both the past and present. These activities were primarily focused on agricultural practices and ASGM, and related activities. The criteria for inclusion were as follows: individuals were selected based on their demonstrable knowledge and experience with their livelihood activities during questionnaire surveys; participants were required to have engaged in local livelihood activities, and must have participated in farming, trading or ASGM at some point in the past or currently; individuals must have been residents and old enough to have engaged in livelihood activities since at least from the early 1990s; participants were selected from diverse wealth groupings, defined by size of farmland holdings (<1ha, 1-3ha, >3ha). Additionally, gender, age (40-60, above 60), and formal education level (none, primary, high school) were also considered to ensure a broad and representative range of views. Each interview lasted approximately 1 hour. The focus here was

to explore how livelihood activities of the locals may have changed since the 1990s in the light of growing ASGM. See Chapter 4 for further information on this method. Figure 3.5 shows an oral history session with a participant at Akwabouso.

Fig 3.5 Oral history session with a participant at Akwabuoso, October 2021

3.6.2.5 Interviews with ASGM miners as key informants

Interviews with ASGM miners were conducted using a purposive sampling approach, selecting five individuals per community (three men and two women) based on gender, age (younger - 18 to 40, and older- above 40), and mining scope (artisanal and small-scale miners). These criteria were chosen to capture diverse perspectives and experiences, recognising the influence these factors have on resource accessibility, decision-making, and socioeconomic dynamics within mining communities (Arthur-Holmes and Abrefa Busia, 2020). While the sample size was limited due to time and resource constraints, this allowed for a balance between diversity and depth of insights. This interview complemented data gathered from miners in the oral interviews and household questionnaires, and so the interview sample was enough to reach saturation, with no new information being received (Bowen, 2008). Each interview lasted approximately 30 minutes and was facilitated using a structured interview schedule to ensure consistency in data collection and recorded with a voice recorder. Figure 3.6 illustrates the researcher interacting with some ASGM miners at Pameng. Permission was sought from all participants for their photographs to be used.

Fig 3.6 Researcher in interaction with some artisanal miners at Pameng, November, 2021.

3.6.2.6 Environmental field survey

Environmental field surveys have been commonly used in studies on the impacts of ASGM (e.g. Mantey, 2016; Ofosu et al., 2020; Owusu-Nimo et al., 2018). An environmental field survey was used in this thesis to capture basic environmental data to understand how land degradation due to ASGM, may be affecting the farming and other rural livelihoods in the study areas and to identify opportunities as to how ASGM could be more sustainable. It was not intended to provide a technically extensive analysis of any environmental impact that may occur, since the focus was on addressing governance related challenges rather than undertaking a detailed environmental impact assessment.

The field survey consisted of site visits to two purposively selected farmlands in each community, to carry out a visual environmental impact inventory, and physical estimation of impacted sites, alongside interviewing and seeking clarifications from the farmer. Farmland selection was based on its proximity to the community, presence of considerable ASGM

impacts, and ease of accessibility to site. Tools used to capture data included an environmental checklist, digital audio recorder, and digital camera. Farm owners were some of those who had been selected for the oral history interviews. The farmlands included a mix of active farms and fallow fields (left uncultivated for two or more years) that were impacted by ASGM. Surveys were conducted in the company of each selected farmer to identify the forms of land degradation present. The conditions were explored by observing, asking, listening, looking, taking pictures and notes. Information recorded included: type and size of farm; type of ASGM operation on the land; activity status; resource use inventory including machinery and equipment; estimation of impacted area and the forms of land degradation, for example surface water impacts, soil impacts, ground contaminations, vegetation, and wildlife impacts. Surveys of irregular and large land tracts can use various methods. In this study, ASGM impacted areas were assessed by simply estimating the length and width of the affected sites in meters and multiplying them to determine the affected area. The lengths and breadths estimation were done by pacing (where possible) or by visual estimation.

3.6.2.7 Interviews with stakeholders (practitioners and experts)

Stakeholder identification was conducted prior to the field study to understand the key actors and organisations involved, their roles and links with the ASGM sector. This process ensured that the study would capture diverse perspectives and address potential conflicts effectively. It was also to gain insight into the capacities and effectiveness of institutions and policies at local, regional, and national levels.

The first step involved conducting a desk-based review of academic articles and grey literature pertaining to ASGM in Ghana. Ghana Government documents reviewed included ASM Handbook for Ghana (Tychsen et al., 2017), ASM Framework 2015-2023, and the ASGM section in the national mining law (Act 703), all obtained from the Minerals Commission (www.mincom.gh.com). Websites of active mining NGOs in Ghana particularly A Rocha Ghana and Solidaridad (Solidaridad, 2021) were explored. The review provided an overview of existing governance frameworks, local dynamics, and key stakeholder groups involved in ASGM, generating a broad initial list of potential stakeholder categories. This categorisation helped ensure that all relevant actors were considered.

The stakeholder categories mapped include:

Primary Stakeholders: These are individuals or groups directly involved in or impacted by ASGM activities, such as miners, local gold buyers, farmers, landowners, local communities, chiefs and local leaders, and community-based organisations.

Secondary Stakeholders: Groups with indirect influence over ASGM activities, including regional gold traders or "middlemen" buyers, as well as environmental organisations like A Rocha and Solidaridad.

Regulatory Stakeholders: Government agencies and local authorities responsible for the policy, regulation, and enforcement of ASGM activities.

Financial Stakeholders: Financial institutions, both public and private, along with informal lenders that provide financial support to mining operations.

Civil Society Stakeholders: Non-governmental organisations (NGOs) and advocacy groups focusing on issues such as human rights, environmental protection, and labour rights.

Other Actors: This category encompasses additional relevant stakeholders, including academics and researchers, journalists, and consultants who contribute to the broader stakeholder network.

To ensure alignment with the thesis objectives, participants were selected through purposive sampling, specifically targeting individuals in managerial or decision-making roles such as directors, or technical officers within their organisations. Broadly, selected participants needed to possess detailed knowledge of ASGM processes, its governance frameworks and implementation issues, or ASGM impacts on environment and livelihoods, gained through the performance of their roles and duties, such as direct involvement in projects, compliance monitoring, or community engagements, linked to ASGM activities. Given the exploratory nature of the qualitative aspect of this study, the sample in this instance was not pre-specified in a strict sense to avoid overlooking key participants that could otherwise be missed (Leech, 2002). As such, heads of selected organisations within the chosen stakeholder categories were contacted for interviews or guided the researcher to the most relevant individual who met the selection criteria. Further details about each category are provided.

Primary Stakeholders

It was important to interview local primary stakeholders because they possess deep, context-specific knowledge of on-the-ground challenges, practices, and cultural dynamics about ASGM that external stakeholders may overlook. Their insights could throw light on whether existing formalisation policies are effective and sustainable, or otherwise, and identify options that are responsive to local needs and can ultimately foster greater community buy-in of ASGM and long-term success. The researcher considered that these insights could be gathered from individuals with significant stakes and interests in community livelihoods, so included community and opinion leaders, those involved in agriculture and trading, and traditional authorities. As such, the community-level key individuals selected for stakeholder interviewing across the district included a traditional leader or their representative; a head of farmers' cooperative; an agribusiness trader; and an Assembly member. However, the researcher acknowledges that interviewing only one individual from each of these categories limits the representation of potentially diverse viewpoints within each stakeholder group. Variations in opinion, shaped by individual experiences, socio-economic contexts, or other factors, might not be fully captured. This limitation reflects the logistical and time constraints of the research. This limitation applies to the remaining categories discussed.

Civil Society Stakeholders/Secondary Stakeholders

Gathering data regarding the perspectives of secondary stakeholders was considered valuable to help elaborate explanations on the (in)effectiveness of Ghana's ASGM legal framework (objective 2, 3). Hence, representatives from two NGOs: A Rocha and Solidaridad, as well as a gold buying company were earmarked for interviews. These selected organisations were contacted via phone call, with phone numbers obtained from their company websites to arrange meetings. However, interviews could not happen due to their officers not being available. To mitigate the loss, information/news items on the websites of the NGOs that were of importance to the objectives of this thesis were gathered incorporated in this thesis (see Chapter 5). Concerning gold trading, inputs were also not fully missed, because some of the ASGM miners interviewed doubled as gold traders, albeit at the local level, providing insights at those scale.

Regulatory Stakeholders

The Government documents reviewed revealed that ASM miners liaise with the following agencies to secure licenses and renew permits: Minerals Commission, Lands Commission, Environmental Protection Agency (EPA), Water Resources Commission and District Assemblies. Additionally, ASGM impact farmlands, waterbodies, forests and local development. Therefore, these agencies across national, regional and districts levels, together with the Ministry of Food and Agriculture and the Atiwa West District Assembly were mapped/purposively selected for interviews to gain practical insights regarding implementation of ASGM legislation and to evaluate for policy coherence (objective 3).

The following Eastern regional government agencies were visited to arrange interviews with the head of institutions or their nominated key representatives who could provide valuable insights due to their roles and duties/experiences: Minerals Commission, Lands Commission, EPA, Ministry of Food and Agriculture, and Water Resources Commission. Interview arrangements were successful except with the Water Resources Commission, where the designated official was unavailable. The processes for water use permits for miners discussed in Chapter 6 is thus based on documents accessed on their website. Although ASGM impacted forest areas, the Forestry Commission was excluded from interviews because they only handle regulatory issues concerning mining in forest reserves, which is the preserve of large-scale mining in Ghana.

At the district level, heads of the agricultural department and the planning department of the Atiwa District Assembly were selected and phoned with numbers obtained from their websites. These individuals were subsequently visited and interviewed. There were no district-level offices for the Minerals Commission, Lands Commission, Water Resources Commission, or EPA in the Atiwa West District, although these entities would have been interviewed if they existed.

In line with purposive sampling processes (Creswell, 2013), upon interviews with a national officer at Minerals Commission and an official from the EPA, the researcher considered that the information gathered was sufficient to complement existing secondary data to highlight issues at the national level in this thesis. During these interviews, there was a notable

convergence of opinion, particularly regarding the challenges and gaps in ASGM governance, which reinforced the reliability of the data collected. Consequently, the researcher did not engage in further interviews with national officials from other identified government agencies. This decision was considered reasonable given that the much of the focus of the thesis was on examining the challenges with implementing existing policies and legislation, which are more directly observed and addressed at the regional, district, and community levels. The convergence of perspectives at the national level suggested that additional interviews would likely yield similar findings, allowing the researcher to concentrate efforts on gathering diverse, context-specific insights from stakeholders operating closer to the ground.

Involving regulatory and state agencies across various governance levels was deemed critical to offer an understanding of the legal frameworks, policy priorities, enforcement capabilities, and enforcement mechanisms necessary for effective governance. Their perspectives had the potential to bridge the gap between grassroots needs and institutional capabilities, ensuring that formalisation strategies are both locally relevant and aligned with broader sustainability goals. Perspectives from these agencies were therefore vital to design inclusive, feasible, and long-lasting solutions for formalised, sustainable ASGM.

Financial Stakeholders

No stakeholders from financial institutions were specifically selected for interviews, as the objectives and research questions of the thesis did not explicitly require that. Information regarding ASGM informal lending was gleaned from interviews with ASGM miners (Chapter 5). Past efforts to support miners with public finance are also discussed in Chapter 6.

Other Actors

While interviews with additional stakeholders, including academics, journalists, and consultants could have offered further insights, logistical and time constraints of the research meant that such other stakeholders were not included and not interviewed. This was also done to ensure that data gathering was focussed and closely aligned with the objectives and research questions of the thesis, so as to reduce risk of gathering too much data which could

impede the timely analysis of data. It is nevertheless recognised that a larger number of interviews may have revealed broader diversity of different views.

In the end, the focus was on selecting stakeholders from the local mining areas, and government agencies, and this helped refine the list, and ultimately 11 stakeholders were selected for interviews, which include:

1. Cocoa purchasing officer (Ekorso)
2. Farmer association chairman (Akwabuoso)
3. Traditional leader (Pameng)
4. Two regional officers from the Minerals Commission (Eastern region)
5. One national officer from the Minerals Commission
6. District manager from the Agricultural Department
7. District extension officer from the Agricultural Department
8. Eastern Regional extension officer from the Agricultural Department
9. Officer from the Atiwa West District Assembly
10. Regional/national officer from the Environmental Protection Agency (Eastern Region)
11. Regional officer from the Lands Commission (Eastern Region).

The one-on-one interviews lasted approximately one hour, allowing for in-depth discussions in a confidential setting, and providing insights into potential policy implications of the study. The semi-structured format facilitated open conversations, encouraging participants to share insights beyond the researcher's predefined questions.

3.6.2.8 Secondary data collection

To complement the primary data, various documents were sought, downloaded, and reviewed. These included Ghana's laws and regulations on ASGM, as well as sectoral policies related to ASGM governance in Ghana (to address objective 3). The inclusion criteria for sectoral policies focused on documents from sectors most directly impacted by ASGM and closely linked to its operational and regulatory frameworks, namely mining, land, water, agriculture, environment, and development. This sample allowed a focused analysis of policies that connect with governance and sustainability within the ASGM sector as well as having a central role in formalisation efforts aimed at achieving more sustainable ASGM

practice (Horsley et al., 2015; Mensah, 2021; Mkodzongi and Spiegel, 2019; Mujere and Isidro, 2015; Siegel and Veiga, 2009). Other sectors considered to have a more indirect relationship with ASGM impacts and formalisation, such as education and transport, were excluded. The sectoral policies included the Minerals and Mining Policy, the National Agriculture Investment Plan, the National Land Policy, the National Environmental Policy, the National Development Policy, and the Water Management Policy. These documents were searched and accessed via credible online portals of various agencies, including the Ministry of Lands and Natural Resources (mlnr.gov.gh), the Minerals Commission (mincom.gov.gh), the Environmental Protection Agency of Ghana (epa.gov.gh/epa/) (see details in Section 6.3). Comprehensive lists of the laws and regulations assessed are provided in Appendices E and F. Additionally, government reports and statistics on cocoa production and ASGM were collected for analysis to gain deeper insights and validate data from other sources. Examples include annual cocoa production data from the Ghana's COCOBOD (used in Chapter 4) and the 2021 Ghana audit report on ASGM (used in Chapters 5 and 6).

Combining these secondary data sources with primary data on livelihood dimensions helped explored essential information across national and local levels. This approach also helped identify connections between national policies and formal or informal institutional arrangements.

3.7 Approaches to data analysis

3.7.1 Quantitative analysis

Questionnaire survey data was transferred to the Statistical Package for the Social Sciences (SPSS) for data cleaning and analysis. Various analyses were performed, including a Kruskal-Wallis test to identify differences among the livelihood trajectory groups (see Chapter 4). Additionally, several descriptive analyses were conducted, with results presented in graphs and tables to provide a synthesised overview. Microsoft Excel was also used, including to analyse quantitative data from the environmental surveys, as well as secondary data (see Chapters 4, 5 and 6).

3.7.2 Qualitative analysis

3.7.2.1 Thematic analysis

Thematic analysis was employed in the analysis of the primary qualitative data generated from the interviews, transect walks and FGDs and environmental surveys. This was in line with the epistemological position underpinning the research, as well as the need for a qualitative method that complements the research questions and the researcher's expertise in using such method (Bryman, 2016). Thematic analysis involved analytically examining narrative materials from oral histories and interviews by breaking the text into relatively small units of content and submitting them to descriptive treatment (Braun and Clarke, 2006; Vaismoradi et al., 2013) to draw out themes on ASGM's impacts, drivers of informality in ASGM and the challenges to sustainable ASGM.

The study utilised a combination of semantic and latent coding. A semantic theme is at an explicit level whilst a latent theme is at an interpretative level (Bzoyatzis, 1998). The semantic meanings provided an analysis that stayed close to the participants' experiences, thus providing surface level meanings, whilst latent coding explored the frameworks underpinning those semantic meanings (Braun and Clarke, 2006).

The study used an inductive approach whereby the themes were linked strongly to the data and did not attempt to fit with an existing coding frame or the researcher's pre-existing ideas (Braun and Clarke, 2006; Patton, 1990). This meant that the themes were linked closely to the words and meanings from the interviewees, while guided by research the questions and epistemological positions. The inductive approach has been used in previous ASGM research (Bugmann et al., 2022; Osei et al., 2021; Pokorny et al., 2019).

3.7.2.1.1 Coding and thematic analysis process

The recorded interviews were first transcribed. Each transcription was reviewed and verified against audio files and field notes to ensure accuracy and representativeness (Braun and Clarke, 2006). Coding involved detailed line-by-line manual coding to capture key analytic ideas within the data which may relate to the research questions and was repeated to ensure key codes were not missed. Coding led to the generation of themes and/or groups of meaning which outline the data, guided by the research questions and objectives. The coding process

was recursive and involved movements back and forth with the data and the emerging themes. For this reason, the analysis followed an inductive and iterative method of thematic analysis, focusing on familiarisation with the data, the generation of initial codes, the generation of initial themes, reviewing themes, defining and naming of themes (Braun and Clarke, 2006).

All transcripts were reviewed in detail to ensure that they were adequately coded, and all data extracts were collated together under specific codes. The initial coding served to systematically highlight interesting features across the data sets that appeared to have a repeated pattern in all or most transcripts. The initial codes were then collated or categorised into broader themes by reviewing all the relevant data for each potential theme.

A theme captures something important about the data in relation to the research question and represents some level of patterned response or meaning within the data set (Braun and Clarke, 2006). The relationships between different themes were also considered. In reviewing the themes that were developed, it was then essential to decide whether or not all themes were relevant to the research. Extracts that did not seem to match themes were discarded, as were those themes that did not present useful findings. Sub-themes were also identified within themes to provide more in-depth understanding of the narratives. Each theme was given a title, accompanied by its meaning and interpretation, in line with the research questions and objectives (see Appendix F for themes with interpretation developed guided by research questions and objectives). The themes generated have been presented and discussed in relation to the research questions, including quotes from interviewees, in Chapters 4, 5, and 6. These themes (titles) are listed in Table 3.4.

Table 3.4. Thematic analysis themes aligned with objectives

Thesis objectives	Themes
1	Changes in rural livelihoods and cocoa farming (1990s–2000s) Livelihood diversification, economic gains and environmental impact of ASGM Household characteristics shaping livelihood shifts with the rise of ASGM Resource access and financial assets shaping livelihood transitions with ASGM Infrastructure and external factors driving livelihood shifts toward ASGM Opportunities and livelihood diversification through artisanal mining Barriers to sustainable development amidst artisanal mining emergence
2	Diverse methods employed in ASGM practices Impact of ASGM on agricultural land Impacts of ASGM on water resources ASGM impacts on financial and Infrastructure Institutional linkages between agriculture and ASGM Financial challenges and hardships faced by farmers Complexities of customary land tenure and informal land markets in ASGM Challenges in community leadership amidst mining influx Attitudes of ASGM miners and gold traders Power imbalance and ineffective institutional support in ASGM
3	Connections and coherence between mining and land policies Mining and agriculture linkages and policy coherence Mining and water management links and policy coherence Mining and development connections and policy integration Mining and environment coordination and policy coherence Political influence in ASGM formalisation and policy implementation Institutional challenges in ASGM formalisation and policy coherence Financial challenges hindering ASGM formalisation and policy implementation Regulatory challenges in ASGM formalisation and policy coherence Socio-cultural settings in ASGM formalisation and policy coherence

3.7.2.2 Document review

Key documents reviewed included Ghana's mining laws and regulations on ASGM, as well as sectoral policies related to ASGM governance (listed in 3.6.2.8). These were reviewed to assess the effectiveness of the legal frameworks in supporting ASGM formalisation (objective 3). Details of the steps and the laws are presented in Section 6.3, also see Appendix F for a list of laws and regulations reviewed. The coherence of these policies concerning ASGM

formalisation and sustainability were evaluated using qualitative document analysis (QDA) (see Section 3.7.2.3 and Section 6.3 for further details).

3.7.2.3 Qualitative Document Analysis (QDA)

The policy coherence investigation (objective 3) used Qualitative Document Analysis (QDA) to facilitate analysis of policy documents (e.g. Altheide et al., 2008). QDA provides an approach that examines the meaning and implications of policy texts rather than just identifying keywords, making it suitable for assessing the coherence of policy frameworks (Altheide et al., 2008). The QDA process and justification for its use is also detailed in Section 6.3. QDA has proven effective in other similar studies, such as that by Antwi-Agyei et al. (2017), which examined the coherence between sectoral policies and climate-compatible development in Ghana, and England et al. (2018), who explored policy coherence in water, agriculture, and climate change adaptation across selected Southern African countries.

The analysis phase of the QDS employed a content analysis approach (Stemler, 2001) based on scoring criteria of 0-3 to assess coherence (see Section 6.3). In the content analysis, six key topics were deductively identified: i) support for artisanal and small-scale miners, ii) land use management, iii) ASGM-agriculture connection, iv) water management, v) sourcing of gold, and vi) land degradation/reclamation. These topics aligned with the research questions in objective three, crosscut the three pillars of sustainable development: economic, social and environmental, and reflect the main dimensions across the six selected mining-sensitive sectors.

This was followed by a review of the selected policies' objectives, principles, and strategies and/or management plans which led to identification of specific keywords or codes, grouped under economic, social and environmental headings (Horsley et al., 2015) (Section 6.3.2). These identified keywords were then used to analyse relevant sections of each document, where strategies or measures related to the mining-sensitive sectors were outlined. The content of the sentences or paragraphs containing the keywords provided insights into government plans, priorities, and policy measures. Strategies were subsequently grouped, synthesised, and organised into themes, which were entered into tables for each policy (see themes in Table 6.3). This facilitated cross-comparison of the main emphases in each sector, offering key contextual information. The content analysis thus facilitated a comprehensive

assessment of policy coherence across sectors, ensuring a more nuanced evaluation of coherence across sectors in addressing ASGM sustainability.

To enhance the reliability of the findings, interviews with a number of experts of those listed in 3.6.2.7 were done to validate the QDA scores, providing additional perspectives and clarifying any discrepancies (see details in Sections 6.3 and 6.4). This expert validation offered an extra layer of scrutiny, ensuring that conclusions were not solely based on the researcher's interpretations but that they were corroborated by knowledgeable independent actors familiar with the sectors and regional context. This dual approach of content analysis and expert input as employed to strengthen the accuracy and reliability of the results, reduces the risk of oversimplification, and provides a robust qualitative measure of coherence that captured the complexities of policy interactions.

When conducting document analysis, both quantitative and qualitative methods can be applied. While quantitative methods, which emphasise the use of statistics have been suggested by others (Duraiappah and Bhardwaj, 2007), they were not deemed appropriate for this research as the primary focus was not statistical data aggregation, but on understanding and interpretating the pre-existing policy texts. QDA was also chosen due to the readily availability of policy documents from credible sources, and its cost-effectiveness (Morgan, 2022).

3.7.2.4 Validating findings

Multiple data sources were used to validate findings and ensure their reliability. For example, findings from environmental surveys and transect walks validated aspects of key points raised during focus group discussions. Triangulation, the comparison of data from different sources or methods, helped to corroborate findings and identify any discrepancies that needed to be addressed. In this study, any contradictions in the data sources were addressed through careful analysis and comparison. This involved scrutinising the data to understand the underlying reasons for discrepancies and considering the context in which they arose. To resolve conflicting information, validation was carried out by cross-referencing the contradictory data with supplementary information from credible sources or consulting experts for clarification. For instance, aspects of oral history narratives were validated with

historical cocoa production data obtained from the Ghana Cocoa Board. Ultimately, a comprehensive understanding of the issue was sought, and efforts were made to reconcile conflicting data through thorough investigation and critical interpretation.

3.8 Risks and ethical considerations

The research team collaborated with district agricultural officers and sought communities with no ongoing conflicts or tensions in line with requirements set out on the risk assessment. To gain community support, the research team initially approached influential chief farmers and opinion leaders to explain the research's purpose. The research's purpose was also clearly explained during household surveys, FGDs, and interviews and helped douse potential suspicions. Considering the hazardous nature of ASGM sites, the team assessed health and safety issues before conducting environmental surveys of mine sites. They wore appropriate safety gear, carried British Standard first aid kits, and followed recommended routes with farmers. The team observed Ghana's and the University of York's COVID-19 protocols, which included conducting interviews and discussions in open, shaded, and well-ventilated spaces. The team provided hand sanitizer and facial masks, encouraging participants to use them, while minimising physical contact.

This research was approved by the Environment and Geography Ethics Committee at the University of York. In the field, ethical considerations focused on ensuring that participants were well informed about the study, their confidentiality and anonymity assured, and participants' consent secured, through signing a consent form or obtained verbally, prior to the commencement of the study. Participants were also made aware that involvement in the research was voluntary (no compensation), and they had the right to opt out at any stage of the study prior to data analysis. The principal researcher trained the research assistants in these ethical considerations to ensure the protection of research participants, the integrity of the research process, and the credibility of the research findings. The assistants were thoroughly trained on *Participants information sheets* (Appendix A) to effectively communicate the research purpose and procedures to participants during surveys; equipped to explain participants' rights, and to address any queries or concerns raised by participants. For data collection, alongside fieldnote books, electronic tools including tablets, smart

phones, and audio recorders were utilised, secured with password protection and accessible only to the research team. All data collected were carefully secured, and electronic data was stored on encrypted/password protected memory sticks or external drives and was remotely uploaded to the University of York virtual drives as soon as practicable.

3.9 Research limitations

This thesis conducted environmental surveys, which helped in validating information from other methods such as FGDs, but these surveys were not technically detailed since the study was focussed on exploring governance challenges to sustainable ASGM practices rather than providing an in-depth environmental impact assessment of ASGM activities. The thesis explored challenges with ASGM activities along its value chain. The value chain of ASGM is complex, transcending from mineral extraction activities and reclamation, in-country sourcing, processing or refining and sourcing across national borders. Value chain consideration in this thesis is limited to the local ASGM activities (digging and washing of gold and state of abandoned mine sites) and within-country gold trading (from miners to 'middlemen' or government agents).

Participatory methods were used in this research because they allowed the researcher to gain local insights into the complexity of ASGM operations and how it affects agriculture and rural livelihoods in the study communities. While this proved valuable, their application was not without limitations. There are concerns regarding the generalisability of findings derived from context-specific participatory approaches like focus group discussions and transect walks. To mitigate these shortcomings, quantitative methods such as household surveys, environmental surveys, and the utilisation of secondary quantitative data from recognised institutions like The Ghana Cocoa Board were integrated alongside participatory approaches. This combination, alongside gathering data at multiple scales allowed for a broader scope of generalisation. Table 3.5 presents limitations or challenges associated with the methods applied and how they were addressed.

Table 3.5 Strengths and limitations of the research methods

Method	Strengths	Limitations	Practical solutions
Household Questionnaire survey	Permitted exchange of knowledge between researcher and participants. Relatively cheaper, flexible and adaptable (Bryman and Bell, 2007).	Time consuming, when gathering data from a large sample size, as was the case in this study (Bryman and Bell, 2007).	Researcher recruited assistants and trained them to conduct surveys. Research team kept respondents on the topic under discussions and avoided unnecessarily digressions that did not add to the interview responses.
Transect walk	Understanding land use changes, livelihood issues and biophysical resource distribution and vulnerability. Very informative and interactive for researcher (Antwi-Agyei et al., 2013).	Many issues were raised within a short time limiting learning outcomes on any specific subject. Lack of exchange between different groups, as allowing multiple groups to undertake the same transect walk could enable comparing their experiences, but that would require additional time.	Concentrated on significant social and physical features of the community. Recorded and photographed features for later discussions with key informants, alongside environmental surveys, helped to further validate points raised. Engaging community leadership early on facilitated the selection of knowledgeable participants from diverse livelihood backgrounds for the transect walk, enriching the information gathered.
FGDs	Helped to validate secondary information, and information from other sources such as household surveys. Issues on poverty and development deemed significant were given attention (Denscombe, 2017).	Certain individuals dominated, while some were shy to talk, felt intimidated. There were also occasional tense moments because some people had problems with others regarding other matters not under study e.g. allegations of unequal distribution of state-supplied fertilisers by farmer union leadership.	Researcher moderated to make sure each participant was given opportunity to express themselves and share their experiences (Hopkins, 2007). Researcher ensured timely interventions to safeguard disagreements in opinions did not escalate into uncontrolled arguments, maintaining that discussions were relevant to the scope of the research and digressions by participants were kept to the minimum. Opinions from less powerful members of the communities provided valuable insights into the power relations at work at the local scale.
Environmental survey	Helped in validating/triangulating information from other methods such as FGDs (Bansah et al., 2016).	In-depth contextual information regarding observed phenomena on sites may be insufficient or lacking	Combining environmental surveys with key informant interviews of farmers whose lands were mined enriched the data gathered.
Key informant interviews	Allowed in-depth discussions on main issues found in surveys (Robson, 2002).	Difficulties encountered in identifying appropriate key informants.	Got inputs from opinion leaders such as chief farmers, union leaders and assemblymen. More informants identified during the FGDs.
Expert and stakeholder interviews	Provided expert opinion on ASGM activities and their challenges, and links with agriculture and livelihoods.	Difficulty in getting experts to participate in interviews (Robson, 2002).	Used personal contacts and referrals to link up with experts. Booked interview appointment to suit experts and stakeholders.
Oral history	Very informative and highlighted past experiences and events, which facilitated a deeper understanding of livelihood challenges.	Memory lapses and distortions caused potential biases in responses by residents (Antwi-Agyei et al., 2013).	Respondents were prompted with significant local and national historical events. Cross-checked narratives with secondary data e.g. historical cocoa production data from COCOBOD.
Policy and institutional analysis	Allowed the targeting of specific policies to enhance the relevance of research.	Difficulty in getting access to some policy documents from governmental agencies and institutions.	Used personal contacts in the ministries to advice access routes to policy documents. Also, during expert interviews, requests were made for any other relevant secondary data.

3.10 Chapter summary

This chapter extensively covers the case study areas, research approach, methods, and analytical techniques utilised. It also addresses methodological issues and ethical considerations crucial for maintaining academic rigor and validity. Both quantitative and qualitative approaches are discussed, highlighting their respective advantages and disadvantages. A mixed-methods approach has been employed to ensure comprehensive data collection and analysis, aimed at developing strategies or frameworks for promoting sustainable ASGM development across household, community, and governmental institutional levels. The subsequent chapters (Chapters 4–6) present the findings derived from this study.

Chapter 4. The impacts of artisanal and small-scale gold mining on rural livelihood trajectories: Insights from Ghana

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The content of this chapter has been published as follows:

Adranyi, E., Stringer, L. C., & Altink, H. (2023). The impacts of artisanal and small-scale gold mining on rural livelihood trajectories: Insights from Ghana. *The Extractive Industries and Society*, *14*, 101273. https://doi.org/10.1016/J.EXIS.2023.101273

Abstract:

Rising gold prices, together with other challenges faced by smallholders, mean rural people in sub-Saharan Africa are increasingly taking advantage of ASGM's low barriers to entry and engage in artisanal and small-scale gold mining (ASGM) to make money on a regular basis. Yet, adequate knowledge on the impact of ASGM's emergence on rural livelihood trajectories is lacking, particularly for emerging ASGM communities. Understanding the long-term dynamics of community livelihoods as small-scale mining emerges is important to inform the design of appropriate sustainable rural livelihood policies. Existing scholarship has predominantly examined livelihood snapshots rather than exploring how present livelihood outcomes have emerged over time, and for whom. Guided by the sustainable livelihood framework, this paper uses a household questionnaire survey, oral history interviews, focus group discussions and transect walks to investigate livelihood trajectories in three farming communities engaged in ASGM in Atiwa West district, Ghana, from the early 1990s up to 2021, focussing particularly on changes since the rise of ASGM in 2010. Three distinct livelihood trajectories emerge — consolidation, fluctuation, and marginalisation — reflecting the different pathways followed by rural households. In this constrained, yet shared resource space, ASGM's emergence has benefitted the farmers-turned-miners and enhanced their livelihood outcomes. But it has had damaging consequences for livelihoods dominated by subsistence farming so that more rural people find themselves locked into poverty, due to competition for arable farmlands with ASGM appealing as a more lucrative option in the short term. Findings evidence the differential and unintended consequences of livelihood adjustments. They highlight the urgent need for well-targeted policies and sustainable livelihood strategies in farming communities where ASGM is emerging to provide effective linkages between rural livelihoods, agriculture, and mining, and address growing inequalities in livelihood trajectories posed by ASGM's emergence.

Keywords: artisanal and small-scale mining, gold, agriculture, livelihood trajectories, Ghana.

4.1 Introduction

Rural livelihoods are closely linked to the landscapes in which people live and the natural resources present. Across sub-Saharan Africa, increasing pressures from environmental and socio-economic changes – e.g., population increase and migration, climate change, global market demand for resources, and changes in land use – influence the livelihood strategies rural people adopt (Shackleton et al., 2019). Multiple cross-scale stressors such as high levels of poverty, food insecurity, health concerns, low levels of development, rapid urbanisation, weak governance, natural resource management systems, and ecosystem degradation shape the possible livelihood activities people can pursue.

A livelihood comprises the capabilities, material and social assets, and activities required to make a living (Chambers Conway, 1992). A livelihood is deemed sustainable when "it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base" (Scoones, 1998: p.5). The Sustainable Livelihood Approach (SLA) recognises that people compose complex, dynamic livelihood portfolios influenced by socio-economic, political, and climatic uncertainties and variabilities (Ellis, 2000). The SLA focuses on the income-generating, cultural and social activities that people engage in, the assets that enable those activities to make a living, and what people gain as a result (livelihood outcomes) (Scoones, 1998; 2009). In pursuing a livelihood, both access to natural, physical, financial, human, and social assets and those that are subsequently used, are mediated by transforming structures and processes (e.g., laws, policies, and institutions). Livelihoods are also affected by external factors, referred to as the 'vulnerability context' (Allison and Ellis, 2001). The SLA provides insights into livelihood vulnerability and inequalities that confront households (van Dijk, 2011)

Combining the SLA with the concept of livelihood trajectories, i.e., the directions that livelihoods follow over time (Bagchi et al., 1998; Sallu et al., 2010), enables the dynamics of livelihoods to be captured and analysed across multiple scales, and can help account for social, political and environmental variability over time (de Haan & Zoomers, 2005; Scoones, 2009). Consideration of livelihood trajectories allows exploration of the life histories of individual households regarding how the present conditions have emerged and evolved over time, and for whom, as well as the strategic behaviours that underpin those changing livelihoods (de

Haan and Zoomers, 2005). It helps identify change processes and barriers to change, as well as the differential and potentially unequal effects of new livelihood strategies and people's capacity for action and decision making (Sallu et al., 2010; Orchard et al., 2016; Trung Thanh et al., 2021).

By using the SLA as its underlying framework alongside the concept of livelihood trajectories, this paper examines the impact of the emergence of new livelihood activities on the livelihood trajectories of rural people engaged in farming in Ghana. In particular, it focusses on the emergence of artisanal and small-scale gold mining (ASGM) and considers its livelihood trajectory impacts in a study area previously dominated by agricultural livelihoods, focusing on multiple scales – households and community – over the period 1992 – 2021.

The main occupation across sub-Saharan Africa is smallholder agriculture (≤ 2 ha), chiefly organised as a family enterprise. Almost all agronomic activities (e.g., weeding, sowing and harvesting) use family labour, with rudimentary equipment for farming (Stringer et al., 2020). In Ghana, agriculture plays a key economic role, contributing 20% of GDP and is a significant employer (Ofosu et al., 2020). Smallholder farming is nevertheless fraught with challenges, with some areas consequently experiencing deagrarianisation (Pritchard et al., 2017). Decades of insufficient government budgetary allocations have resulted in minimal support for agriculture. Subsidies for innovative technologies and crucial inputs such as fertilisers are lacking. Farmers have to pay exorbitant prices for their inputs due to high inflation and currency fluctuation (Okoh and Hilson, 2011). Smallholders also face poor access to markets and low prices for their produce. These and other factors, such as changing climatic conditions, mean that smallholder farming is losing its viability, causing diminished farm productivity, high levels of poverty (Hilson, 2016a) and in some cases exit from agriculture altogether (Stringer et al., 2020). Available land for smallholders has declined, largely because of growing rural populations and inheritance-based land fragmentation over decades (Pritchard et al., 2017). Many farmers consequently find themselves in unstable situations, struggling to produce sufficient yields for the market on their undersized plots (Hilson and Garforth, 2012). Farming households increasingly experience continued hardships linked with over-dependency on unprofitable agricultural activities for survival. When rural people encounter such 'agricultural poverty' (Hilson and Garforth, 2012), they tend to consider other possibilities and potentially pursue other undertakings to secure a livelihood and supplement

their incomes. Such livelihood diversification or 'branching out' is common across sub-Saharan Africa (Sabates-Wheeler et al., 2018) as rural people with access to mineral rich lands reorient to engage in artisanal and small-scale gold mining (ASGM) (Hilson & Garforth, 2012; Banchirigah & Hilson, 2010).

Artisanal and small-scale mining of minerals and metals (mostly informal and labour-intensive, low capital, low-tech, and a risky form of mining) (ASM) has become a vital livelihood activity and one of the main non-agricultural rural livelihood activities in the Global South due to its low entry level (Hilson & Osei, 2014). Rises in gold prices since the early 2000s – US$ 8,652/kg in Nov 2000 rising to US$60,688/kg in Dec 2020 (World Gold Council) – mean artisanal and small-scale gold mining (ASGM) is very lucrative in Ghana (Osumanu, 2020). Together with the promise of rapid returns, this has encouraged many rural people to engage in it. It has also changed ASGM's operation and reach, with the use of more sophisticated methods and rapid expansion into traditional farming areas (Ofosu et al., 2020).

ASGM is seen by many African governments, development partners, and donor organisations like the World Bank, as a means to create jobs, generate wealth, boost rural livelihoods and offer greater distributional benefits to mining communities (Amankwah and Anim-Sackey, 2003). Studies have shown that ASGM serves as a viable source of income for rural inhabitants in the developing world (Banchirigah, 2008; Tschakert, 2009; Teschner, 2014). It can enable improved standards of living, as reflected in asset acquisition, provide for the family and can increase abilities to afford education and healthcare (Hilson & Osei, 2014; Arthur et al., 2016; Osei et al., 2021). Recent studies indicate that ASM is now a platform for wealth creation for its participants (Hilson and Hu, 2022). Various reasons have been provided for the widespread prevalence of artisanal and small-scale gold mining (ASGM) as a way of branching out of agriculture in sub-Saharan Africa including: ease of entry (no prior special skillset required) (Hilson and Potter, 2003); proven extensive distributional benefits (Banchirigah, 2008); failure of the IMF/World Bank's Structural Adjustment Programmes to improve rural livelihoods more generally (Hilson & Potter, 2005; Banchirigah, 2006) and because ASGM is seen as a way to escape poverty (Hilson and Osei, 2014).

ASGM creates employment, promotes improved livelihoods (Hilson and Hu, 2022; IGF, 2018) and contributes to national economies (Osei et al., 2022), yet itself is fraught with many

challenges. Many studies have shown that ASGM activities come with high environmental costs (Ncube-Phiri et al., 2015; Bansah et al., 2018; Ofosu et al., 2020). Osei et al. (2022) found in Ghana that most youth ASGM operators lacked considerable knowledge on the long-term impact of their activities on the environment and prioritised their financial needs for survival over any environmental costs. Studies have also highlighted how existing customary land tenure practices largely dictate miners' access to lands, enforcing informality of the ASGM sector (Nyame and Blocher, 2010) and how the intersection of state-based mining titling systems with customary land tenure arrangements impacts ASM formalisation efforts (Mensah, 2021).

The ASM sector dovetails subsistence agriculture, in many instances generating finance used to support farming including to purchase essential farm inputs such as fertilisers, improved seeds, and tools (Pijpers, 2014; Brugger & Zanetti, 2020; Hilson & Hu, 2022). However, ASGM's informal nature and environmentally-unfriendly methods have the potential to adversely impact other livelihood options, both in host communities and beyond (Baffour-Kyei et al., 2021). Despite these complexities, scholars have paid scant attention to how ASGM activities impact other rural livelihoods. The existing literature on ASGM's impact on livelihoods, mostly treats the participants in the sector as a homogenous group or, at best, shows evidence of gendered impacts (Yakovleva, 2007; Arthur-Holmes & Abrefa Busia, 2022) and highlights ASGM as an opportunity for youth employment in rural areas (Osei et al., 2021; Osei et al., 2022). Some ASGM-related livelihood studies have been undertaken in Ghana (e.g., Ontoyin & Agyemang, 2014; Arthur et al., 2016; Osumanu, 2020) but they have not fully provided evidence of aspects of livelihoods that have improved and those that become more vulnerable due to ASGM development. When ASGM emerges in established farming settings, it remains unclear if it benefits everyone in those spaces. It is unclear which groups benefit most, which ones are most affected, and what factors shape this livelihood differentiation (if any). Although published studies provide some useful insights for livelihoods, significantly less attention has been paid to how the expansion of ASGM has affected livelihood dynamics in new rural mining communities (new frontiers) and what this means for overall livelihood trajectories. Also, little attention has been given to historical perspectives to trace livelihood dynamics and trajectories linked to ASGM, which is particularly important given households' differing capabilities that enable, constrain and shape their livelihood decisions and outcomes (Antwi-

Agyei, 2012; Hilson & Hu, 2022). Similarly, it remains unclear how different groups in rural communities benefit from or are constrained by ASGM's emergence.

This paper aims to identify and analyse livelihood trajectories linked to ASGM in new frontier communities, with a view to informing policy interventions that support the development of sustainable rural livelihoods. It improves knowledge on the complex interactions between multiple drivers of livelihood change, and the impacts of, and responses to these changes, exploring the outcomes of different local responses, external interventions, and policy actions, that purport to enhance sustainable rural livelihoods. It asks:

1. What household livelihood portfolios existed prior to and after the rise of ASGM, and what key factors have influenced changes in livelihood activities?
2. What are the impacts of ASGM emergence on livelihoods?
3. What opportunities and barriers have evolved for different livelihood trajectory groups since ASGM emergence and how do these interact to shape overall livelihood trajectories?

4.2 Methods and data

4.2.1 Study area

Atiwa West District in Ghana's Eastern region is located in the semi-deciduous forest agro-ecological zone and is highly suitable for agriculture. The district is predominantly rural, and cocoa production is the main economic activity. It is part of the Atiwa enclave that produces the region's highest annual cocoa yields (Codjoe et al., 2013; MOFEP, 2021). Since 2010, artisanal and small-scale gold miners (both legally and illegally operating) have been exploring and mining gold in the district with sophisticated machinery, triggered by commercial discovery of huge gold deposits (7.4 million oz) in nearby Birim North District by Newmont Mining Inc. in 2010 (Mining Technology, 2014).

4.2.2 Data collection methods and analysis

Fieldwork was undertaken from October to December 2021 in three farming communities involved in ASGM operations: Akwabuoso, Ekorso and Pameng. These communities were chosen following review of online news publications (e.g., Thecocoapost.com, 2020), use of Google Earth imagery to observe recent mining activities, and communications with a district

agricultural extension officer. The communities cover the three Area Councils (Kwabeng, Abomosu and Akropong) ensuring data was gathered across the district. They were accessible by road; and residents were willing to participate in the study. Qualitative and quantitative methods were applied to gather empirical data (Table 4.1).

A questionnaire survey was firstly administered among residents across the three communities (n=360) seeking information on livelihood portfolios and how they were impacted by ASGM. Respondents identified the positive and negative impacts of ASGM on their households. Quantitative demographic, economic and social data, and opportunities and barriers that emerged, were also collected. The questionnaire was piloted with 30 households to ensure content was contextually relevant, but the sample was excluded in the final dataset. Some farmers who took part in the main questionnaire later participated in focus group discussions (FGDs) following preliminary descriptive statistical analysis of the survey data. They were selected based on their experiences and interest to participate, ensuring representation across gender and age groups. FGDs were used for clarification, validation of survey findings and to provide forward-looking insights. FGDs focussed on the community rather than individual level to enable those raising sensitive issues, such as illegal mining activities, to do so generally. Oral history interviews were conducted among 30 purposively selected residents who had participated in the survey (Table 4.1). Oral histories explored household accounts of livelihood changes and responses to livelihood disruptions over the period 1992 – 2021. The year 1992 was selected as a starting point because up to then, Ghana faced considerable political instability, including coups. The 1992 presidential and parliamentary election was the first election since 1979. Interviewees were of different age, gender, and capabilities, and engaged in varied livelihood activities including farming, ASGM, trading, and artisanship.

Key informant interviews were also conducted with five purposively selected officials in the district (one district agricultural officer; one Atiwa West District Assembly official, one cocoa purchasing officer; one educationalist; and one chairman of the farmers' cooperative). Informants were selected based on their knowledge and experience and interviews continued until we reached saturation, with no new information being received (Bowen, 2008). Transect walks were conducted in each community with three community leaders, who were purposively selected based on recommendations from the chief farmers and associated

leaders. This exercise observed the distribution of resources, infrastructure, land use patterns and different activities taking place within the three communities. Data collection tools were developed in English and translated into Twi. Three research assistants fluent in both languages assisted with data collection. All data collection was conducted in Twi, with data translated into English for analysis, and in accordance with ethical approval. Interviews and FGD recordings were transcribed and translated. By means of manual coding, themes were identified from recurring ideas and described. Primary results regarding cocoa farming and productivity were triangulated with data on annual cocoa bean production obtained from their online portal of Ghana Cocoa Board (https://cocobod.gh/cocoa-purchases).

Table 4.1 Research methods and sampling techniques

Method	Sampling method	Sampling size	Data capture Tools	Data analysis
Face-to-face household survey with semi-structured questionnaire	Simple random sampling	360* (117-Akwabuoso; 121-Ekorso; 122-Pameng) c.30 mins each	Questionnaire; Qualtrics Offline Surveys; Tablets; Field notebook	Descriptive statistics, using SPSS v27+
Transect walk with 3 community leaders	Across community	1 per community	Voice recorder; notebook; Smartphone camera	Data transcribed & translated; Thematic analysis by manual coding
Focus group discussions (FGDs) with farmers	Purposive sampling	1 FGD per community; 10 members each (7 men, 3 women); 1 hour each	Voice recorder; Smartphone camera; FGD schedule	Data transcribed & translated; Thematic analysis by manual coding
Oral history Interviews	Purposive sampling	10 per community (7 men 3 women); 30 mins each	Voice recorder; field notebook; Interview schedule	Data transcribed & translated; Thematic analysis by manual coding
Key informant/ stakeholder interviews	Purposive sampling	5 actors/officials; 30 mins each	Voice recorder; field notebook; Interview schedule	Data transcribed & translated; Thematic analysis by manual coding

* Information from District agricultural officers indicated ASGM was present in several communities, so the study assumed 1/3 of the district population was experiencing ASGM (61,219/3=20,406) (GSS 2021). Our sample population was 5,102 (20406/4) households (GSS 2021, p. 83) and sample size determined at 360 based on a statistical confidence level of 95%; margin of error of 5% as well as time, and cost (Bryman and Bell, 2007; Qualtrics.com, 2022). Estimate of community population obtained through discussion with district agricultural officers: Akwabuoso – 3,000; Ekorso – 3,000; and Pameng – 4,000.

+ Statistical Package for Social Sciences software (SPSS) version 27.

Analysis of livelihood activities of households between 1992 and 2021 following oral history interviews, together with indicators from – financial, physical, natural, human, and social livelihood capitals (Appendix B)**,** identified livelihood trajectory groups and their outcomes. Indicators were developed (n=12; adapted from Carrie et al. (2022) and Antwi-Agyei et al. (2013)) and used to group households based on data collected during household surveys (Appendix B). Due to data type and distribution (see test for normality in SPSS, Appendix C1-3), a Kruskal-Wallis H test with Dunn-Bonferroni nonparametric post hoc comparison test was used to analyse differences in mean rank values between groups.

4.3 Results

4.3.1 Household livelihood portfolios before and after the rise of ASGM, and factors influencing changes in the livelihood activities

Findings from FGDs and oral history interviews revealed six main livelihood activities in the study communities before the rise of ASGM in 2010 (Table 4.2).

Table 4.2. Main livelihood activities prior to ASGM emergence in the study area, obtained through oral interviews (n= 30).

	1992-2000			2001-2010			Livelihood change (2001-2010) - (1992-2000)		
Main livelihood activities	Akwabuoso %	Ekorso %	Pameng %	Akwabuoso %	Ekorso %	Pameng %	Akwabuoso %	Ekorso %	Pameng %
Cocoa farming	19	23	35	40	42	39	21	19	4
Arable farming	25	46	53	40	37	44	15	-9	-9
Forest resource exploitation	6	15	0	0	11	6	-6	-4	6
Waged labour	13	8	6	7	0	6	-6	-8	-1
Trading in agricultural produce	0	0	0	0	5	0	0	5	0
Service – e.g. tailoring/sewing	38	8	6	13	5	11	-25	-3	5
Total count of livelihood sources	16	13	17	15	19	18			

Legend: Increase in livelihood source | No change in livelihood source | Decrease in livelihood source.

Oral history interviews and FGDs revealed less human pressure and more forested areas during the 1990s, which enabled the provision of food, land for agriculture, fuel, timber, potable water sources, palm wine tapping, and animal hunting. Cocoa was considered to yield well due to fertile lands coupled with adequate and predictable rainfall patterns, while cocoa farmers were respected and influential in their communities. Arable crops were mainly maize, cassava, plantain and vegetables. Oral histories further revealed that during the 1990s, young adults would either move to cities to search for jobs or learn a trade (e.g., tailoring), or stay in the village and go into arable crop farming, before later moving into cocoa farming. At this time, residents lacked electricity access and mobile telecommunications. Roads were not tarred, making motoring difficult, and affecting transport of farm produce to markets, while fewer vehicles were available to transport goods and people.

Farmers mentioned in the oral histories and FGDs that in the 2000s, cocoa farming was still vibrant, and they had expanded their cultivated land. More migrants arrived to undertake cocoa farming as they accessed farmlands without capital. Migrants farmed, either as tenants (where they shared half the proceeds with the landowner) or as caretakers (who managed existing farms for a one-third share). Ghana Cocoa Board's data reflects this, showing a steady rise in annual cocoa beans production from 1990s – 2010s in the Eastern region (26,196 tonnes in 1992 to 79,842 tonnes in 2010, Fig. 4.1).

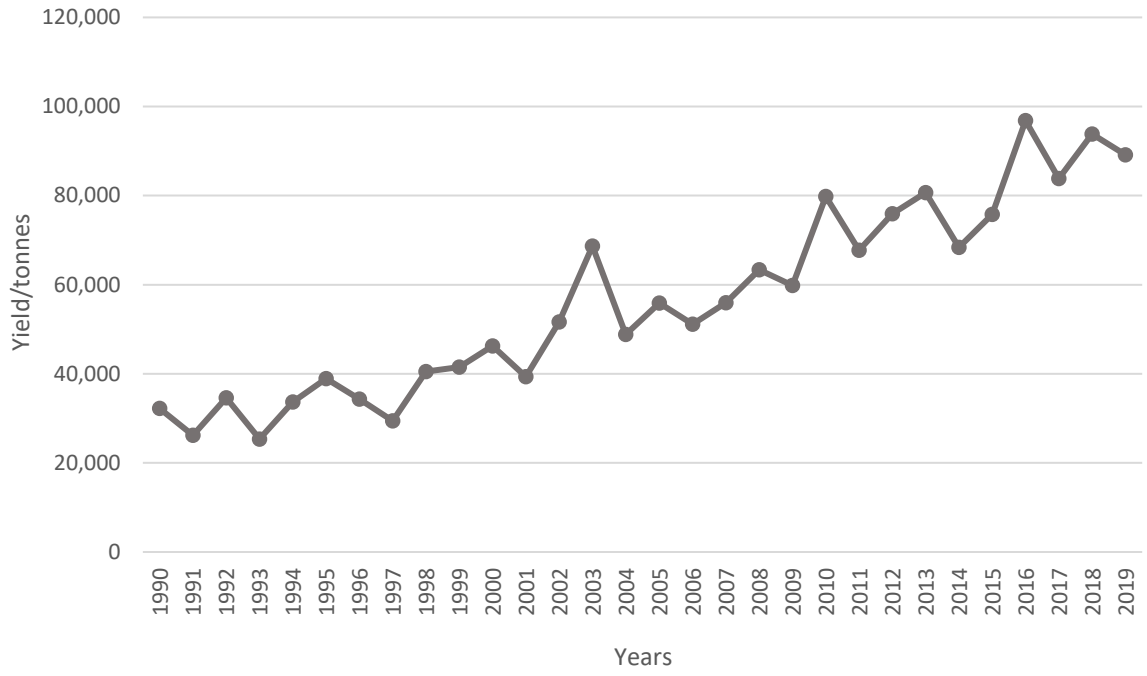

Fig. 4.1 Annual cocoa bean yield in Eastern region, Ghana. Data source: Ghana Cocoa Board website - https://cocobod.gh/cocoa-purchases.

Interviews revealed that even though farming faced many constraints, limited government interventions in the 2000s had facilitated continuing involvement and investment in the sector by cocoa farmers. Interventions included annual free mass spraying of cocoa farms to control pests and diseases, and a fertiliser subsidy programme, alongside increased access to extension officers. Gradual introduction of electricity, tarred roads, and mobile telecommunications in the 2000s allowed locals to venture into linked livelihood options (e.g., trading, communication services, driving).

4.3.1.1 Livelihood portfolios after the rise of ASGM (2010 – 2021).

Table 4.3 shows the livelihood portfolios across the three communities and their percentage income contributions according to the analysis of quantitative data from household surveys. Across the three communities since 2010, ASGM on average contributed 76% of total household income for those engaged in mining. Agriculture remained dominant while trading in agricultural produce increased, alongside increased participation in goods and service sectors, and a boost in local markets. Interviews revealed that ASGM drew migrants into the study communities and miners made enough money to purchase items helping local businesses to thrive. Alongside ASGM's emergence, electricity, tarred roads, and mobile telecommunications enabled livelihood diversification. Questionnaire findings nevertheless

show that ASGM practices were not always carried out responsibly. Community transect walks confirmed this, with local rivers and streams polluted and brown due to liquid waste discharges from mine sites. Mine pits were left uncovered, and most mine sites were unreclaimed, with deforestation and degradation in and around the communities. This caused livelihood activities such as fishing, and forest resource exploitation to decline considerably.

Table 4.3 Household livelihood sources and their percentage income contributions after ASGM's rise from 2010, based on questionnaire survey

	Akwabuoso, n=117		Ekorso, n=121		Pameng, n=122	
Source of livelihood	Participants (%)	Income contribution (%)	Participants (%)	Income contribution (%)	Participants (%)	Income contribution (%)
Cash crop cultivation	63	62	47	63	47	65
Arable crop cultivation	67	31	49	29	34	29
Livestock	23	11	17	11	5	26
Fishing	0.9	5	0	0	0	0
Forest resource use	0.9	5	0.8	100	0	0
ASGM	13	79	17	83	34	71
Professional	0	0	2	70	4	58
Waged labour	3	70	4	44	4	57
Industry/Manufacturing	0.9	100	3	38	3	70
Agribusiness	10	47	16	48	9	51
Service	21	74	29	78	28	69
Retiree on pension	0	0	2	100	3	49
Remittances	3	100	3	27	2	65

4.3.1.2 Factors that influenced changes in livelihood activities since ASGM's emergence from 2010

FGD, oral histories and questionnaires revealed three sets of factors that influenced households' livelihood decisions since the arrival of mining, enabling, or constraining movement along a productivity-enhancing pathway (Table 4.4).

4.3.1.2.1 Household-level characteristics:

Age was a significant factor influencing households' decision to change livelihoods. Questionnaires revealed most household heads were aged 35-54. The youngest, most energetic household heads had greater opportunity to shift into ASGM or linked livelihoods e.g., driving. Households with more working-age members were likely to be more productive, while those with more dependants were less able to convert resources such as cash into productive opportunities and investments. There were schools in the communities and interviews indicated that household heads who had attained higher education levels were better able to negotiate involvement in ASGM. Similarly, households' capability to change livelihoods depends on good health, as it provides flexibility. Primary health care is free and universal in Ghana, but inequitable resource distribution meant residents were forced to pay for major treatments in the district. Residents indicated that ASGM's revenue was more decent and regular than from farming and so enabled them better to handle health challenges.

4.3.1.2.2 Household's available resources:

Interviews indicated customary land tenure predominated and influenced households' abilities to change livelihoods. Those who owned land or had rights of access due to cultural norms could decide to undertake ASGM themselves on their land or lease portions of land for ASGM. Funds raised enabled livelihood change/enhancement. Those without secure tenure rights were sometimes forced to change their livelihoods e.g., shift into ASGM if their farmlands were taken back by landowners. Similarly, households' financial assets influenced livelihood change. Prior to ASGM's arrival, access to affordable formal loans was lacking, restricting capabilities to change or enhance livelihoods. Lenders did not accept farms as collateral considering farming high-risk due to variable weather patterns, pests, and price fluctuations and lack of formally defined property and land-use rights. Even though cocoa bean prices are regulated by the government, there was no government-led credit scheme for cocoa farmers, forcing some to take high interest informal loans from middlemen along the cocoa supply chain. Arrival of ASGM was therefore perceived by residents as an opportunity to generate funds.

4.3.1.2.3 External circumstances:

The communities had access to key infrastructure such as tarred roads, electricity, and communication networks. Hence, households with means were able to own and use technologies such as a television, radio, and mobile phone, which they considered relevant for their livelihoods. The presence of such key infrastructure empowered residents to shift easily into the provision of ASM support services. For instance, some residents ran taxi services and motorcycle rentals with ease due to the presence of good roads; others were able to run electricity-dependent services like restaurants, bars, and hair salons, catering for miners as well as local residents. Other services that saw an increase in sales following ASGM emergence include the sale of water, machine maintenance, general shop/petty trading, shoe repairs, masonry (house construction), tailoring, carpentry, and house rentals. The presence of communication network services meant residents could easily use mobile phones, facilitating the running of their businesses. Poor prices for farm produce and increasing input prices drove farmers into ASGM when opportunities arose. There was a demand for gold and miners had direct access to gold markets. No policy protected cocoa farms from competition for arable farmlands with ASGM, and tenant farmers struggled, facing landowners who leased cocoa farms to miners against their will. Artisanal miners perceived the ASGM registration process as expensive and complicated, so operated informally. Farmers also stated that rainfall patterns in the past decade have become increasingly erratic and unpredictable, with cocoa trees producing lower yields. This too encouraged livelihood diversification.

Table 4.4. Key factors that influenced changes in livelihood activities since ASGM's emergence from 2010 in the study area, based on FGDs and questionnaire survey of residents

Factors	Akwabuoso (%), n=117	Ekorso (%), n= 121	Pameng (%), n=122
Land tenure rights (those who own lands)	59	38	39
Education/awareness (highest education level completed - Junior high school)	60	56	64
Finance (No access to credit)	77	88	53
Age (age group with highest frequency)	35-44 & 45-54 (21.4%)	35-44 (24%)	35-44 (25.4%)
Infrastructure (Households that own the following items)	TV – 66 Radio – 64 Mobile phone – 90 Car/truck – 7 Motorbike – 7 Crop sprayer – 33	TV - 59 Radio – 66 Mobile phone – 97 Car/truck – 3 Motorbike – 12 Crop sprayer – 36	TV – 78 Radio – 87 Mobile phone – 89 Car/truck – 3 Motorbike – 10 Crop sprayer – 25
Health (households' ability to handle health issues/hospital treatment; options grouped: easy, somewhat easy, moderate)	38	47	50
Miners' ease of access to land for ASGM (options grouped: very easy, somewhat easy, moderate)	77	52	71
Access to market*	-	-	-
National policy*	-	-	-
Weather variability*	-	-	-

* These additional factors were revealed during FGDs but not in the questionnaire, so no percentages are assigned.

4.3.2 The impacts of ASGM emergence on livelihoods

Analysis of household livelihood activities 1992-2021, together with the 12 livelihood capitals indicators based on oral histories, FGD and questionnaires, revealed individual households have pursued various strategies, influenced by multiple interacting factors, resulting in different livelihood outcomes. Households used diverse strategies to respond to interruptions, including ASGM's emergence, drawing on savings, bank loans, social and kinship networks, and use or sale of assets and labour. Three distinct livelihood trajectories emerged: consolidating, fluctuating, and marginalised (Fig. 4.2). In all communities, the fluctuating group was largest, followed by the marginalised, and finally the consolidating group (Fig. 4.2). Further analysis (see Kruskal-Wallis results in Appendix C1-3) revealed that observed differences in household frequency among the livelihood trajectory groupings were significant ($p < 0.05$).

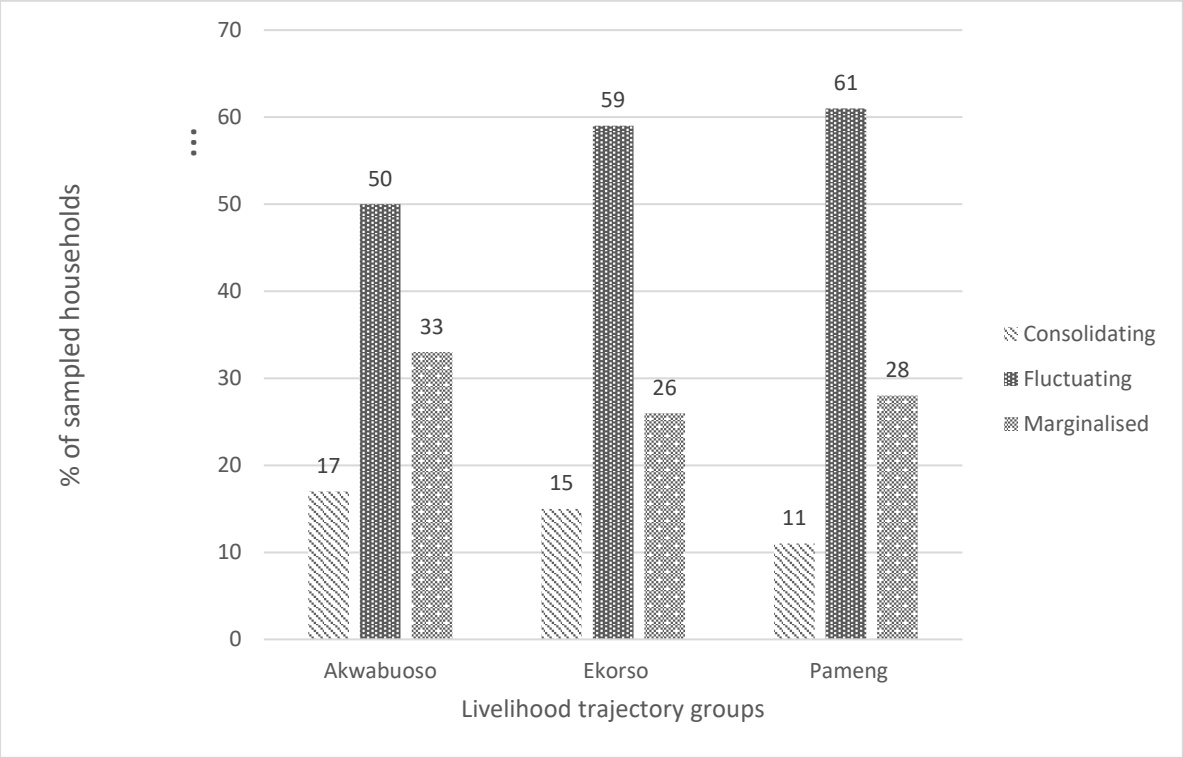

Fig. 4.2 Household occurrence across livelihood trajectory groups in the three communities, based on indicator scores from questionnaire surveys.

A Kruskal-Wallis test provided evidence of a difference ($p < 0.05$) between the mean ranks of at least one pair of groups. Dunn's pairwise tests were carried out for the three pairs of groups. There was very

strong evidence ($p < 0.05$, adjusted using the Bonferroni correction) of a difference between all three groups (Appendix C1-3).

4.3.2.1 Consolidating trajectory

This trajectory is followed by households that exert power and social influence in their communities. They are characterised by relatively high incomes, middle-aged male head (45-64 years) or elderly men (65 years and over), and low livelihood diversity. They have access to large tracts of farmland, inherited from their ancestors or acquired over time, with secure land-use rights and/or owning functional businesses. They have access to and benefit from limited government agricultural interventions, especially regarding cocoa farming, easily accessing extension officers who advise on farm management, and can secure more productive cocoa plant varieties. They prosper through a combination of access to emerging external markets, capital, social networks, and progressive farming knowledge. Challenges and constraints faced by those on a consolidating trajectory include continuing increases in farm input prices and labour, meaning profits remain limited. They are industrious, proactive, risk takers and willing to utilise any perceived opportunities to accumulate assets. The impact of ASGM emergence on this group has been generally positive. They reinforced this trajectory of prosperity by leveraging assets, social influence, and networks to their advantage, e.g., interested landowners engaged with miners, leasing out lands to them for well-negotiated fees. Younger residents ran their own ASGM operations alongside farming, while others rented-out mining equipment/accessories or became gold traders.

4.3.2.2 Fluctuating trajectory

Households on this trajectory tend to own small farmlands/trade or are caretaker farmers or waged labourers in agriculture or service sectors. They have limited access to communal community resources such as family lands and forest products. Households are characterised by mid- to low-level incomes, male/female heads, young to middle-aged adults (18 to 44 years), with mid to low livelihood diversity and some land-use rights. Although farm-based livelihoods have continued to play an important role, past, and current limited agricultural interventions have not yielded appreciable improvements. Households on this trajectory proactively shifted into ASGM because of the high, quick financial returns. Some households also entered ASGM because their farmlands were being mined and left unreclaimed. These households access informal loans or pool resources with family or friends to engage in ASGM.

This increased their incomes and enabled acquisition of assets such as houses and motorcycles. These households improved their livelihood trajectory through a combination of human capital, social networks, and forging reputations as good workers. The local economy provides an adequate living for them, and they can overcome livelihood disturbances and further fluctuations by seeking alternative employment opportunities elsewhere within their communities because of their human capital and assets acquired through ASGM. Many of these households still engage in farming for consumption, to supplement income, or to address potential livelihood shocks and stresses.

4.3.2.3 Marginalised trajectory

Households on this trajectory are typically from poor backgrounds and are marginalised due to severely limited access to livelihood resources (e.g., land, networks, funds) and a lack of power and influence. These households are struggling to survive and are characterised by low incomes, young female/male heads, the aged, and widows, with high livelihood diversity and insecure land-use rights. These households rely heavily on farming for income and subsistence. Increased degradation of farmlands and waterbodies due to ASGM disproportionately negatively affects this group, who are least able to defend their livelihoods or harness other opportunities. Some households shifted from the fluctuating trajectory to this one following sickness/death of household members, or forceful mining of their farms without reclamation, or when mine waste polluted their farms increasing their susceptibility to poverty. Migrants lacking social networks, local knowledge and secure access to natural resources also constituted a large proportion of this group. To cope with shocks, these households increased livelihood diversity, engaging in waged labour activities in agriculture, artisanship, or construction or taking informal loans from community members. Some have pre-existing debt from failed ventures and sometimes resort to asset selling. ASGM-linked deforestation has reduced forests normally available for this group to harvest products for sale. They are likely to experience trajectory lock-ins due to limited access to natural capital, networks, and support from local authorities. Households whose farmlands have been mined without reclamation and who have few other options lose the capacity to respond to future changes. Those who have the capability to do ASGM reluctantly engage, with no clear future plans.

Three distinct life-stories selected from 30 interviewed households, with respective factors contributing to poverty or development over time, are illustrated in Table 4.5. These three lived experiences illustrate the three livelihood trajectories - consolidating, fluctuating, and marginalised - that are clearly traceable throughout the three farming communities. At community level, our findings showed that informal mining caused degradation of farms, land, waterbodies, and forests in all three communities. However, ASGM companies undertook development work in Pameng (public toilet, boreholes, renovation of chief's palace and regular cash donation) as demanded by community leaders. No development projects happened in Ekorso and Akwabuoso, as leadership did not press for them. Yet, presence of community infrastructure can impact livelihood trajectories of households.

Table 4.5 Livelihood trajectories of households most reflective of the impact of ASGM emergence

Case study household	Limiting (L) and Enabling (E) factors leading to poverty or development
Consolidating trajectory Case 1 – male, 55 years, Pameng	
He has always loved to work for himself, and prior to ASGM he owned shops trading in household goods as a businessman. When ASGM emerged, he ventured into it alongside his business. He sought permission from local landowners, negotiated and compensated them before mining started. The mining business has been profitable. Presently, he has secured a deal with a large-scale mining company, and mines portions of their concessions that the company considers uneconomical to mine. He mines using his own machinery and shares the gold proceeds with them. He finds it profitable and has good relations with the large-scale mining company, including helping him to negotiate with difficult landowners during land acquisition. He was able to secure bank loans to grow the mining business and now he uses sophisticated machinery such as excavators and trommel to mine. Presently he has 86 employees. His mining work also draws self-employed artisanal miners who search for residual gold (kuli-kuli). He often permits them because they do it to survive. He ensures that water bodies and forest reserve near his site are protected and not degraded [*mine site visit confirmed efforts made in this regard*]. *The profits obtained from the mining have enabled him to expand his trading business as well. He takes steps to link well with the village people and their leaders. There is a percentage of his mining proceeds he gives to the chief and elders to support the chieftaincy. Due to limited government support, he has provided a bore hole, and two KVIP toilets based on community demands, and has donated an ambulance to the Atiwa West District Assembly*.	E1. Human and financial capital/productive capacity E2. New livelihood opportunity E3. Access to land E4. Financial accumulation E5. Access to business support networks E6. Access to financial credit E7. Possession of new assets E8. ASGM employment option E9. Ease of entry for artisanal miners E10. Financial accumulation E11. Community benefits L1. Limited state support E12. Benefits to society

Case study household	Limiting (L) and Enabling (E) factors leading to poverty or development
Fluctuating trajectory Case 2 - Female, 42 years, Akwabuoso	
She has lived in Akwabuoso all her life. In the 1990s, her mum operated a traditional eatery business. She took over in the late 1990s whilst her mum helped. She did this for 14 years, worked on weekdays and farmed on Saturdays. The business helped look after two younger siblings in secondary school. During difficult times, the business and her mum helped. Later she stopped the eatery when her mum became ill. In the 2000s, she switched to selling rice and beans (waakye) and fried yam, which was less intensive but profitable. Afterwards, she shifted into selling corn porridge and meat pie due to inadequate time for the waakye. She did this till ASGM arrived. Hearing how lucrative ASGM was, she joined in 2010. Initially she faced resistance from male colleagues who insisted it was a man's/tough job, but she prevailed. Later, she was made a gang leader [*a gang constitutes 10 - 12 members, including about 2 ladies*]. *Sometimes the manager took her to do gold prospecting in nearby communities. She participated until mining wound up, as most miners moved to Pameng (a more productive deposit found). ASGM enabled her to build a 3-bedroom house, cared for her ill mum for 3 years ($40/week for the treatment); and later cared for her sick husband for a year. After mining declined, she went into meat barbecuing at social events, which supports her children's education. Future mining is possible in the community because not all deposits were mined. However, miners now need a license from the government to freely operate, but it is expensive. Hence, they do not see a lot of miners back in the community. Presently, the meat barbecuing is profitable. There is opportunity for growth because there is demand for it.*	E1. Diversification of income E2. Good quality land for farming E3. Social support networks E4. Livelihood diversification L1. Lack of time E5. New livelihood opportunity L2. Cultural aspects barriers E6. Enhanced human capital E7. Possession of new assets E8. Financial accumulation E9. Empowered livelihood diversification E10 Enhance human capital L3. Lack of financial capital E11. Rising market demand

Case study household	Limiting (L) and Enabling (E) factors leading to poverty or development
Marginalised trajectory Case 3 - migrant, male, 40 years, Ekorso	
He was born in the northern part of Ghana. As an adult, due to difficulties between him and his dad and lack of access to adequate farmland, he moved to Ekorso in 2009 with the intent to go into cocoa farming. He got farmland and cultivated a 9-acre cocoa farm. When the miners arrived, they mined his farm, even though he disagreed. He is a tenant farmer, and the landowner agreed to the mining, so he was helpless. He had to look for other farmland far from the village and start the cocoa farm all over again setting his plans back. The compensation given to him and the landowner was $2000, of which he was given one-third. This was regrettably inadequate. Presently, ASGM activities have made his farm roads unmotorable, especially when it rains. He is a member of a cooperative, which helps him to access the agro-chemicals to do the annual spraying of the cocoa farm, but once a year is not enough. He wants the government to protect cocoa farmers enacting a regulation that does not permit miners to mine in areas where there are cocoa farms. He plans to trade in goods alongside the cocoa farming if he manages to access some funding. He would want the government to provide loans to cocoa farmers at a moderate interest rate, to support him so the money is paid at the end of the cocoa season.	L1. Inadequate family support L2. Lack of access to farmland E1. Access to farmland E2. ASGM emergence/new livelihood opportunity L3. Unsecured land under customary land tenure system L4. Inadequate compensation L5. ASGM degraded farm roads E3. Access to social network L6. Limited government support L7. Lack of state support for cocoa farmers against miners L8. Lack of access to financial credit.

4.3.3 Opportunities and barriers for different livelihood trajectory groups since ASGM emergence

Oral histories, key informant interviews, FGDs and questionnaires revealed a number of opportunities and barriers to people's capabilities to shape their livelihood trajectories resulting from ASGM's emergence (Table 4.6). Households on a consolidating trajectory had access to most of the available opportunities, while those on the marginalised trajectory had the least. Consolidators leveraged available household assets and utilised opportunities to set up businesses, diversify and accumulate more assets. ASGM has become an important source of income and employment for households on a fluctuating trajectory. These households were generally making greater financial gains since the arrival of ASGM. Conversely, the marginalised faced most of the barriers identified, followed by households on a fluctuating trajectory with the consolidating group facing the least of the identified barriers (Table 4.6). Findings revealed that local miners lacked access to affordable credit, limiting their capabilities to become self-employed artisanal miners using sophisticated mining equipment and employing several workers. In Akwabuoso, mining activities had slowed because most migrant ASGM companies had moved out due to new gold discoveries elsewhere. Local miners were unable to fill the gap due to lack of access to finance and complications with acquiring ASGM licence. Fig. 4.3 demonstrates the different livelihood trajectories – consolidating, fluctuating and marginalised – that households followed after ASGM's emergence.

Table 4.6 Opportunities and barriers that evolved for the different livelihood trajectory groups upon ASGM emergence

Opportunities/Barriers	Livelihood trajectory groups		
Opportunities	Consolidating	Fluctuating	Marginalised
Livelihood diversification or change/employment prospects in ASGM	x	x	x
Leveraging prospects	x		
Increased access to business/social networks	x	x	
Sale/lease of natural assets, including land	x		
Rental of mining implements	x		
Acquisition of new knowledge and skills	x	x	x
Boost to local economy (increased access to market and finance, increased purchasing power of locals)	x	x	
High levels of human capital (influx of mine workforce)	x	x	x
Barriers			
Land and water degradation due to irresponsible ASGM	x	x	x
Inadequate support from local assembly and Police to resolve ASGM related complaints	x	x	x
Lack of or limited access to financial credits		x	x
Insecure land tenure rights (customary systems)			x
Social-cultural barriers affecting employment			x
Limited state support for farmers and miners	x	x	x
Ineffective implementation of mining regulation	x	x	x
Increased prices for food items			x
Limited access to farmlands		x	x
Decrease in farming labour	x	x	x
Decreased school attendance affecting quality of future labour		x	x

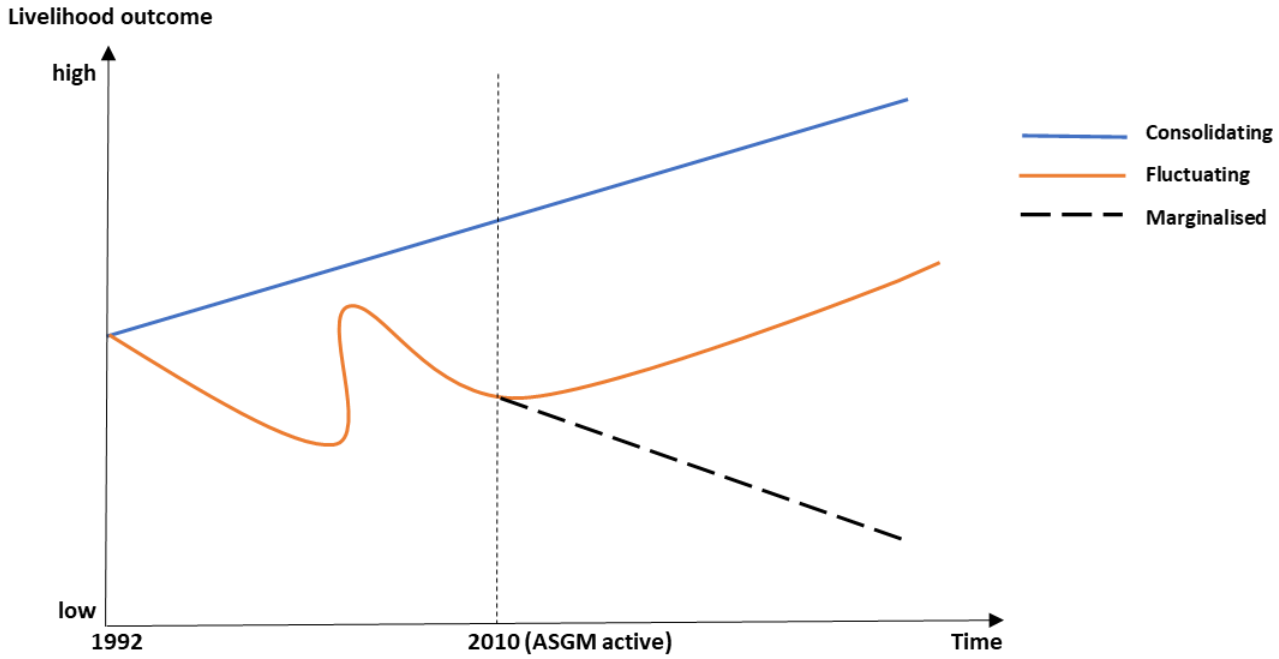

Fig. 4.3 Illustrative representation of livelihood trajectories of households following ASGM emergence.

Source: Author's construct.

4.4 Discussion

4.4.1 Impact of ASGM adoption on livelihood trajectories

ASGM is expanding in Ghana, like in many other sub-Saharan African countries (Hilson & Maconachie, 2020), and the future exploitation of minerals in farming areas will likely intensify due to soaring demand for minerals and metals to manufacture devices that promote the carbon net zero agenda. Combining the Sustainable Livelihood Approach (SLA) with livelihood trajectories, this study analysed livelihoods dynamics of residents in cocoa farming areas experiencing ASGM across multiple scales – households and community. It explored how their present conditions have emerged over time, and the strategic decisions and behaviours underpinning those changing livelihoods. Residents demonstrated complex, dynamic livelihood portfolios, depending on household capabilities and level of access to livelihood assets but livelihood outcomes were influenced by structures and external factors relating to socio-cultural, economic, political, and biophysical variabilities. Both access to natural, physical, financial, human, and social assets and those that are subsequently used, were mediated mainly by customary norms and traditional institutions but also affected by statutory laws and policies. Our findings revealed that prior to ASGM emergence in the communities, households who had acquired or had access to more assets and generally had improved livelihood outcomes, were better positioned to take advantage of the opportunities that ASGM presented, compared with households who had few assets and household capabilities. This study has shown that ASGM will not fully replace agricultural livelihoods because new frontier communities will continue to rely on farming for food and livelihoods, and identities will likely remain linked to agriculture. The study helped identified opportunities and barriers to change processes, as well as the differential and unequal effects of ASGM emergence that confront households, and showcased people's capacity for action and decision making and livelihood trajectories that evolved.

This study highlighted that the ASGM sector comprises both poverty-driven and profit-driven actors with widely different opportunities and resources (see also: Hilson & Maconachie, 2020). Due to its wealth creation potential, individuals, and entrepreneurs with access to financial, socio-political and/or natural capitals, notably mineral rich lands, ventured into and operated ASGM companies for profit-generating purposes, employing community members

as casual ASGM workers. However, most residents shifted into ASGM simply because of the opportunity to get employment or diversify and generate funds to improve their living conditions. Thus, constraints associated to farming, limited rural employment opportunities and the pressing need of local households to generate cash income opportunities as well as chance to generate wealth were the primary drivers of local people's entry into ASGM. These findings are similar to other studies across sub-Saharan Africa (Hilson, 2002; Okoh & Hilson, 2011; Pokorny et al., 2019). Our findings have shown that ASGM development can create livelihood alternatives and income opportunities to households and be an incubator for local economic development because of the ASGM support services that emerge because of mining operations (see also Hilson & Maconachie, 2020). ASGM managers are inclined to support local development if community leaders negotiate such demands, because ASGM productivity depends on the goodwill of local workers and their host communities.

Yet the expansion of ASGM was one of the underlying drivers of income inequality in the communities. Because of differences in access to and use of livelihood assets, there are power asymmetries in the ASGM sector (see also: Maconachie & Conteh, 2021; Van Bockstael, 2019) such that ASGM impacts households unequally. Consolidating and fluctuating livelihood trajectories moved towards development, whilst those of the marginalised moved towards poverty. Benefits from ASGM were largely driven by market forces that served the interests of a small number of households (consolidating group) with abundant resources (e.g., land and other physical assets, funds, skills and labour, business and social networks). Consolidators encountered more opportunities than barriers and accumulated further assets. Households on a fluctuating trajectory were generally making more financial gains since ASGM's arrival, due to increased opportunities for mining and provision of ASGM support services. However, this group faced difficulty shifting into the consolidating trajectory. They lacked access to credit to boost their enterprises. While the government has enacted laws to regulate the ASGM sector, our findings found no deliberate attempt to support local artisanal miners to extend their undertaking. Some households on the fluctuating trajectory could drift into the marginalised when faced with ASGM-linked external shocks/stresses e.g., tenant farmers losing farms to mining. Marginalised households faced reduced access to resources due to degradation from ASGM. This potentially increases the vulnerability of marginalised households as it reduces their options for livelihood diversification in response to internal and

external disturbances and shocks. For instance, some female-headed households who had lost farms and become artisanal miners (*kuli-kuli)* did not have free access to mine sites as accessibility was closely controlled by ASGM managers, affecting how much revenue they could generate. The restriction of access to assets such as land, loans, equipment, and networks hinder movement in the sector for the more marginalised households and signals the propensity of the marginalised having little chance to escape poverty. However, the ASGM livelihood trajectory of the marginalised was better than that from farming. Farming households on marginalised livelihood trajectories faced the worst situation and mostly, out of desperation, opted to join ASGM as casual workers, becoming caretakers of other peoples' farms, looking for new farmland elsewhere to restart farming or simply becoming dependent on families in order to cope. Our results are similar to those of Pokorny et al. (2019) and Brugger & Zanetti (2020),for Burkina Faso where the distribution of income from ASGM was also highly unequal, reflecting the disproportionate concentration of resources among a small number of high-income households. Likewise, in Zimbabwe ASGM has brought economic benefits to high- and middle-income households but significantly compromised the livelihoods of low-income and landless farmers (Mkodzongi and Spiegel, 2019).

These consequences of ASGM expansion in new frontier communities should be viewed in light of wider socio-economic developments in Ghana and in sub-Saharan Africa, and its impacts on long-standing livelihoods among farming communities. Although non-farming employment encouraged by the gradual introduction of key infrastructure such as electricity, mobile network and good roads has opened new livelihood options and facilitated livelihood diversification and mobility, these pathways have not been accessible to all. Some elite households and groups with more capital and flexible endowments have benefitted more than less affluent and less privileged farmers. Such uneven uptake and differential flourishing and struggles linked to ASGM emergence further exacerbate power asymmetries that put disadvantaged farmers at even higher risk. Despite the multiple factors that affect livelihood trajectories of farming communities, evidence from this study suggests that ASGM expansion plays a fundamental role in uneven development pathways. It intersects with and reinforces other drivers (e.g., limited access to finance, soil fertility decline, lack of markets) to significantly alter farming livelihoods. Despite long-term constraints affecting productivity, most households continue to rely on farming as their main livelihood source. Hence, the

experiences, and aspirations of farming-dependent households need to be reflected in pro-poor rural development programmes, especially given the continuous growth of farming in forested areas and its complex role in the political economy of the sub-Saharan Africa region. Customary norms e.g., land tenure rights and other regulations that govern mineral resource access for various social groups and shape the prospects for mining as a viable livelihood strategy, need to be understood and reviewed so they offer benefits for local people and migrants in mining areas (Brottem & Ba, 2019). Asset acquisition at household level alone cannot enable rural households to become non-poor. Structural transformation of the context/environment to support such a transition is needed. Several factors affect whether a household will improve their position (in relation to a specific indicator), if at all, and the pace at which they do so. Thus, livelihood trajectories are shaped by household characteristics and access to resources as well as wider social, economic, environmental, and institutional factors.

4.4.2. Future outlook for rural people in new frontier communities

This study highlights the need to design policies to effectively target and appropriately support different livelihood trajectory groups and to lessen undesirable and unequal livelihood trajectories. This suggestion was strongly endorsed by the communities. In Ghana, presently there are policies that would be beneficial for the three groups (e.g., the Investing for Food and Jobs (IFJ) initiative has been designed to provide investment to develop infrastructure to modernise the agri-food system) but are not reaching them and better implementation measures are needed. Sub-Saharan African governments should liaise with donors and create opportunities such as affordable finance to those on consolidatory trajectory to enable them to expand their enterprises or create new ones such as agro processing units. Policies regarding the fluctuating trajectory group, should support rural people in either moving up to profitable mining/farming systems or moving out of agriculture to engage in other viable non-farm employment opportunities. Interventions could include better training, improved land rights and enhanced access to financial as well as non-financial services such as access to regulated markets and guaranteed good prices. Farmers and miners should be assisted to form functional community cooperatives so that government support for them is better targeted and supervised, for instance enhancing the capacities of qualified miners to scale-up production and move from fluctuating trajectory onto desired consolidatory trajectory. In Ghana, the government has launched a community mining

scheme. However, the success of cooperative approach will depend on political will and effective coordination among stakeholders to monitor and to improve processes.

The government of Ghana and other sub-Saharan African governments should provide marginalised trajectory households with opportunities to build productive livelihood strategies and cushion against shocks. Social protection interventions could include in-kind and food transfers, conditional (and unconditional) cash transfers, fee waivers, and subsidised inputs/tools for agriculture and mining. Safety net schemes should be designed to ensure a minimum level of food consumption, protection, and assets building/income generation boosting when shocks hit.

4.5. Conclusion

ASGM is expanding across mineral rich farming areas in Ghana and many parts of sub-Saharan Africa. This study provides important insights into livelihood trajectories that emerge following ASGM emergence in these new frontier communities, the opportunities and barriers various livelihood trajectory groups have encountered and how they have managed these changes in pursuit of their livelihoods. Findings show that ASGM can provide broad positive livelihood outcomes and increased livelihood options. However, differential household capacities to respond to associated changes linked to ASGM's emergence result in differential trajectories — consolidating, fluctuating, and marginalised – with some households able to improve their livelihood trajectory but less desirable consequences for others, which can amplify over time with interactions with concurrent developments and external factors. Differences in the distribution of ASGM-linked benefits depends on people's access to, control and use of resources in pursuing their livelihoods and fulfilling their capabilities. ASGM's expansion thus plays a fundamental role in uneven development pathways. It intersects with and reinforces other drivers (e.g., limited access to finance, soil fertility decline, lack of markets) to significantly alter farming livelihoods for both those who engage in ASGM and those who do not. ASGM is dynamic and connected to broader land-uses that are likely to experience increasing change. Careful consideration is needed about how interventions might modify the impact of such maximum changes. Additionally, to ensure sustainable livelihood development, socio-economic support should be oriented towards the needs of different

groups in new frontier communities, depending on their movement towards poverty or development.

Acknowledgements

The authors would like to thank all study participants, chiefs, and local agricultural officials in the Atiwa West district for their contributions. The authors would also like to thank Musah Seidu, Jeffery Amoah, and Sylvester Adranyi, without whose assistance this research would not have been possible. Informed consent was obtained from all participants prior to data collection.

Chapter 5. Joined-up governance for more complementary interactions between expanding artisanal small-scale gold mining and agriculture: insights from Ghana

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The content of this chapter has been published as follows:

Adranyi E, Stringer LC, Altink H (2024) Joined-up governance for more complementary interactions between expanding artisanal small-scale gold mining and agriculture: Insights from Ghana. PLoS ONE 19(4): e0298392. https://doi.org/10.1371/journal.pone.0298392

Abstract

Rising gold prices have led artisanal and small-scale gold mining (ASGM) operations to proliferate in sub-Saharan Africa, extending into agricultural areas. Little is known about the interactions between agriculture and mining in these new frontiers. This study aimed to investigate the impacts of ASGM on natural and physical livelihood capitals, ASGM's interactions with agriculture at household, community and institutional levels and the drivers underpinning those interactions, and the policy implications for the co-existence of sustainable agriculture and ASGM. Alongside literature review, fieldwork took place in Atiwa West District and Koforidua, Ghana using environmental field surveys, questionnaires, focus group discussions and interviews. Questionnaire and field survey data were analysed using descriptive statistics, with thematic analysis of interviews and focus group data. Findings revealed that most miners were unregulated, mined irresponsibly and degraded land, waterways, and farm roads. Over one-third of farmers (38%) suffered land degradation, and 79% of affected farmers' lands were not reclaimed. Farmers diversified into ASGM, and mining proceeds boosted farming. Young farmers (18-40 years) shifted into ASGM full-time because it is more lucrative. Yet, ASGM is not replacing agriculture: cocoa farming remains a vital economic activity. Informal ASGM generates short-term income at household level for some but imposes long-term costs at community level, linked to cumulative loss of agricultural land and degradation of forest areas and water bodies, creating tensions, and increasing vulnerability. Financial hardships faced by farmers, landowners' desire to benefit directly from gold and lack of law enforcement drive informal ASGM. There are no institutional linkages between the agricultural and mining sectors. More joined up governance across agriculture and mining is needed and between formal and informal (traditional) institutions. ASGM should be incorporated into broader rural development policy reforms that support farmers, incentivise miners to operate legally and responsibly and ensure effective stakeholder engagement.

Keywords: sub-Saharan Africa, ASM governance, institutional linkages, development, cocoa, livelihoods, land use change

5.1 Introduction

Artisanal and Small-scale Mining (ASM) – a low-tech, labour intensive, low investment mineral extraction and processing activity - has grown to become a viable livelihood of global significance in recent decades (Hilson and Hu, 2022). A livelihood comprises the capabilities, material and social assets and activities required to make a living (Chambers and Conway, 1992). An estimated 40 million people work in ASM across 80 countries in the global south and about 10 million ASM operators exist in 40 countries in Africa (IGF, 2018). ASM is focused on various precious minerals and stones, and in particular gold. Artisanal and small-scale gold mining (ASGM) represents an estimated 20% of annual global production (IGF, 2018). The upsurge in ASGM since the early 2000s is due to steady rises in gold prices, coupled with limited rural employment avenues (Owusu et al., 2019). Sub-Saharan Africa (SSA) is a leading region in ASGM operations, where the growing industry provides substantial economic benefits (Hilson, 2016b). Ghana is Africa's largest gold producer and the sixth largest in the world, producing 138.7 tonnes in 2021 (World Gold Council, 2023b). In Ghana, ASGM accounts for c. 35% of total annual gold production (Owusu et al., 2019, p.3) a significant increase from the c. 5% (<0.62 tonnes) in the 1990s.

ASGM targets ore deposits that are often close to the land surface and can be extracted easily and quickly. Miners are thus highly mobile in their chase for new discoveries or higher-grade ore deposits, which can result in rapid shifts in local population and emergence of new settlements over short periods (O'Faircheallaigh and Corbett, 2016). ASGM's rise raises important questions worldwide about how ASGM interacts with and impacts pre-existing agricultural livelihoods. ASGM can negatively affect agriculture through deforestation, water pollution, farmland degradation, input competition and a shift of farm labour/resources into mining and can thereby increase chances of conflict and impact the health of residents (Tenkorang and Osei-Kufuor, 2015). ASGM can also positively complement agriculture. Agricultural income can provide capital to enter into ASGM, and ASGM income can be used to purchase farm inputs, hire labour, and maintain farms, helping to supplement farm incomes and providing the possibility that ASGM emergence can help accelerate agricultural development (Ofosu et al., 2020). Malone et al. 2021 examined the coexistence between ASGM and farming and fishing in Peru. They found that ASGM could coexist with farming but

the practicality of this over the long term was threatened by the rapid pace of ASGM growth, immigration and social change, alongside uncertainty about water contamination that could undermine other livelihoods (Malone et al., 2021). In Guyana, illegal miners took over territory and pushed out agriculture, undermining traditional livelihoods and forcing locals to shift into mining (Gilbert and Albert, 2016; Hennessy, 2014).

Agriculture in SSA is exposed to multiple stresses and shocks (Stringer et al., 2020; World Bank, 2017). Mismanagement and poor land use practices are common, and lead to land degradation. Here, land incorporates soils, vegetation, and water (Stavi and Lal, 2015; Webb et al., 2017) with land degradation defined as ‘‘a negative trend in land condition, caused by direct or indirect human-induced processes including anthropogenic climate change, expressed as long-term reduction or loss of at least one of the following: biological productivity, ecological integrity, or value to humans’’ (Shukla et al., 2019, p.4). ASGM poses an extra burden on agriculture because mined lands can render previously fertile lands unsuitable for cropping (Bansah et al., 2018). Only effective reclamation (that ensures physical stability, waste management, and acceptable land uses) can return mined areas to an acceptable condition for continued productive use (Cao, 2007; Mantey et al., 2016). Hilson and Garforth (2012) found in Mali and Ghana that diminishing returns from agriculture provided the overarching incentive for farm families to branch out into ASGM. Others simply enter ASGM because of their belief they will earn more revenues and achieve their dreams from doing so (Okoh and Hilson, 2011; Pijpers, 2014).

Existing studies on ASGM and agriculture interactions in SSA include case studies from Tanzania (Kitula, 2006) Zimbabwe (Ncube-Phiri et al., 2015) Ghana (Obiri et al., 2016) and Mozambique (Mujere and Isidro, 2015) which showcase negative environmental effects of ASGM on neighbouring farms. Studies have also noted the ensuing competition between ASGM and agriculture in the acquisition and use of land, capital, labour, and water, resulting in resource-use conflicts (ACET, 2017; Pijpers, 2014). ASGM can also generate positive relationships with agriculture as noted in case studies from Sierra Leone (Maconachie and Binns, 2007) Malawi (Kamlongera, 2011) Mali and Ghana (Hilson and Garforth, 2012) Zimbabwe (Mkodzongi and Spiegel, 2019). These studies found that smallholder farmers often shift between farming and mining and use small-scale mining income to support agriculture and enhance productivity. Such complementarities are important for poor

smallholder farmers for whom poor access to credit and markets often affect agricultural productivity. A few studies have also examined both the positive and negative dynamics between small-scale mining and agriculture (ACET, 2017; Pijpers, 2014).

Scholarship on ASGM-agriculture relationship, however, has largely focussed on describing negative or positive relations as observed in field studies, providing snapshot views of happenings on the ground (Hilson and Garforth, 2012). Studies have not explored for instance if positive relations can continue over the long term; nor have they sought to understand how dynamics in each sector may affect the other. Furthermore, existing literature has not paid attention to the institutional linkages between ASGM and agriculture (Okoh and Hilson, 2011; Pijpers, 2014). Understanding of these relationships and their dynamics is needed to foster a more mutually supportive relationship between ASGM and agriculture. This study addresses these gaps by exploring agriculture-ASGM interactions at household, community, and institutional levels, to find out whether households and communities in cocoa farming areas in the new frontiers of ASGM can embrace both mining and agriculture to advance their livelihoods, not just in the short – but also long – term. It examines the socio-economic, biophysical, customary, institutional, and political factors that shape relations between ASGM and agriculture in cocoa farming areas. In doing so, this paper offers a more nuanced understanding of the dynamics of ASGM-agriculture interactions in new mining frontier regions.

ASGM's rise in Ghana in the past two decades is characterised by operations on land, on riverbanks and in riverbeds by an increasing number of both local miners and foreign illegal miners using sophisticated machinery (Hilson et al., 2014). Governance framework for ASGM in Ghana - the Minerals and Mining Act, 2006 (Act 703) and the Minerals Commission Act, 1993 (Act 450) - stipulates that all mineral deposits in Ghana belong to the state, which via the Minerals Commission (MC), has sole responsibility to grant mineral rights, controlling mineral access and concession licensing (Ghana Government, 2006). Only citizens of 18 years and above can obtain small-scale mining licenses. However, miners' access to mineral rich lands is highly influenced by Ghana's complex land ownership system. There are government lands, customary lands, and private lands (Mensah, 2021). Customary lands constitute c.80% of Ghana's land surface and are administered by family/clan heads and chiefs (Kasanga and Kotey, 2001). This distinction – between mineral rights and land rights – poses challenges to

mining administration (Luning and Pijpers, 2017a). Many customary landowners who think they ought to benefit directly from the minerals are able to directly deal with ASGM miners, granting miners access to lands to mine outside of the direct control of the state. Transactions are quick and informal, making it popular with community members and illegal ASGM miners alike (Larbi et al., 2004; Nyame and Blocher, 2010).

ASGM in Ghana is rapidly extending into areas traditionally known for agriculture such as cocoa production. This is the case in our study area – Atiwa West district, raising questions about the impact of ASGM on cocoa farming and agriculture more generally (Cocoa Post, 2020). Agriculture is the main source of livelihood in Ghana's rural communities (Pijpers, 2014). It accounted for 19.7 % of GDP, US$ 77.59 billion, in 2021 (World Bank, 2022a, 2022b) and is the largest employer, with ~77% of rural dwellers in Ghana making a living through agriculture (Ghana Statistical Service, 2020). Cocoa is the country's most important agricultural export delivering an average of 30% of the country's total export earnings (Ahoa et al., 2020). Yet, Ghana remains a country in food deficit (ACET, 2017). Smallholders face numerous constraints that significantly affect agricultural productivity and keep farmers poor e.g., lack of farm inputs (Antwi-Agyei, 2012; Atiwa West District, 2021). The shifting nature of ASGM activities makes the relationship between ASGM and agriculture complex, and its dynamics remain incompletely explored and understood.

Considering that both agriculture and ASGM are important sources of livelihoods for many rural people, there is a need for greater understanding of the ASGM–agriculture relationship to ensure their balanced interaction, producing social and economic development without disrupting rural livelihoods.

Based on the problems described above, the overarching aim of this paper is to investigate ASGM's impact on natural and physical livelihood capitals and interactions with agriculture, in order to understand policy implications for a positive co-existence of sustainable agriculture and ASGM. To achieve this, the following three research questions have been established:

1. How have agricultural lands, water resources and local infrastructure been altered through ASGM activities and what agriculture-ASGM interactions occur at the household, community, and institutional levels?
2. What individual and societal drivers have shaped the interactions between ASGM and agriculture and brought about changes in the natural and physical livelihood capitals?
3. What are the policy implications of the agriculture-ASGM interactions?

5.2 Methodology

5.2.1 Study area description

Ghana has 31 million inhabitants and is made up of 16 administrative regions. Atiwa West District in the Eastern Region in southern Ghana (Fig 5.1) was selected as the case study area given its recent growth in ASGM activity. The district is about 118 km north of Accra, Ghana's capital city. Following commercial discovery of huge gold deposits (7.4 million oz) in the neighbouring Birim North District by Newmont Mining Inc. in 2010 (Mining Technology, 2014) ASGM miners (both legal and illegal) have since been exploring and mining gold in Atiwa West. In Ghana, illegal miners are those who mine without a valid license and have no authorised concessions of their own and their activities are called *galamsey* (gather them and sell) in local parlance. Legal miners are those who have a small-scale mining license and operate in accordance with mining regulations and within approved concessions of no more than 25 acres, as stipulated in Act 703 (Aryee et al., 2003; Hilson et al., 2013).

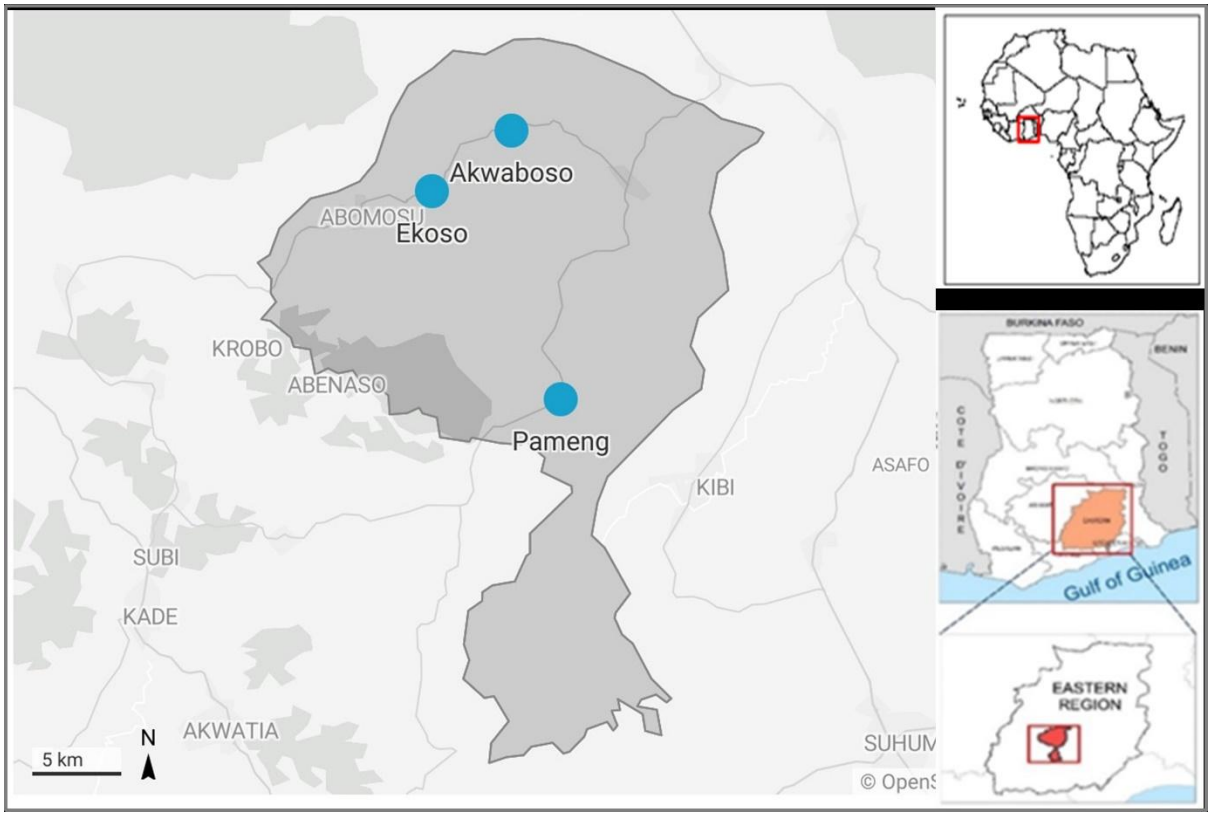

Fig 5.1 Map of Atiwa West District, showing the selected communities. Source: Author's construct with Datawrapper.

Due to its abundant fertile lands and optimum local climatic conditions, regulated by the lush Atewa Range Forest, the district's 660.7 km^2 area is known for agriculture and forms part of the enclave producing the region's highest annual yield of cocoa (*Theobroma cacao*) (Atiwa West District, 2021; Codjoe et al., 2013). Media reports indicate that ASGM is expanding rapidly in Atiwa West district, with activities affecting farms and the broader environment, putting not just food and cocoa farms at risk but also destroying forest areas that provide important ecosystem services (Arthur, 2022; Cocoa Post, 2020). Nevertheless, independent academic analysis has not yet corroborated this. Given Ghana's contribution to the global growth of ASGM activities, this case study has broader relevance and can inform the development of policies that foster more sustainable agriculture-ASGM interactions.

5.2.2 Methods

To answer the research questions in the present study, an explanatory research design and mixed qualitative-quantitative research approaches were applied in collecting, integrating, and analysing empirical data, to gain deeper understanding of the research problem. To answer the first research question, a combination of environmental field survey, household questionnaire survey, focus group discussions (FGDs) and interviews were applied to collect data. The second research question was assessed using focus group discussion, interviews, and household surveys. These methods ensured consultative and participatory approaches of engagement with individual households, community groups and institutions. Research question three was addressed by discussing findings from research questions one and two within the context of Ghana's legal and policy framework on ASGM. This helped to explore policy options for complementary ASGM-Agriculture interactions along household, community, and institutional levels. Table 5.1 highlights the different sampling techniques, methods, tools and data analyses used to address the research questions.

Table 5.1 Research methods and sampling techniques applied

Research Question	Method	Sampling method	Sampling size	Data capture tools	Data analysis
1, 2	Face-to-face household survey with semi-structured questionnaire	Simple random sampling	360* (117-Akwabuoso; 121-Ekorso; 122-Pameng) c.30 mins each	Questionnaire; Qualtrics Offline Surveys; Tablets; Field notebook	Descriptive statistics, using SPSS v27+
1, 2	Focus group discussions (FGDs) with farmers	Purposive sampling	1 FGD per community; 10 members each (7 men, 3 women); 1 hour each	Voice recorder; Smartphone camera; FGD schedule	Thematic analysis (by manual coding)
1	Environmental field survey in communities and mined farms - visits with farmers	Transect walk; field observation; Pace counts; visual estimation of length and breadth of site	Within each community + 3 farms per community	Voice recorder; smartphone camera; environmental checklist	Descriptive statistics using Excel**
2	Interviews with ASGM miners	Purposive sampling	5 per community (3 men 2 women); 30 mins each	Voice recorder; Interview schedule	Data translated & transcribed; Thematic analysis
2	Stakeholder interviews	Purposive sampling	11 in total; 30 mins each	Voice recorder Interview schedule	Data translated & transcribed; Thematic analysis
3	Document review	Results from questions 1 & 2 purposively compared with laws/policies on ASGM in Ghana	-	-	Results interpreted at multiple scale within the context of existing laws/policies on ASGM in Ghana

* Information from District agricultural officers indicated ASGM was present in several communities, so the study assumed 1/3 of the district population was experiencing ASGM. The district population is 61,219, so 1/3rd is =20,406 (GSS 2021)(Ghana Statistical Service, 2021). Number of individuals per household is approximately 4 (GSS 2021, p. 83), so our sample population was 5,102 households (20406/4). The sample size thus was determined at 360 based on a statistical confidence level of 95%; margin of error of 5% as well as considering time and cost (Bryman and Bell, 2007; Qualtrics, 2022). Estimate of community population obtained through discussion with district agricultural officers: Akwabuoso – ~3,000; Ekorso – ~3,000; and Pameng – ~4,000.

+ Statistical Package for Social Sciences software (SPSS) version 27.

**Microsoft Excel Version 2207, released in 2022.

Fieldwork was undertaken between October and December 2021 in Akwabouso, Ekorso and Pameng. These communities were selected because they are all farming communities experiencing ASGM operations; are accessible by road; residents were willing to participate in the study; and between them they cover the district's three Area Councils (Kwabeng, Abomosu and Akropong) ensuring data was gathered across the district. The three communities were chosen following a review of online news publications (Arthur, 2022; Boateng et al., 2014; Cocoa Post, 2020; Snapir et al., 2017) use of Google Earth imagery to observe recent mining activities, and communications with a district agricultural extension officer. The stakeholder interviews were conducted in the communities but also in Kwabeng – the Atiwa West district capital, and Koforidua, the Eastern regional capital.

Questionnaires were conducted with residents of the three communities to gather data on the everyday reality of farming and gold mining in the district. After the questionnaires, Focus Group Discussions (FGDs) were used for clarification, validation of findings and to provide forward-looking insights. Farmers were selected based on their experiences and interest to participate, ensuring representation across genders and age groups. Additionally, environmental field observations were conducted in the communities to identify the prevailing situation of gold mining with a particular focus on the impacts of ASGM on land, waterbodies, and local infrastructure. Some FGD participants whose lands were mined were later visited to conduct environmental field surveys. Afterwards, miners were interviewed. Interviews with miners and FGDs with farmers were conducted to uncover a wide variety of political, socioeconomic, cultural, and environmental factors related to ASGM and its interactions with agriculture. Stakeholder interviews were also conducted with 11 officials (the community and district level interviews included: two district agricultural officers; one Atiwa West District Assembly official, one cocoa purchasing officer/traditional leader; one educationist; one chairman of a farmers' cooperative/traditional leader; while the regional level interviews at Koforidua included two officers from the Minerals Commission, one from the Environmental Protection Agency (EPA), one from the Ministry of Food and Agriculture, and one from the Lands Commission). Here, participants were identified based on their knowledge and experience. This expert judgment process was used to verify the reliability of the information obtained in the interviews with the miners and farmers and to explore the

nature of institutional linkages and challenges. Interviews continued until we reached saturation, with no new information being received (Bowen, 2008).

Regarding data analysis, quantitative data collected in questionnaire surveys using Qualtrics were transferred to Scientific Package for Social Sciences (SPSS) version 27 and analysed using descriptive statistics. Quantitative data from environmental field surveys were analysed using descriptive statistics in MS Excel, version 2207. Findings are presented in tables and in the text. Analysed data from questionnaire surveys are also in Appendix D. Qualitative data (interviews and FGDs recordings) were, where required, translated from Twi into English and transcribed (as data collection in the communities was in Twi). Thematic analysis was then applied, where data were manually coded and indexed and major themes identified from recurring ideas were described, including extraction of illustrative quotations. Appropriate quotes from farmers, miners and experts were used to provide more emphasis to enrich the discussions. In line with ethics approvals, participants are anonymous but titles of those interviewed in their official capacities are provided. All quotes in Twi were translated by the first author. Primary results were triangulated with data from published documents, newspaper articles and laws and policies that were reviewed. Policy implication deductions were made from the findings.

This study was approved by the Ethics Committee of the authors' University. The ethics process ensured that participants were well informed about the study, their confidentiality and anonymity was assured, and participants' consent was secured (verbally or through signing a consent form) prior to the commencement of the data collection. Participants were also told that their data would be carefully stored and who would have access to it. Participants were further made aware that involvement in the research was without compensations, and that they could withdraw at any stage up to the point of data analysis.

Field-work was restricted to one administrative region, one district and three communities within the district due to limited time and funding. The study did not include laboratory testing of samples to detect chemical contamination of soil, water, plants, and humans caused by ASGM, since the focus was on the governance and policy implications of the interactions, rather than on technical environmental impact assessments.

5.3. Results and Discussion

5.3.1 Alterations to agricultural land, water resources, and Infrastructure and ASGM-agriculture interactions at household, community and institutional levels

In this section, ASGM interactions with agriculture are analysed at household, community, and institutional levels. Each level of interaction is examined in relation to ASGM's impacts on agricultural land, water resources and infrastructure.

5.3.1.1 ASGM-Agriculture interaction at household level

Traditional small-scale food and cash crop farming dominates land use and 80% of farmers farm cocoa (Appendix D). Farmers also cultivate oil palm, tubers, rice, plantain, and vegetables for subsistence and for trade. Farmers cultivate under different land tenure arrangements (Table 5.2) while average landholdings cover 2.74 ha (6.76 acres), similar to elsewhere in Africa (Okoh and Hilson, 2011).

Table 5.2 Kinds of land tenure arrangements held over farmland based on data from 259 respondents

Types of land tenure	Percentage (%)
Owner (inherited)	49
Owner (gifted)	8
Owner (private)	6
Rented	1
Share cropping	34
Caretaker	2
Total	100

Interviews and field surveys showed that ASGM in Atiwa West is intensive and marked by use of sophisticated machinery. Most ASGM operations are informal, without licenses and permits. With the influx of ASGM entrepreneurs into the communities, residents engaged in ASGM using diverse approaches (Table 5.3) and practised surface mining using various operational methods across different locations within the landscape (Fig 5.2; Table 5.4). In return, farmers generated significant income to support their farming activities, thus permitting movement of labour and finance between the two sectors. Questionnaires showed

31% of farmers branched out into ASGM (farmers, n=219; farmers diversified into ASGM, n = 55) (also see Appendix D). Similar linkages have been found elsewhere (Cartier and Bürge, 2011; Hilson et al., 2013). Questionnaires showed miners mostly leased lands from landowners (73%), enabling landlord farmers to raise considerable funds to support their livelihoods. Land invasion occurs on minor scale (27%).

Table 5.3 ASGM practice approaches

ASGM operational type	Percentage, n=118
ASGM only on permanent basis	31.4
ASGM mainly with some farming elsewhere or shifts between farming and ASGM seasonally	46.6
Just as investor (do not physically take part)	1.7
Other (does non-farm job with mining as a support)	20.3

Fig 5.2 Types of ASGM methods practised in the study area.

A – Mine waste scavenging (Kuli-kuli), Pameng – picture by first author.
B – Washing board with water pump (Suagum), Ekorso – picture by research assistant Jeffrey.
C – Metal detector mining (kwee-kwee), Pameng – picture by research assistant Sylvester
D – Excavator, loader, and sluice (Washing plant), Pameng – picture by first author.

Table 5.4 ASGM methods practised in the study area, based on FGDs, interviews and field surveys

Method and machinery used	Landscape location	Local name
Excavator/pickaxe & shovel, pan, washing board, water pump. Soil is dug and heaped, gangs hired to fetch and wash soil.	Farmlands near waterways, low lying areas and valleys containing alluvial gold deposits.	*Suagum*
Locally–made floating machines with suction tubes – dredgers – that draw gold bearing mud from riverbeds	On or along rivers/other waterbodies.	*Chanfan*
Excavator, loader, sluice, trommel, water pumps/engine. Excavator heaps soil, loader collects soil into wash plant (machine intensive and less labour).	Any farmland that bears gold, also targets alluvial deposits.	*Washing plant*
Use pickaxe and shovel to collect mud and wash with pan mostly or washing board.	Farmland near waterways, low lying areas, valleys.	*Foo-foo/dig and wash*
Use pickaxe, shovel, and pans to scavenge mine waste for residual gold.	Active or derelict small-scale mining sites.	*Kuli-kuli*
Metal detectors, pickaxe, shovel, and pans are used to expose and loosen the ground to enable detectors to find and collect the nuggets	All types of farmlands - cocoa farms, fallow fields; within communities.	*Kwee-kwee*

Miners applied trial and error techniques, based on their field know-how, to undertake mining which resulted in hit and miss outcomes and mounted environmental costs. Questionnaires and interviews showed most miners (80%) are 18-40 years old and ASGM is strongly gendered: men mostly engage in digging and women tend to carry the dug materials to washing centres. Ore-containing soil extracted after washing is mixed with mercury to form a mercury-gold amalgam, then burned to vapourise the mercury, leaving behind a semi-pure form of gold. Some miners use cyanide to extract gold. These chemicals, once released into the environment, can contaminate soils, waterways, and the atmosphere.

5.3.1.1.1 Agricultural land

Farmlands constitute important natural capital in local livelihoods. Yet informal ASGM has affected farmlands. Household questionnaire surveys revealed that 38% of respondents deemed their farmlands were degraded by ASGM. Affected farmers lost on average one-third (32%) of their holdings to ASGM degradation (Table 5.5). Of the affected farmers, 79% reported unreclaimed mined areas, while in many cases where reclamation was attempted, it was not done properly. Surfaces were left covered in gravel and other subterranean materials instead of topsoil, rendering land unfit for farming.

Table 5.5 Proportion of farmers affected by ASGM, and the extent and forms of land degradation occurring

	Farmland degraded by ASGM (n=220). NO YES	Percentage of household farmland degraded (mean land area degraded, n=80; mean of total farmland, n=219, in hectares)	Dominant forms of land degradation
Aggregate score	62% 38%	32% (0.87; 2.74)	
Akwabuoso	63% 37%	30% (0.67; 2.25)	***Soil degradation**:* Degraded lands covered in shrubs, heaps of mine waste, rainfed pits with some containing dangerous water-loving animals, overflow of wastewater into cocoa farms ***Vegetation degradation**:* Clearance of cocoa farms and deforestation of fallow fields. ***Water resources degradation**:* river/stream pollution with mine waste.
Ekorso	68% 33%	25 % (0.93; 3.73)	***Soil degradation**:* Denuded landscape, bare ground covered in gravel, mine waste and huge pits/ponds, soil exposed to wind and water erosion, depleted topsoil/organic matter, holes dug in cocoa farms, likely chemical pollution from mercury/cyanide use. ***Vegetation degradation**:* Deforestation/clearance of virgin farmlands, Clearance of cocoa farms. ***Water resources degradation**:* river/stream pollution with mine waste.
Pameng	55% 45%	47 % (1.04; 2.23)	***Soil degradation**:* Bare ground experiencing water erosion, mine heaps, mine holes dug within community, in between cocoa crops causing plants to wilt, likely chemical pollution from mercury/cyanide use. ***Vegetation degradation**:* Deforestation, clearance of cocoa farms, fallow fields, and marshy areas. ***Water resources degradation**:* pollution of streams.

5.3.1.1.2 Water resources

Water resources are also vital natural capital that miners depend on as much as farmers. Miners consider rivers, riverbanks, low-lying areas and valleys as sources of alluvial gold so

have mined those areas, with many water resources becoming heavily polluted, despite regulation stipulating that a 300 m buffer zone next to water bodies should not be mined (Min of Water Res, 2013). Miners use the polluted water to wash the soil, but they purchased drinking water. Farmers reported that they no longer fetch water from these rivers/streams to drink but instead buy sachet water and are unable to use polluted sources to irrigate vegetable farms during dry seasons. Those who previously used polluted water on their crops reported that plants wilted, possibly due to excessive mud, chemicals, and fuel waste contamination.

5.3.1.1.3 Finance and infrastructure

Questionnaire surveys and FGDs revealed that at the household level, informal ASGM enabled customary landowners and households that ventured into mining to attain financial and physical livelihood assets to improve their livelihoods (Table 5.6). Interviews with artisanal miners revealed that 1 carat of gold is sold for GHS 60, which equivalent to US$60 for 1 gram of gold [as 5 carats equal 1 gram, and the exchange rate is 5GHS = 1US$].

Table 5.6 Assets households acquired as a result of significant contribution from ASGM income (more than 50% of the cost was covered by ASGM income). Data based on questionnaires

Assets acquired	Frequency
TV	40
Radio	32
Mobile phone	55
Shop	18
Car/truck/van	9
Motorbike/motor tricycle	20
Bicycle	2
Motor/manual boat	0
House	28
Land for building	32
Farmland	5

5.3.1.2. ASGM-Agriculture interactions at community level

5.3.1.2.1 Agricultural land

Field surveys across the communities showed that miners generally did not reclaim lands after mining. Some licensed concession holders did not reclaim land, despite government requirements contained in licensing processes. A given area mined using excavators covered anywhere between an estimated 4 ha and c.20 ha. Field surveys again revealed that ASGM-degraded farmlands were characterised by vegetation and topsoil removal and crop destruction (Table 5.5), with deformed bare ground and surfaces filled with subterranean rocks and gravel. Heaps of mine waste of various volumes were also present, interspersed with polluted streams, patches of eroded land and pits. Field surveys and interviews with small-scale miners showed that pits created were 4 to c. 40 m in diameter, mostly shallow (<30 m), with many turned into rain-fed ponds (Fig 5.3).

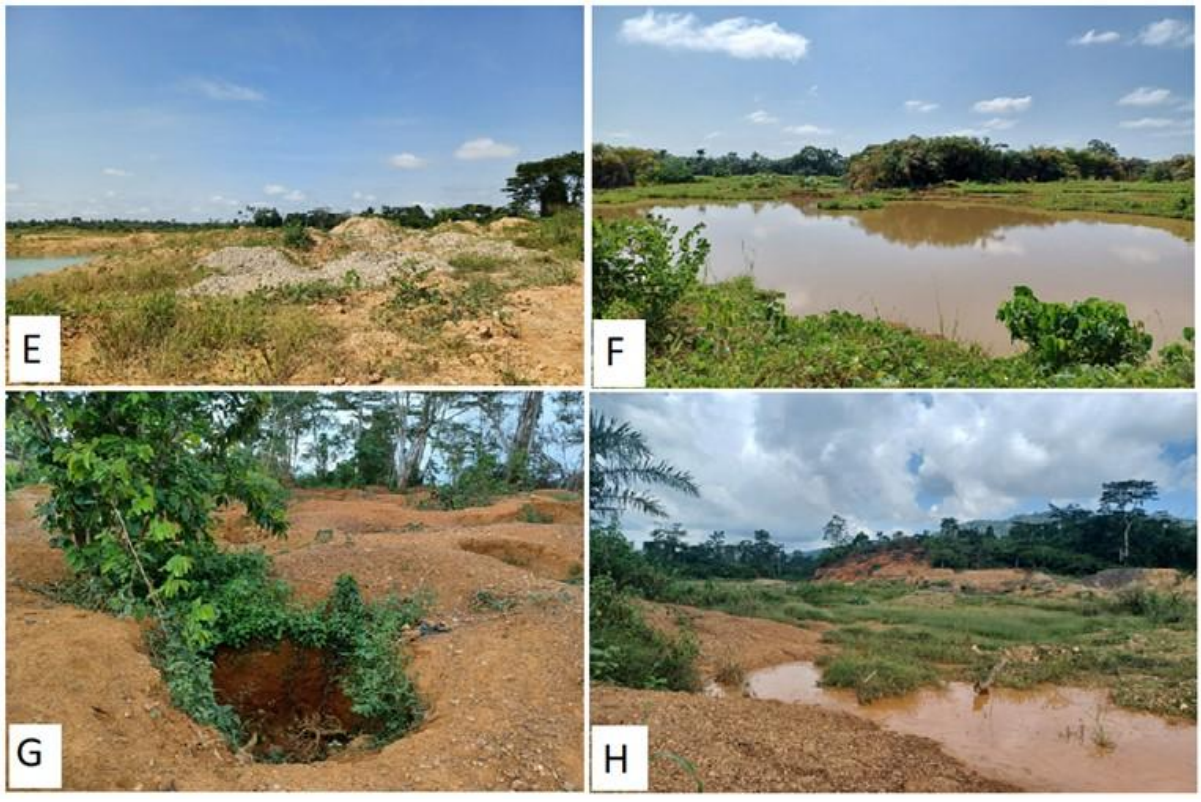

Fig 5.3 Degraded farmlands in the study area.

E – Mine heaps, pond and weeds at an abandoned mine site, Ekorso.
F – Mine pit turned into rainfed pond stretching over 40m in diameter, Ekorso.
G – A farmland mined using metal detectors, Pameng.
H – A low lying area mined using excavators, Pameng.
Source – all pictures taken by the first author.

FGDs revealed that ponds provide habitat for crocodiles, pythons, and other water-loving animals dangerous to livestock and humans, while people have fallen into ponds and died. Ponds have also become breeding grounds for mosquitoes, increasing malaria risk. Field visits revealed overflow of polluted water from mine sites into neighbouring farmlands, affecting crops, while ASGM had also drained groundwater from neighbouring farmlands into mine sites, causing crops to wither. These practices forced neighbouring farmers to lease their farms to the miners to avoid financial loss. These activities, along with the abandonment of miners' storage structures reduced farmland.

Field surveys showed that miners who use metal detectors operate everywhere including backyards and dig holes of 1 - 2 m diameter and 1 - 3 m depth, often leaving them uncovered, with holes dangerous to residents and causing crop withering due to root exposure and reduced access to and availability of groundwater (Fig 5.3). Farmers noted that metal detector miners come from outside the communities, but mine because they have support from local people. However, there was lack of community level effort to ensure they reclaim lands. Miners are also willing to invade and work during the night. Because miners operate in gangs, farmers are left to deal with them, resulting in tensions, as reported by a 58-year-old male cocoa farmer in a FGD at Ekorso:

''*Gold mining guys have destroyed our cocoa farms…our farm roads have been badly damaged. As for kwee kwee* [metal detectors], *the operators are outsiders; they invade our cocoa farms to mine. You will only discover their activities when you visit your farm; and if you try to confront, they can kill you. In that sense did you profit or lose? So, in Atiwa West the gold mining is really affecting the farmers*.''

At community level, FGDs revealed residents are worried, and many women are scared to use routes and farm paths marked by these pits and ponds, fearing they might fall into them, while overall, pits, ponds and heaps of sand and the inaccessibility they cause, result in considerable losses of cultivable land area. Older farmers and women who traditionally farm near their communities have been impacted greatly as most mining activities have been carried out on the community fringes. ASGM's emergence, characterised largely by informal and irresponsible mining practices, caused cumulative degradation and abandonment of farmlands, forest areas and water bodies at the community level.

Yet, in some instances where mining sites were properly reclaimed, FGD participants argued that those areas were suitable for farming and could even enhance yields of tubers. Questionnaires showed 54% of respondents asserting this, probably because mining and reclamation loosen the soil, making it suitable for crops (Yaro, 2014). Usually farmers restart with mixed-crop farming on reclaimed land, introducing cocoa as the fertility improves, as cocoa plants do not thrive on improperly or recently reclaimed sites. Oil palm (*Elaeis guineensis*) was also reported to do well on reclaimed lands, including poorly reclaimed areas (Solidaridad, 2021). However, it is unclear from these findings if farm produce from reclaimed lands meets desired food quality standards.

According to the responses of community members to our questionnaire, there was a decrease in farm labour and increased cost of hiring farm labourers due to the emergence of ASGM (Table 5.7). Most labourers are shifting into ASGM because of its perceived higher profit and because of farmland degradation.

Table 5.7 Residents' perception of ASGM effects on access to and cost of hiring farm labourers.

	Access to labourers (%), n= 215	Cost of hiring labourers (%), n=216
Increased	8.4	78.7
Decreased	70.2	2.3
No change	12.6	9.3
Not sure	8.8	9.7

5.3.1.2.2 Water resources

Residents revealed in FGDs that degradation of forests around waterbodies and disruption of river courses by miners increases flood risks to farms. Field surveys showed that in Akwabuoso and Ekorso, the Birim river has turned brown and muddy, with farmers noting a reduction in flow. The sides of the river and parts of the riverbed have been mined, exposing adjoining land and nearby farms to the risk of flooding (Fig 5.4). Local streams in Ekorso and in Pameng have also been heavily polluted and turned brown by liquid waste discharge from mining sites.

Fig 5.4 Degradation of natural and physical capitals in the study area.

I - Degraded farm road at Ekorso.
J - River Birim polluted and farm bridge damaged at Akwabuoso.
K - Rainfed pond covered in weeds and algae in a mine site abandoned for > 5 years, Akwabuoso.
L - Cocoa farm polluted with mining wastewater from neighbouring farmland at Akwabuoso.
Source – all pictures taken by the first author.

Farmers now must travel further to access alternative water sources for on-farm use or stop vegetable farming. These changes increased farmers' expenditure, affecting profit margins. A 65-year-old retired male teacher and farmer interviewed in Akwabuoso shared that:

''…mining has polluted our waters. Due to greed, miners apply all kinds of inappropriate methods. They would divert a river course to let the water pass, and mine the riverbed. Some would later reconnect the diverted route to the original course. Some don't care and move on.

Before mining, river Birim and Akuku were clear with fish presence, and we easily drunk from the rivers when returning from the farm.''

Loss of farmlands and waterways can threaten farmers' livelihoods, as well as creating food security challenges. These communities could become ghost towns at the cessation of mining activities if farmland losses continue unabated. Continued loss of cocoa farms due to increasing ASGM could significantly affect Ghana's annual production and supply of cocoa to the international market, a concern shared by the leadership of the Ghana Cocoa Board (COCOBOD) (Arthur, 2022). The degradation of waterways and forest areas leads to loss of grounds for fishing, hunting, collection of fuelwood and other non-timber forest products. These changes can increase rural-to-urban migration and exacerbate the poverty of those staying behind.

5.3.1.2.3 Infrastructure

Field surveys showed local infrastructure/physical capitals damaged by ASGM, including farm roads (in Akwabuoso, Ekorso and Pameng), and farm bridges (in Akwabuoso), which miners did not repair (Fig 5.4). This had community level impacts and restricted movement and access to farms. Farmers said miners did not pay any compensation for the harm caused and they were unable to cart enough produce from farms to their homes, causing produce to spoil and available food in the communities to decline.

The interactions between agriculture and ASGM at household and community levels, analysed across the five livelihood capitals – Natural, Physical, Human, Finance and Social are summarised in Fig 5.5., adapting Scoones' checklist on the sustainable livelihood framework (Scoones, 1998, p.4) (Scoones, 1998).

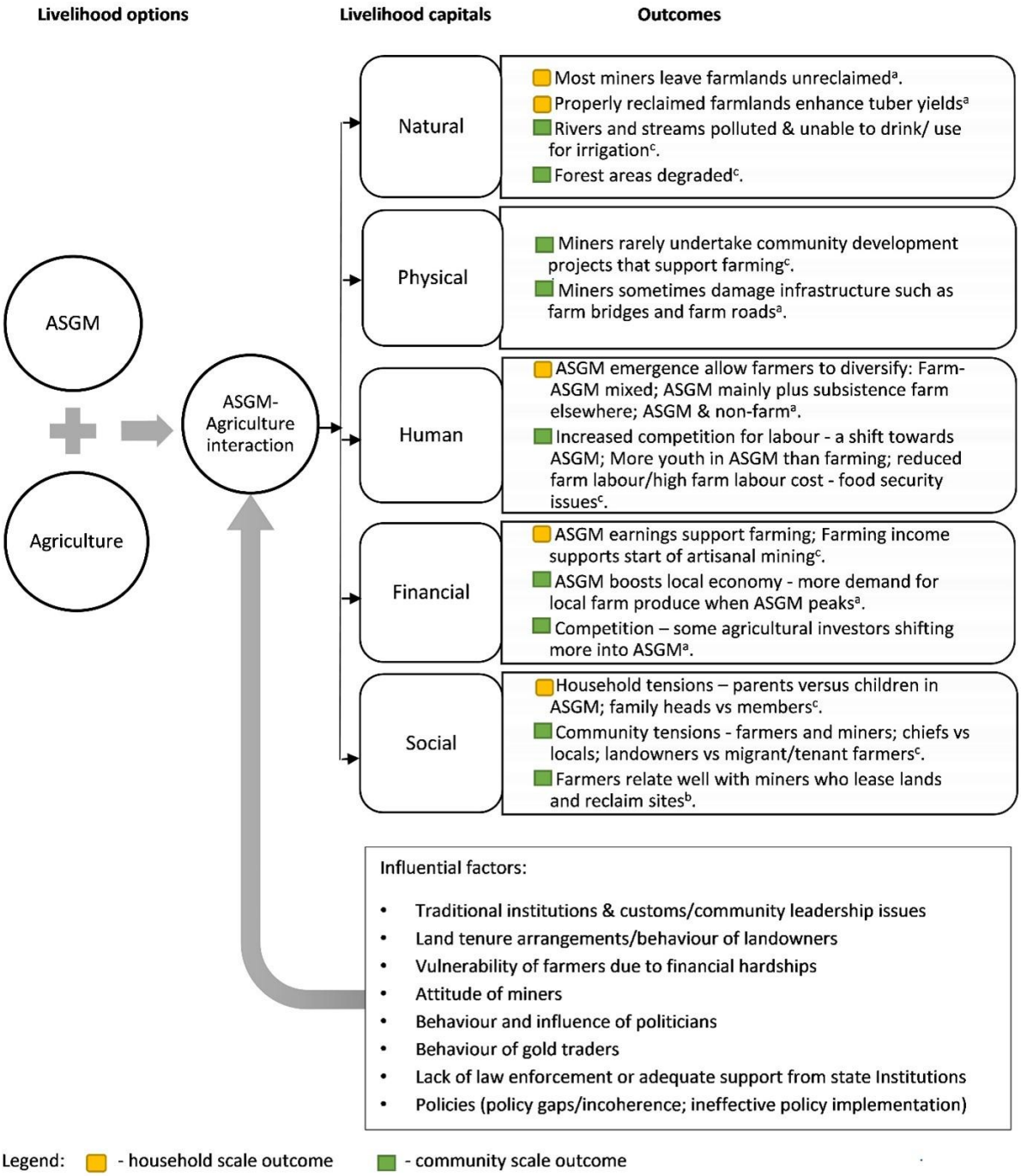

Fig 5.5 A summary of the ASGM-agriculture interactions across the five livelihood capitals at household and community scales.

Source: Author's construct.

5.3.1.3 Interaction between agriculture and ASGM at institutional level

Our findings from stakeholder interviews revealed a lack of formal institutional linkages between mining and agriculture at district, regional and national levels. Minerals Commission (MC) officials mentioned they did not have a direct working relationship with the agricultural department, and agricultural officers stated the same. One district agricultural official, for instance, remarked that:

''*Even though we are informed about mining issues when we go for district assembly meetings, our department is not officially involved and plays no role in any of the stages regarding small-scale mining, be it land acquisition, the mining itself, or the land reclamation stage, and it's a big worry…''.*

The current mining law (Act 703) requires that at the critical stage of site plan evaluation, MC officials should check whether the proposed mining site overlaps with an existing concession. Existing land-uses such as food and cash crops, irrigation, and farm infrastructure are not considered in licensing processes as officials rely solely on geological and concession maps to approve site plans. Despite the importance of smallholder agriculture and the many people it sustains (Hausermann et al., 2018; Li, 2014) the sector is not considered in the granting of ASGM mining licences. In FGDs, farmers expressed their frustration about this. A 55-year-old male cocoa farmer in Ekorso, for example, said:

''Which government would go about nursing cocoa seedlings, farmers would go and plant and nurture them and when they grow to produce cocoa fruits, then some miner will show up and say the same government has given him permission to clear those cocoa trees and mine there? How does that help us, did you go [improve] *or come* [declined]*? As a result, farmers are always suffering/crying within.''*

Our interviews with traditional leaders in the communities further revealed that there were no formal linkages between traditional institutions and state institutions (e.g., the District assembly and MC) regarding ASGM. Traditional institutions are not actively engaged in the governance and management of ASGM activities. Interviewees stated that they were only occasionally invited by the District Assembly to take part in an ASGM related forum, often following community level agitation. Presently, Ghana's Act 703 (section 92) only requires that one representative of the district level traditional authority is appointed to a six-member Small-scale Mining Committee in a mining district. This committee must assist the MC District

Office to monitor, promote and develop mining operations. However, these committees operate on terms and conditions determined by the Minister responsible for mining. This regulation does not meet the expectation of local traditional authorities and customary landowners, who want to be more actively engaged in ASGM governance and management (Fig 5.6).

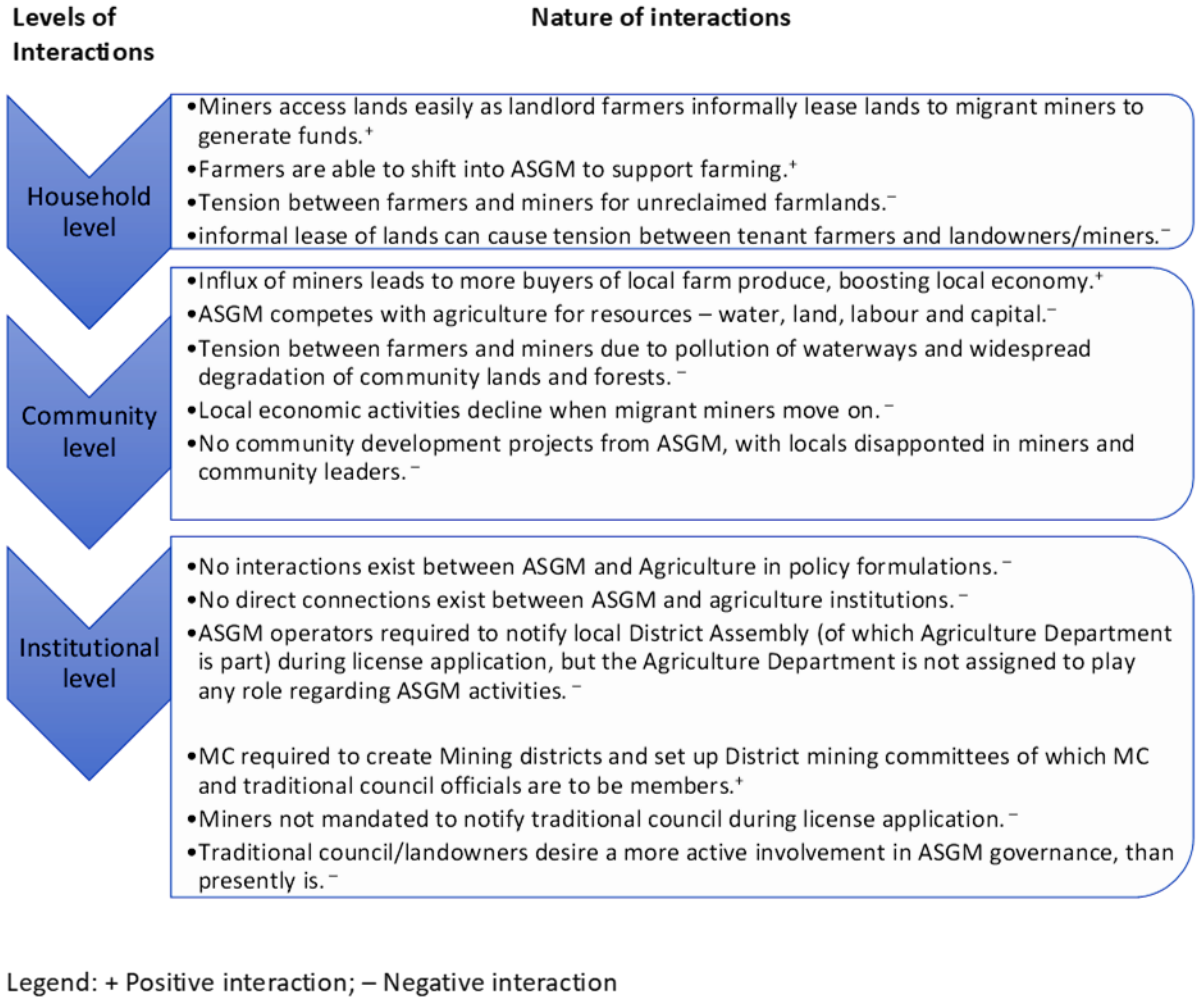

Fig 5.6 ASGM-Agriculture interactions across multiple levels

Legend: + Positive interaction; – Negative interaction

Source: Author's construct.

The next section identifies and analyses the drivers behind the observed changes and ASGM's interactions with farming.

5.3.2 The drivers behind interaction between ASGM, agriculture and capital

This section presents findings and discussions concerning drivers that influence the interactions between ASGM and agriculture. It touches on financial challenges of farmers, the nature of existing customary land tenure systems and informal land trading, ineffective community leadership, the mindset of miners and gold traders towards their operations, and ineffective supervision by state institutions.

5.3.2.1 Financial challenges and hardships faced by farmers

Farmers revealed in FGDs and interviews that they faced financial hardships and lacked adequate subsidies and incentives, while simultaneously facing climate change, poor fruiting/productivity of crops due to pests and diseases, unavailable or limited markets for farm produce, and unpredictable income due to changing input prices. A district agricultural extension officer said:

''Farmlands in the district are fertile, but farmers face multiple challenges. This year [2021], *the usual rains we experience between May-July did not occur, cocoa plants could not fruit properly, and it is the end of the year now, and farmers report of low cocoa beans harvest due to poor fruiting. We think this is linked to climate change.''*

FGDs and interviews revealed that insufficient income from agriculture and few alternative livelihood options drove farmers to lease their land to miners, with miners promising to reclaim the lands after mining. However, most miners did not reclaim sites and farmers did not take any form of insurance against lack of reclamation. A 70-year-old male farmer from Akwabuoso explained in the FGD:

''Every farmer needs money. Maybe you can only produce 5 bags of cocoa in a year, yet the miner comes and offers millions for your land, you will collect it! The miner will promise you to properly reclaim the land, so you can have it back. It is because of poverty that is why we give our lands away to the miners. If I have money and lands, why will I give my land out. So, in a way due to our vulnerabilities that's why they [*miners*] *too had the opportunity to manipulate us in the manner they did.''*

Cocoa bean prices are fixed by the government (GHS 660/US$ 88 per 64 kg bag at the time of data collection). Yet farm input prices (agrochemicals and fertilisers) and farm labour costs

are unregulated and keep increasing. The government offers free annual cocoa farm spraying but farmers consider this inadequate and not all farmers benefitted from the opportunity. As such, farmers spend more money (often borrowed with high interest due to absence of any state-led credit scheme) on buying farm inputs. Nyame and Blocher (2010) similarly found in Western Ghana that because of the difficulties linked to farming, landowners easily leased lands to miners because they perceived ASGM ''...as an attractive and economically beneficial promise of income'' (p.51).

5.3.2.2 Customary land tenure systems and informal land markets

Customary land tenure arrangements are predominantly held over farmland in the Atiwa West area (Table 2). Interviews with the MC, Environmental Protection Agency (EPA), District Assembly, and the Lands Commission revealed that officials often blame traditional authorities and landowners for allowing ASGM and land-use conversions. A MC official at Koforidua said: ''*In our view, chiefs and landowners are the main people responsible for the rise in ASGM. Outsiders cannot enter their lands and mine without their consent.*'' However, FGD findings indicate that licensed miners usually approach village chiefs and landowners after licenses have been procured from the head office in Accra. They negotiate, seek permission from local chiefs and make payments before mining begins, whilst they pay compensation to farmers/local landowners for crops.

Farmers/landowners stated that concessions are granted without their consent and involvement, so miners suddenly enter their lands holding papers stating that the government granted them concessions, which causes tensions. A 60-year-old male farmer in Ekorso stated:

''When miners with concessions come, they first go to the palace to seek their consent and make payments. So, you will be there, and they will come with their machinery into your land and present some documentation as their concession from the government [MC] *in Accra to mine. When you oppose, they don't listen, your protests go nowhere. So, either you give it and get some compensation, or they will say, take them to court.''*

Nyame and Blocher (2010) similarly observed in Western Ghana, that landowners ''…voiced strong displeasure at the legal mode of acquisition of mining rights especially relating to access to traditional lands'' (p.51).

These findings show deviation from the law regarding the acquisition of an ASGM license. To acquire an ASGM licence, a prospective miner is first required to submit a site plan to the district MC for approval after identifying an area of interest (which ideally should happen with consent of the rightful landowner). Officials check this and if the proposed site does not overlap with an existing concession (ASGM or large-scale), they forward the application to Accra. In Accra, a cadastral search is undertaken and the site plan is referenced against master geologic and concession maps. If the site is free or not under a pending application and is within a designated area (i.e. not within forest reserves or buffer zones of waterbodies) MC officials allow the applicant to proceed with the remaining steps to secure a license (Ferring et al., 2016; Ghana Government, 2006; Tychsen et al., 2017).

Finally, licenced small-scale miners must follow compensation regulations (Ghana Government, 2012a). Using baseline values including land improvements and crop ages, compensation should be calculated by ‘‘compensation committees’’ to provide farmers fair prices. However, interviews and FGDs revealed that formal practices tend to be replaced by informal negotiations that do not always ensure fair compensation and transparency, particularly for women and tenant farmers. Other studies have found similar outcomes [(Hausermann et al., 2018; Nyame and Blocher, 2010). These frustrations also drive local landowners to exercise control over and benefit directly from the minerals in their land, despite laws on mineral rights, making it easy for illegal miners to strike direct lease deals.

While land-grabbing literature focusses on theft and dispossession (Hall, 2013), our findings show that complex informal land markets facilitate miners’ mineral access, reflecting dynamic relationships and practices. Hausermann et al. (2018) also found this dimension of land-grabbing of artisanal miners in Western Ghana, while Van Bockstael (2019) has observed the same for Cote Ivoire. Local land-users, particularly men, are not just exploited in this system but they also actively influence land-grabbing outcomes, firmly stating their price. Mining cannot begin until landowners are satisfied with compensation. These complex land markets and negotiations result in social differentiation within communities and affect food insecurity and malnutrition (Hall, 2011; Nyantakyi-Frimpong and Bezner Kerr, 2017; Thomson, 2014) Considering the shift in blame between state officials and customary landowners, consistent and early stakeholder engagement between state officials and chiefs and

residents/landowners is critical in addressing the ASGM challenges linked to current land acquisition and mining approaches.

Land-grabbing linked to informal ASGM, alongside issues of unsustainable farming practices, climate change impacts, endemic conflicts, and lack of rural employment prospects outside agriculture, particularly for the youth, also contribute to urbanisation in West Africa, affecting the region's urban centres (Guneralp et al., 2017). A well–governed ASGM sector that complements farming and allows the sustainable co-existence of both sectors would improve job opportunities in rural areas and reduce rural-to-urban migration. Critical to this is identifying productive ore deposits and demarcating ASGM zones separate from farmlands at district level. Effective ASGM zone demarcation requires the government to engage effectively with customary landowners, communities, and artisanal miners to address their varying concerns, including those bordering on mineral rights. At present, landowners' inclination to exercise mineral rights under customary norms is driving increased illegal ASGM activity but also undermining attempts by government to formalise the ASGM sector.

5.3.2.3 Community leadership issues

Many community leaders in new frontier areas currently lack the experience to manage the influx of miners into their spaces. Questionnaire surveys, FGDs and interviews revealed that community members were not pleased with the leadership of their chiefs and their associates. They expected them to negotiate with miners to support community developments e.g., provision of boreholes, and to restrict ASGM operations that degrade farmlands and waterbodies. Field surveys showed no developmental projects were carried out with mining funds received by traditional authorities. However, elsewhere in Ghana, Hausermann et al. (2018) found instances where mining funds were used by community leaders to build classrooms and boreholes. Informal land dealing between miners and landowners/community leaders may be convenient due to its quick and non-bureaucratic tendencies but does not guarantee direct community development.

Leaders also need to work with community members to address ASGM related challenges. Questionnaire surveys revealed that residents desired responsible ASGM practices that could coexist successfully with agriculture (Table 5.8). In communities where the chiefs cooperate well with their residents, they can successfully resist illegal ASGM, as reported in Asunafo – a

neighbouring village to Ekorso, where *galamsey* activities do not thrive, but regulated community small-scale mining is permitted (Ghanaian Times, 2022).

Table 5.8 Preferred changes towards ASGM activities, based on questionnaires.

Options	Percentage, n=357
No change/do nothing	0.8
ASGM stopped outright	10.6
Progressively replaced with alternative livelihoods	5.0
ASGM kept but modified to co-exist with other livelihood activities	81.8
Other	1.7

5.3.2.4 Attitudes of ASGM miners and gold traders

FGDs and interviews with farmers and miners showed the mindset of most miners was to 'dig, strike, and move on'. Most miners were in a hurry and focussed on how much and how quickly they can find gold due to the high demand for it, and the pressing need to make returns on monies taken from investors/creditors. Mining gangs are in constant competition, showing little interest in related environmental and social issues. Instead of spending time reclaiming mined sites, they searched for and mined new deposits. A 49-year-old male miner in Pameng shared in an interview that:

''The high demand for gold means it is competitive out there, so it's helpful to have the backing of a 'big man' who has political and financial influence to push for your interests. In some cases, they appoint agents to work with us on sites.''

Miners linked the lack of reclamation to the non-enforcement of laws. Interviews suggested that because their colleagues do not reclaim sites, they too did not see the need. Consequently, there is little difference between the operation of the regulated and unregulated miners. This was emphasised by a 55-year-old male miner from Akwabuoso:

''I worked with one of the mining companies that ensured we were environmentally compliant. They would not pay a gang, if any member washed their dirt in the Birim river, plus they reclaimed sites. However, as more miners came, we saw chanfans on the river, others not reclaiming lands, but were not stopped/punished. So, our managers also joined. This led to the

rampant use of inappropriate methods, with everyone essentially seeking as much gold as possible.''

Interviews with miners revealed informal support systems in which some gold traders give interest free loans and mercury to artisanal miners that are in financial need and the miners later repay with gold. However, local gold traders did not apply any internationally recognised due diligence procedures, such as the Organisation for Economic Co-operation and Development (OECD)'s Due Diligence Guidance. They showed little interest in whether the miners they buy from operate legally and responsibly (MLNR, 2014). Gold traders were preoccupied with ensuring they were not outwitted by 'dodgy' gold sellers (who sometimes sell gold samples embedded with stone/other metals). Some traders demanded the mercury-gold amalgam to be heated in their presence before making payments.

5.3.2.5. Ineffective monitoring and support from relevant institutions

Weak enforcement of laws and regulations drive degradation. Farmers in FGDs complained of insufficient assistance from state agencies such as the MC, EPA, District Assembly, and the police, in dealing with miners that have degraded lands (also see Table 5.9). Farmers argued that miners often paid their way out of trouble. Because miners have more money than the farmers, and sometimes political backing, it was difficult to challenge them or engage in legal disputes. A 47-year-old male cocoa farmer in Ekorso stated:

''We see government personnel mandated to supervise the miners come around with police and do their rounds but, in the end, the miners will continue to work in bad ways, with some not having the correct paperwork. If you report your case to them, you get no good treatment, and it gets nowhere.''

This highlights the increasing power imbalance between the more powerful ASGM entrepreneurs (with more money) and the relatively powerless smallholder farmers.

Table 5.9 Residents' perceived levels of organisational support, based on questionnaire survey. Units are percentages.

	Farmer association	Local mining association	Community social support association	Local traditional council	Local district assembly/other government agencies
Not at all	53.7	87.2	56.8	50.0	48.6
Low	11.6	4.3	10.3	4.9	2.7
Medium	28.9	7.0	23.2	7.1	7.0
High	5.3	1.1	9.2	24.7	16.8
Very high	0.5	0.5	0.5	13.2	24.9

A 58-year-old male cocoa farmer in an FGD in Ekorso stated:

''When our farm road got damaged and our chief farmer and other elders informed the district police commander, he said he would come and see it, but nothing happened. With such an outcome, what can you do? Do you have the money to pursue a legal case with the miners?''

Effective supervision of ASGM by state agencies is compromised by the interest and interference of politicians, as well as miners' financial capabilities and interests to pay their way out of trouble. Farmers feel helpless and increasingly overwhelmed, which can increase confrontations if the trend continues. Lack of MC and EPA district offices in new mining areas such as our study area compound law enforcement challenges. Interviews with MC and EPA officials revealed that they do not have enough personnel and resources to adequately monitor ASGM in all locations, with MC officers adding that they were now in the process of creating a mining district in Atiwa West.

5.3.3 Policy implications of agriculture and ASGM interactions

Existing literature on ASGM-agriculture linkages has centred on exploring how the two practices interact on the ground and how farming and mining households adapt consequently. ASGM and agriculture have been described by others as complementary rural poverty-reducing activities, focusing on the individual/household level, including a fragile co-existence found in Peru (Hilson and Garforth, 2012; Malone et al., 2021; Mkodzongi and Spiegel, 2019). The novelty of this study is that it has explored ASGM-agriculture interaction

at multiple levels – household, community, and institutional levels – in a frontier area where ASGM is growing. These interactions are discussed in the next subsections.

5.3.3.1 Household level

Our findings indicate that ASGM activities can be beneficial to its practitioners and can support agricultural activities at the household level but that the links between ASGM and agriculture are not entirely complementary. To foster household level complementarity, the Minerals Commission (MC) should link with the agricultural department and other relevant stakeholders including District Assemblies, traditional authorities, and the EPA, to deal with land degradation risks by: i) Adopting land degradation preventative approaches: educate farmers to be wary of irresponsible mining practices and insure in case of miners' lack of interest in reclaiming lands; train miners to adopt responsible mining practices; support farmers to form or join functional farmer-based cooperatives; and train farmers/landowners on valuation and negotiation skills that enable them to demand appropriate compensation for crops and lands; ii) Tackling improperly reclaimed lands: Agricultural officers should train affected farmers in land-crop suitability and guide them to plant suitable crops e.g., oil palm that can enhance stability of soils and stimulate faster recovery of soil nutrients over time, as well as ensuring farmers are provided with an overview of the longer-term risks associated with planting particular crops.

Additionally, the agricultural sector, including Ghana Cocoa Board, needs to introduce policies that protect the interests of farmers, such as an insurance scheme that insulates farmers from forceful eviction from lands by landowners wishing to lease lands to miners. Farmer associations need to be strengthened to better advocate for farmers in the face of growing ASGM activity. Government must similarly take steps to make farming, including cocoa cropping, more lucrative and attractive by: i) educating and building the capacities of smallholders to shift from unsustainable farming practises and improve their agribusiness skills; ii) providing more support to farmers through regular supply of adequate farm inputs e.g, improved seeds at affordable prices and iii) providing adequate financial, logistical, and technical support for increased profitability.

Miners in the ASGM sector struggle to obtain investment finance yet they must still front the costs for land reclamation. Regulation 23 of (L.I 1652) (Ghana Government, 1999a) mandates

the EPA to ensure that prospective small-scale miners post reclamation bonds. Policy considerations regarding costs and financing are necessary. Illegal miners have easy access to the gold market because licensed gold traders buy from both legal and illegal miners. Regulations and policies need updating to ensure that more artisanal miners are motivated to register and operate responsibly so that they can complement rather than undermine agricultural activities. For instance, gold traders could be empowered and supported by the state to buy gold at higher prices from registered and certified responsible miners.

5.3.3.2 Community level

The itinerant nature of miners and the irresponsible mining practices the majority adopt mean that benefits obtained from ASGM at individual or household level are undermined by aggregate long-term costs at community level linked to degradation of physical capitals and natural capitals such as farmlands, water resources and forests. Our study highlights important aspects of gold mining activities that are related to agriculture, such as land tenure conflicts, land reclamation and land grabbing. The Ghanaian government launched a national land reclamation project in 2021 (Ministry of Lands and Natural Resources, 2022) targeting abandoned unreclaimed lands. This needs to incorporate innovative community-based reclamation processes that are economically affordable, socially acceptable, and ecologically viable (Stacey, 2019). In Indonesia, community participation in land reclamation projects proved very successful (Fisher et al., 2019). Community leadership and farmers' cooperatives need to be empowered on ways to handle the influx of ASGM operators and related social conflicts between ASGM and agriculture.

5.3.3.3 Institutional level

Our findings again revealed a lack of institutional linkages between the mining and agricultural sectors. It shows that without intervention, ASGM and agriculture are far from complementary rural poverty-reducing activities. A key proposition of this paper is that sustainable and mutually-beneficial interactions between agriculture and ASGM activities on the ground require interactive linkages among relevant state and non-state institutions within the agricultural, mining, land and local authority sectors, functioning within an effective dynamic legal and regulatory setting to enforce responsible ASGM as well as sustainable agricultural activities.

Ghana's mining legal framework only mandates the mineral rights holder to negotiate with and compensate the landholder before mining operations begin. These negotiations and compensations are, however, centred on an economic valuation of land use activities on the land (Ghana Government, 2012a). Compensation procedures do not consider any costs linked to potential post-mining land use challenges, or potential impacts of mining pollution on health of residents. Similarly, landowners do not get to share directly in the proceeds of gold mined from their lands. The growth of informal ASGM shows that there is a disconnect between mining legislation and the realities on the ground.

Ghana's existing ASGM formalisation regime is strictly state-centred, and customary land tenure rights are not effectively incorporated. Most small-scale miners choose to disregard state laws and deal exclusively with customary landowners to access land and mine informally. Currently there are few incentives for landowners to engage in ASGM formalisation processes, causing landowners to approve miners to mine illegally. Formalisation of ASGM is a global challenge, and this study prompts the urgent need for states to closely consider customary land tenure rights and interests in ASGM formalisation processes.

The findings from this study, however, also point to a problem with customary laws. Many local and traditional leaders abuse their power, and this reinforces socio-economic differentiations and inequalities. Therefore, mineral-endowed nations in the Global south and particularly in SSA, need to move away from state-centric formalisation to integrating customary laws in ASGM formalisation processes. States should engage with traditional leaders and landowners to collaborate and map out a hybrid customary and statutory governance approach. It should support environmentally responsible and socio-economically viable ASGM activities that will enhance agriculture and rural development and allow landowners and local and traditional authorities to share in ASGM benefits (also see Mensah, (2021)).

Through effective collaboration with traditional authorities and customary landowners, governments should be committed to proactively prioritise geological assessments and block out mineral rich lands for ASGM to limit interference with agricultural productivity and other relevant land use activities such as large-scale mining. The MC and EPA should adopt strict

monitoring and enforcement of laws that lead to responsible mining operations and reclamation of mined lands, ensuring reclamation works are verified and certified, taking appropriate action when expected reclamation standards are not met.

Our findings have shown how closely the agricultural and ASGM sectors are linked in practice and have revealed some of the many factors that drive, shape, and explain their relationship. But these linkages are not reflected in policy and governance in Ghana, as is the case for some other African countries (ACET, 2017). In Ghana, each sector has traditionally developed policies independent of the other and there is no formal district, regional and national level institutional coordination between the two sectors (Fig 5.7). ASGM, when regulated and practised sustainably, can effectively co-exist with cocoa farming and other agricultural practices. There is a pressing need for a joined-up governance framework that sees ASGM and agriculture as interconnected activities rather than as livelihood alternatives (Cartier and Bürge, 2011).

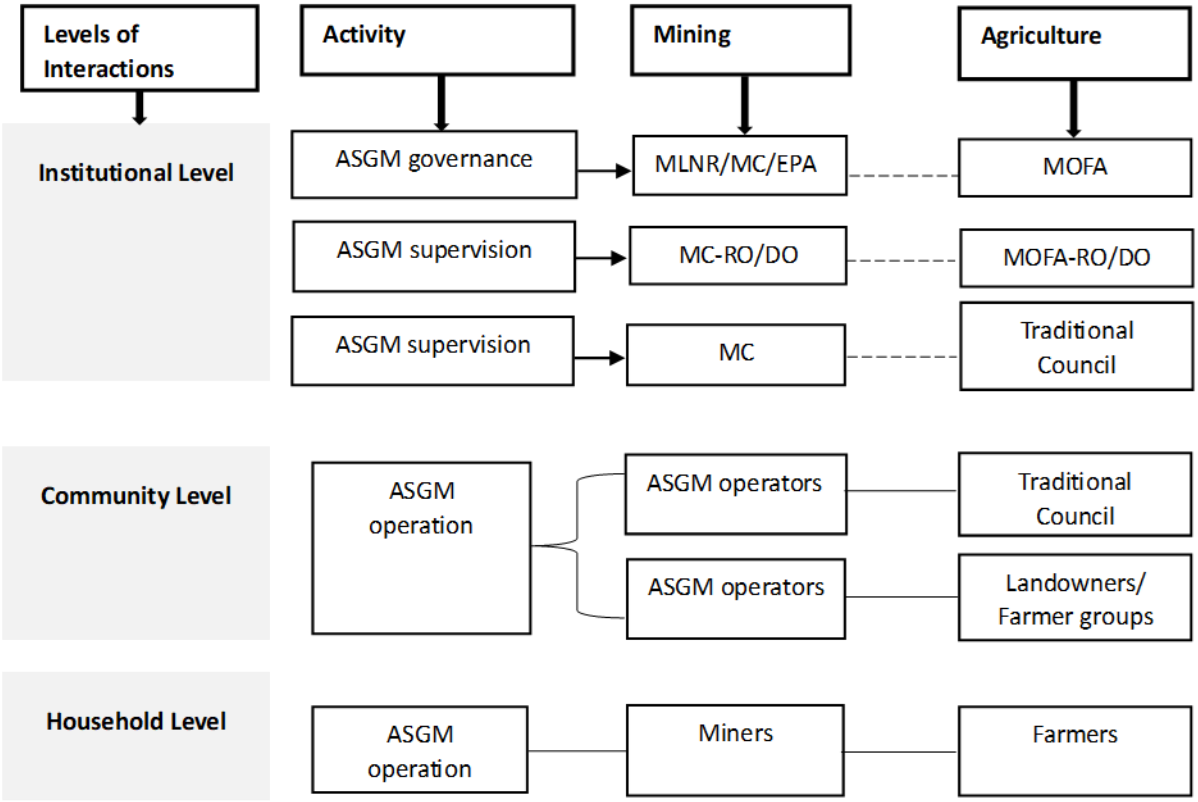

Fig 5.7 ASGM-Agriculture interactions across institutions

Legend:

---------- No direct connection between sectors

———— Direct connection exists between sectors

MLNR — Ministry of Lands and Natural Resources; MOFA — Ministry of Food and Agriculture

MC — Minerals Commission; EPA — Environmental Protection Agency

RO — Regional office; DO — District Office

Source: Author's construct.

A more comprehensive rural development policy stimulating sustainable enhancement of the two livelihood options is necessary. Policies and regulations should demand effective stakeholder engagement regarding acquisition of lands and ensure responsible practices in both livelihood activities. Stakeholders should include the government agencies on mining especially the MC, the agricultural ministry, customary landowners and traditional councils, farmers and their unions/associations, miners and their associations, the local government ministry and district assemblies, government land agencies, EPA, and Water Resources Commission, amongst others.

5.4 Conclusion

This study has shown that ASGM emergence boosts local economic activities and triggers movement of labour and finance across ASGM and agriculture sectors at household level. ASGM is not replacing farming in non-traditional mining areas but adds to the existing rural livelihood mix. However, most miners are unregulated entrepreneurs and mine irresponsibly, degrading natural capital such as farmlands, waterbodies, and forests, as well as physical resources like farm roads. Miners generally do not undertake community development projects. This relationship between ASGM and agriculture is unsustainable because irresponsible itinerant ASGM is creating tensions between farmers and miners. While ASGM generates short–term income at an individual and household scale for some, benefits are outweighed by the long–term costs of ASGM at the community scale, linked to the aggregate degradation and loss of agricultural lands, soil contamination, and pollution of waterways and the atmosphere.

Low profitability in farming drives landowners to lease lands to miners and generate funds to enhance livelihoods, causes youth to move into mining full time, and leads farmers to diversify into ASGM and raise funds to support farming. Lack of law enforcement, absence of appropriate incentives and ineffective stakeholder engagement and the mindset of many miners and investors to maximise profit quickly also drive informal ASGM. Government's inconsistent engagement with landowners and traditional leaders and inadequate compensation to landholders for mining sites, drives landholders into informal direct lease deals with miners to exercise control.

ASGM interacts with agriculture in communities but in governance the two are not considered simultaneously. Our study of ASGM in newly mined areas shows that without intervention, ASGM and agriculture are far from complementary rural poverty-reducing activities. There is an urgent need for more joined–up governance both across the sectors and between formal and informal (traditional) institutions.

Future studies could assess human capital impacts from mining, drawing on expertise from the health sciences. Food quality tests of farm produce from reclaimed lands could be carried

out in future to test if they are appropriate for human consumption. Additionally, policy alignment between mining and agriculture could be assessed.

Acknowledgements

We wish to acknowledge help from the chief, farmers, and people of Akwabuoso, Ekorso and Pameng. Farmers offered many useful insights on the impact of ASGM on farming and artisanal miners also provided information and opinions on the issue of access to mining lands and their relationships with farmers. Our sincere thanks also go to the officers that granted interviews, to the Agricultural department in Atiwa West district and to our research assistants – Musah Seidu, Sylvester Adranyi, and Jeffery Amoah.

Chapter 6. Artisanal and small-scale gold mining governance and cross-sectoral policy coherence in Ghana

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The content of this chapter has been published in the *Resources Policy* journal as follows:

Enoch Adranyi, Lindsay C. Stringer, Henrice Altink,

Artisanal and small-scale gold mining governance and cross-sectoral policy coherence in Ghana,

Resources Policy, Volume 96, 2024, 105235, ISSN 0301-4207,

https://doi.org/10.1016/j.resourpol.2024.105235.

Abstract

Artisanal Small-scale Gold Mining (ASGM) crosscuts multiple sectors, requiring an integrated approach to its governance and formalisation across its value chain. To avoid policies undermining each other, they need to be coherent. However, little is known about effectiveness of the legal framework and coherence in policies across ASGM and other mining-sensitive sectors. This paper examines the legal framework governing ASGM, using Ghana as a case study, and analyses the coherence of policies across mining-sensitive sectors (mining, agriculture, land, water, environment, and development) concerning sustainable ASGM. It asks: i) Do existing laws and regulations on ASGM formalisation address the main activities along the sector's value chain? (ii) To what extent is mining policy coherent with policies of other mining-sensitive sectors regarding sustainable ASGM? (iii) What challenges impact policy coherence between the mining sector and the other mining-sensitive sectors, thereby affecting ASGM formalisation? Laws, regulations, and selected reports were reviewed, alongside qualitative document analysis of relevant policies, combined with expert interviews with government officials. Findings show a broad legal framework covering ASGM's value chain and linked sectoral institutions, but in certain areas, laws are insufficiently detailed and unsuited to miners' needs, and ASGM governance is not truly decentralised across the different sectors. Coherence between mining policy and other mining-sensitive policies is generally 'partial', causing limited intersectoral coordination along ASGM's value chain, and ineffective monitoring of gold mining and sourcing. Key challenges for policy coherence include a lack of political will to integrate ASGM governance into other sectors; highly siloed ministries/departments and deficient institutional distribution and networks; and inadequate resources for policy implementation, affecting the success of ASGM formalisation efforts. Governments need to actively establish cross-sectoral planning processes through cross-ministerial structures and strengthen institutions. Such efforts should seek to foster integrated ASGM governance and ensure adequate and effective laws across the value chain, boosting policy coherence across national, regional, and district/local levels as well as across sectors.

Keywords:

formalisation; institutional coordination; sustainability; legal framework; sub-Saharan Africa

6.1 Introduction

Artisanal and small-scale mining (ASM) involves low-tech, labour-intensive mineral processing and extraction. ASM is an essential way of life for about 45 million people around the world (World Bank, 2020) and makes an important contribution to economic development in many developing countries. In Ghana, Malawi, and Peru, ASM supports foreign exchange, employment, income, and livelihood diversification for both skilled and unskilled workers (Adranyi et al., 2023; Kamlongera, 2011; Malone et al., 2021). Africa has around 10 million artisanal miners, most unlicensed, extracting gold, diamonds, bauxite, and more (World Bank, 2020). In Ghana, gold is the primary mineral extracted by around 1 million ASM workers. The artisanal and small-scale gold mining (ASGM) sector now accounts for about 35% of the nation's gold production (Fig 6.1). The global demand for gold and other minerals is expected to grow, with prices continuing to rise, driven by expanding urban populations and the shift to low-carbon, metal-intensive energy technologies.

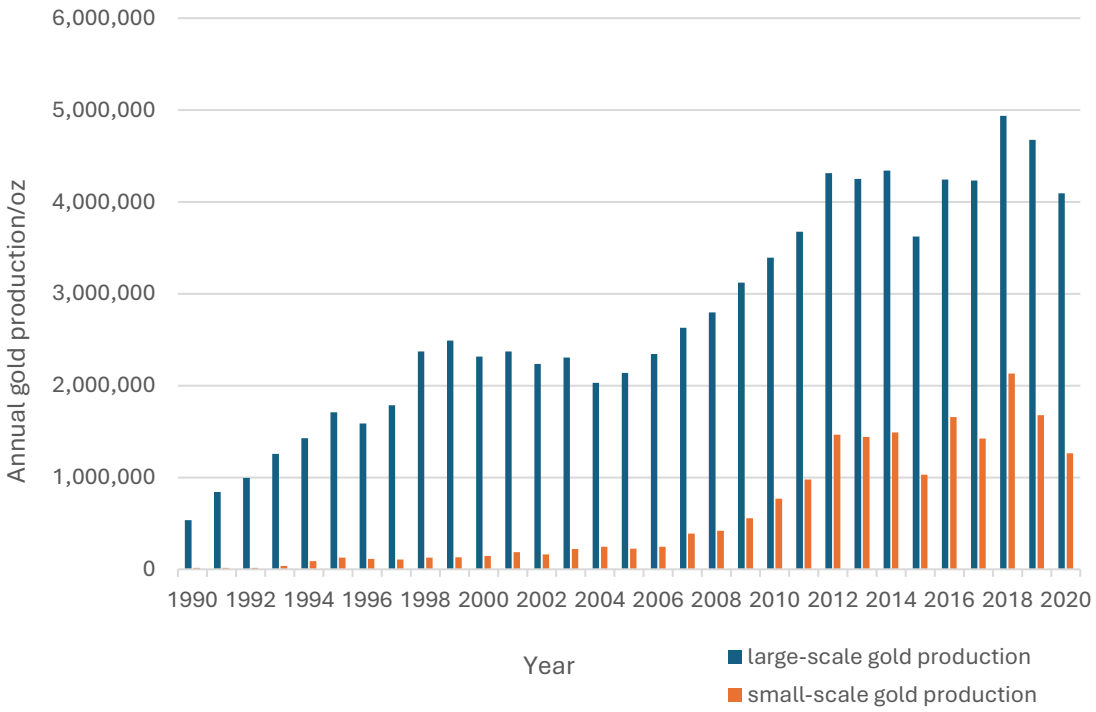

Fig 6.1 Ghana's gold production in the large and small-scale sectors from 1990 to 2020

Data source: Gold production (1990-2015) retrieved from Ministry of Finance - GHEITI Secretariat (2018); gold production (2016-2020) obtained from Minerals Commission (2021).

In Ghana and globally, most ASM workers operate informally without necessary licenses and permits, using poor mining techniques and substandard environmental, social, and governance practices. Environmental impacts include land degradation, river pollution, and mercury exposure, posing health risks (Bansah et al., 2018). Socially, ASGM pressures traditional livelihoods like agriculture and creates tensions between miners and landowners (Boadi et al., 2016). Economically, the lack of technical and financial support leads to underdeveloped market mechanisms and informal lending systems, leaving miners vulnerable to exploitation (Hilson and Maconachie, 2020). This situation also contributes to smuggling and illicit financial flows through tax evasion and illegal foreign exchange (Kalokoh and Kochtcheeva, 2022). Overall, informality presents significant challenges for all stakeholders, especially for miners, resulting in precarious livelihoods, lack of legal rights, insecure land tenure, and dangerous working conditions. Poor mining practices lead to low mineral recovery rates and earnings, while a lack of technical knowledge and access to finance perpetuates the cycle of informality (Pedersen et al., 2021).

There is broad consensus among scholars, policymakers, and governments that ASM should be formalised, integrating it into the formal economy through a standardised legal framework governed by a central state system (Geenen, 2012) and appropriate regulatory and policy actions. Formalisation would transition actors from the informal to the formal sector, addressing ASGM's issues and benefiting both operators and governments (Echavarria, 2014).

However, across SSA and elsewhere formalisation processes often fail due to factors such as partisan politics, corruption, rent-seeking behaviour of government officials, administrative bureaucracy, lack of capacity to enforce laws and the government's prioritisation of the expansion of large-scale mining (Fold et al., 2014; Hilson and Potter, 2005; Kumah, 2022; Verbrugge, 2015). Hilson (2020) attributes the persistence of informal ASGM in SSA to inappropriate laws and policy frameworks that governments are unwilling to directly address. However, ineffective governance frameworks can exacerbate inequalities, especially if licenses are expensive or formalisation processes are unachievable for the poorest miners.

An effective legal framework should address legal issues pertaining to ASGM across its entire value chain. Despite its importance, there is a notable lack of analysis examining how current legal frameworks interact along the ASGM value chain. Exploring the challenges of

formalisation across this value chain can reveal where existing laws and policies may be incompatible with actual ASGM operations, thereby perpetuating informality. This study addresses this challenge by examining the legal aspects impacting ASGM from extraction to market, with the aim of informing policy and enhancing regulatory measures.

Existing studies have focused on reviewing regulations and policies within the ASGM sector (Adu-Baffour et al., 2021), but there is a lack of analysis of policy coherence between ASGM and other productive sectors sensitive to mining activities. This gap hinders full understanding of why informality persists despite formalisation efforts. Addressing ASGM issues without considering its effects on other sectors that sustain rural livelihoods risks unforeseen negative impacts on these activities. Effective ASGM governance requires integration across multiple sectors. Understanding how ASGM policies interface with policies in mining sensitive sectors is vital to enhancing ASGM formalisation outcomes, as well as promoting sustainable ASGM activities in support of other economic activities and livelihoods (Nilsson et al., 2012). To the best of our knowledge, this is the first paper to address this critical gap by considering policy coherence across the mining-sensitive sectors (mining, land, agriculture, environment, water and development), ultimately informing a more holistic and sustainable approach to ASGM governance. These sectors were selected due to their considerable interactions with ASGM operations on the ground (Adu-Baffour et al., 2021; Maconachie and Hilson, 2011; Nyame and Blocher, 2010; Tschakert, 2009).

Policy coherence, defined as "the systematic promotion of mutually reinforcing policy actions across government departments and agencies, creating synergies towards achieving the agreed objectives" (OECD, 2004) is crucial for effective formalisation. Policy coherence analysis can span policy formulation, content, and implementation across sectors (Nilsson et al., 2012). This policy analysis considers policy content (objectives, design, and instruments) and implementation at regional and district levels. Analysing policy coherence can reveal strategies to enhance synergies and co-benefits within policy areas linked to ASGM governance, reducing conflicts among objectives, instruments, and implementation processes. Coherent policymaking can support governments, institutions, and sectors in navigating trade-offs transparently and equitably (Shawoo et al., 2023).

This paper focuses on Ghana, the largest gold producer in Africa and a country that provides a compelling case due to its steady evolution in ASGM. Since the mid-1980s, Ghana has

developed and adopted a legal and institutional framework that governs both its large and small-scale mining industries, aiming to promote, formalise and regulate the mining sector (MLNR, 2014; Teschner, 2012). Despite the government legalising the ASGM sector in 1989 and imposing regulations for responsible mining, informal ASGM remains prevalent (Kumah, 2022). Findings from this study can, therefore, can have wider implications for SSA and beyond. The study aims to examine Ghana's current legal and regulatory framework and analyse intersectoral policy coherence concerning ASGM governance, with a particular focus on formalisation. It asks: Do existing laws and regulations on ASGM formalisation address the main activities along the sector's value chain? To what extent is mining policy coherent with policies of other mining-sensitive sectors regarding sustainable ASGM? What challenges impact policy coherence between the mining sector and the other mining-sensitive sectors, thereby affecting ASGM formalisation outcomes? By addressing these questions, the study provides insights that could have wider implications for the SSA region and globally.

6.2 Literature review

ASGM interacts with various sectors of the society and impacts them in different ways, including critical ones such as development, agriculture, land, environment and water. As such, ASGM governance can be challenging. Poor governance, characterised by inadequate policy design that fails to consider the objectives and interests of other vital sectors, can undermine efforts to formalise and make ASGM sustainable (Maconachie and Conteh, 2021).

ASGM affects livelihoods in mining communities and influences both rural and national development. Most ASGM communities in Ghana exhibit low development levels, relying heavily on natural-resource-based livelihoods. Informal ASGM practices, characterised by rush or seasonal activities, often fail to support community development, as migrant miners typically do not invest locally (Kumah, 2022). Rapid expansion of ASGM has severely impacted forests, farmlands, and waterways, creating disparities in livelihood opportunities and exacerbating social issues such as poor health and safety, disruptions to agriculture, and tensions between miners and landowners (Pedersen et al., 2021; Boadi et al., 2016).

The transient nature of informal ASGM underscores the need for a formalised and regulated sector to drive sustained development. Since the mid-1990s, ASGM formalisation in Ghana

and SSA has been supported by donors, multilateral agencies, and governments (Hilson et al., 2022, 2017). Despite increased attention, ASGM in Ghana remains largely informal and faces governance challenges (Bansah et al., 2018). Likewise, in Zimbabwe, ASGM formalisation policies tend to benefit the politically connected, reinforcing patronage systems and favouring elite groups, while excluding most ASGM miners (Mkodzongi and Spiegel, 2019). This existing scholarship points towards the urgent need to align ASGM policies with development-focused policies to boost ASGM formalisation efforts.

ASGM frequently intersects with agriculture in rural areas in complex ways that can be complementary or competitive. ASGM provides farmers with income diversification opportunities, investing earnings from one sector into the other (Hilson, 2016; Mkodzongi and Spiegel, 2019). The influx of migrant workers into ASGM communities also boosts demand for food crops, benefiting local farmers. However, competition arises due to shared resources like land, water, and labor, leading to potential environmental degradation (Hausermann et al., 2018). While existing research describes the benefits and drawbacks for miners and farmers, it lacks a policy-level analysis of the ASGM-agriculture relationship (Hilson and Garforth, 2012; Pijpers, 2014). Given ASGM's expanding scope and its growing ties to agriculture, a comprehensive analysis of their relationship is crucial.

Access to land is crucial for ASGM operations. Ghana's land tenure system is defined by customary and statutory rules. Customary land tenure, under the control of chiefs and family heads, constitutes approximately 80% of the country's land area (Ghebru and Lambrecht, 2017). Miners are required to manoeuvre customary and statutory procedures to acquire mine sites and comply with regulations to secure land titles and licenses (Frimpong Boamah et al., 2020). Studies have highlighted how existing customary land tenure practices largely dictate miners' access to land, enforcing informality of the ASGM sector (Nyame and Blocher, 2010) and how the intersection of state-based mining titling systems with customary land tenure arrangements impacts ASM formalisation efforts (Mensah, 2021). For instance, marginalised groups may encounter barriers to land access and mining permits, limiting their participation in ASGM and its benefits. Sustainable ASGM thus significantly hinges on effective coordination between the institutions governing the mining sector and the land sector. However, there is limited knowledge on policy coherence and coordination between mining

and land in the Ghanaian context. Understanding these dynamics is crucial for assessing ASGM's broader implications on rural livelihoods and developing sustainable practices.

Many studies have also shown that ASGM activities come with high environmental costs (Ncube-Phiri et al., 2015; Bansah et al., 2018; Ofosu et al., 2020), including land degradation, destruction of flora and fauna, air pollution, and heavy metal contamination of sediments, surface, and groundwater, particularly due to extraction and processing methods that use mercury (Arthur et al., 2016; Aryee et al., 2003; Ofosu et al., 2020). Despite ASGM formalisation efforts, Ghana is experiencing significant environmental degradation from ASGM activities (Adranyi et al., 2024). Close coordination between mining and environmental sectors is necessary to promote sustainable ASGM. However, existing scholarship has not explored this coordination.

Additionally, access to clean water is essential for community development, yet the ASGM sector has led to significant deforestation and water pollution in SSA. Attempts at formalising ASM in Africa seem to inadequately consider water management issues (Arthur-Holmes et al., 2022). In Ghana, ASGM continue to severely pollute major rivers and undermines government efforts to ensure clean drinking water (Arthur-Holmes et al., 2022). The government implemented a ban on all ASGM activities from February 2017 to December 2018, and established Operation Vanguard, composed of police and military personnel, to enforce it and combat illegal ASGM. The Ghana Media Coalition's '#StopGalamseyNow' campaign in 2017 supported these efforts, with the government launching Operation Halt in 2021 and 2022 to further combat illegal ASGM or 'galamsey'. Despite these efforts, informal ASGM remains widespread, indicating insufficient cooperation among various stakeholders and institutions necessary for successful ASGM formalisation. There is a critical gap in understanding the interplay between mining and water sectors, which is essential for safeguarding water resources and promoting clean water initiatives amidst evolving ASGM practices (Hilson and Maconachie, 2020).

6.3 Methodology

A combination of extensive document reviews and qualitative document analysis was used, complemented with expert interviews of actors in mining-sensitive sectors.

6.3.1 Document review

To ensure comprehensive review of the legal framework, the Minerals Commission (MC)'s website (https://www.mincom.gov.gh/acts/) was searched for all current acts and regulations on mining in March 2023. Those that covered small-scale mining were selected and downloaded (see Appendix F for a list of Ghana's laws and regulations on ASGM, with those reviewed in italics; policy documents are analysed separately under Section 3.2). Guided by the documents' 'Table of Contents' and the search word 'small-scale mining', sections and paragraphs of the acts and regulations that centred on small-scale mining were fully read and examined. Documents relating to ASGM licensing in Ghana were also sought. On MC's website, the *Small-scale and Community Mining Operational Manual 2021* was found and selected (MLNR, 2021). A search of an international database on ASM - https://delvedatabase.org/resources, produced the *Artisanal and Small-scale Mining Handbook for Ghana, 2017* (Tychsen et al., 2017) which was selected. Also, to aid assessment of the effectiveness of the laws and regulations, a search was conducted on Ghana's audit service's website (https://audit.gov.gh) using 'small-scale mining' as the search word to find audit reports linked to ASGM. One audit report on regulating reclamation activities at small-scale mining sites was found and reviewed (Ghana Audit Service, 2021).

Study of the selected documents provided insights into ASGM formalisation efforts concerning the various elements of the gold mining value chain: ASGM area designation, land acquisition, ASGM license acquisition, ore extraction and processing, gold trading, and mine closure and reclamation, and the roles of relevant stakeholders/institutions. This was followed by an analysis of the extent of coherence between the minerals and mining policy and other mining-sensitive policies (Section 3.2). Document review informed the selection of experts within the ASGM sector for interviews and served to validate findings. Interviews (Section 3.3) shed light on informal mining, the nature of the implementation of the legal framework and related formalisation challenges for the ASGM sector.

6.3.2 Qualitative Document Analysis (QDA)

The policy coherence investigation used Qualitative Document Analysis (QDA) to analyse the meaning and implications of policy documents (Altheide et al., 2008). QDA uses a subjective scoring system followed by validation through expert interviews (England et al., 2018). QDA can help us understand the extent of policy coherence among mining-sensitive policies. Focus was on interpreting the meaning and implications of text within the document, rather than merely identifying the presence of keywords (Altheide et al., 2008) and we followed explicit steps designed to provide an in-depth analysis: 1) setting criteria for the selection of documents; 2) obtaining documents; 3) analysis of documents; 4) validation; 5) finalisation (Altheide et al., 2008; England et al., 2018).

Step 1 – setting document selection criteria:

We sampled the latest current government policy documents across Ghana's mining-sensitive sectors: (i) mining, ii) land, iii) water, iv) agriculture, v) environment and vi) development (Table 6.1). This list is not exhaustive with regards to mining-sensitive sectors, but we focused on these because existing scholarship has highlighted considerable linkages with and sensitivity to ASGM development (Horsley et al., 2015). These sectors face a significant threat from ASGM and play a crucial role in supporting the livelihoods of the majority of Ghana's population (Arthur-Holmes et al., 2022b; Bansah et al., 2018; Hilson, 2016a; Mensah, 2021), and contribute significantly to Ghana's GDP. Moreover, these sectors can directly or indirectly aid in the formalisation of ASGM processes and the promotion of sustainable ASGM practices. However, it was also important to draw a manageable boundary around the study, so other sectors affected by ASGM (e.g., health and transport), which do not directly address formalisation of ASGM operations were omitted. Nonetheless, considering these other sectors, along with areas such as education, could provide interesting avenues in follow-on research.

Step 2 - obtaining documents:

Internet searches located the sector policies on the websites of government agencies and other credible sources (Table 6.1).

Table 6.1 Current national policy documents forming the sample for qualitative document analysis.

Ghana's active Policy document	Policy vision/goal	Source of document; accessed between 9.4.2021 - 27.3.2023.
Minerals and Mining Policy of Ghana, 2014 (MLNR, 2014).	"The policy seeks to establish a comprehensive and forward-looking framework for mining that catalyses sustainable development."	https://www.mincom.gov.gh/wp-content/uploads/2021/06/Mineral-and-Mining-Policy-Ghana.pdf.
National Agriculture Investment Plan, 2018 -2021; so was likely due for review in 2022 (MOFA, 2018).	"The Government is committed to transforming the agricultural sector with the aim to modernise the sector to catalyse industrial transformation of the rural economy resulting in national economic development."	http://mofa.gov.gh/site/publications/policies-plans/316-national-agriculture-investment-plan-ifj.
National Land Policy, 1999. Policy to be reviewed periodically, no date specified (MLNR, 1999).	"The Land Policy of Ghana aims at the judicious use of the nation's land and all its natural resources by all sections of the Ghanaian society in support of various socio-economic activities undertaken in accordance with sustainable resource management principles and in maintaining viable ecosystems."	https://www.fao.org/faolex/results/details/es/c/LEX-FAOC163491/
National Water Policy, 2007. Policy to be reviewed periodically, no date specified (MSWR, 2007).	"...the overall goal of the National Water Policy is to "achieve sustainable development, management and use of Ghana's water resources to improve health and livelihoods, reduce vulnerability while assuring good governance for present and future generations"."	https://www.gwcl.com.gh/national_water_policy.pdf
National Environmental Policy, 2012. Need to review mentioned but with no date (MESTI, 2012).	"…to manage the environment to sustain the society at large"	https://www.fao.org/faolex/results/details/fr/c/LEX-FAOC174489/
Medium-term National Development Policy Framework 2022-2025 (NDPC, 2021).	"The vision of the medium-term policy framework as adopted from the Coordinated Programme for Economic and Social Policies (2017-2024) is: "create an optimistic, self-confident, and prosperous nation, through the creative exploitation of our human and natural resources, and operating within a democratic, open and fair society in which mutual trust and economic opportunities exist for all"."	https://ndpc.gov.gh/media/MTNDPF_2022-2025_Dec-2021.pdf

Step 3 - analysis of documents:

The documents were systematically examined to determine whether sustainable ASGM was being considered, how it was addressed; and whether those statements were coherent with the other documents assessed. The analysis employed a content analysis approach (Stemler, 2001) based on scoring criteria to assess coherence (Table 6.2). This content analysis step consisted of four stages.

First, each policy was analysed for its dominant objectives, strategies, and narratives relating to six key themes: i) support for artisanal and small-scale miners, ii) land use management, iii) ASGM-agriculture connection, iv) water management, v) sourcing of gold and vi) land degradation/reclamation using a content analysis approach (England et al., 2018; Stemler, 2001). As principles/objectives and strategies were identified, the discursive context in which they were found was noted. This led to identification of specific keywords that were linked to the three building blocks of sustainable development: i) economic keywords – livelihoods, finance/credit facility, licence or permit acquisition, mineral trading, business skills; ii) Social keywords – compensation, community rights, land rights, mineral rights, land use management/planning, water use/management; and iii) environmental keywords – land/soil degradation, water pollution, wastewater discharge, and buffer zone protection.

The second stage used these keywords to analyse the parts of each document where they were located that set out strategies /measures concerning the mining-sensitive sectors: mining, land, water, agriculture, environment and development. These strategies/measures were assessed based on the content of the sentences or paragraphs in which the keywords appeared, providing specific background context and insights into government plans and priorities. The keywords and strategies were then grouped together, synthesised, and entered into tables for each policy, enabling cross-comparison of the main emphases in each sector and providing key contextual information.

During the third stage of the content analysis, we searched for the keywords within the respective themes, which were used to assess the extent to which the other policy documents referred to the same issues. A score was then applied to the level of coherence, ranging from

3 (High coherence) to 0 (no coherence) based on scoring criteria adapted from Le Gouais and Wach (2013) (Table 6.2).

Table 6.2 Scoring criteria to assess coherence (adapted from Le Gouais & Wach, 2013)

Type of Coherence	Description of Coherence	Score
High coherence	Strong inter-sector policy coherence across mining, agriculture, land, water, environment, and development sectors. The policy devotes specific attention to ASGM governance mechanisms that safeguard formalisation and sustainable development of the ASGM sector. It includes detailed complementary activities and plans.	3
Partial coherence	Policy supports inter-sector coherence regarding ASGM governance mechanisms for the sustainable development of the ASGM sector but is less clear how it could be achieved. A few plans and activities are listed but the information provided is not comprehensive.	2
Limited coherence	Policy supports inter-sector coherence in relation to ASGM governance mechanisms that foster sustainable development of the ASGM sector, mostly in the form of general statements. No details on activities or plans to achieve the policy goals are provided.	1
No coherence	No evidence that inter-sectoral statements are coherent and/or coordinated.	0

The score for each policy considered the score for each theme, and then finding the mean coherence score across the themes for each policy (Section 6.4.2).

The fourth stage of the content analysis assessed the coherence of policies relative to each other. This averaged the two values obtained in stage three (Section 6.4.2).

6.3.3 Expert interviews

The final two steps in the QDA process - validation and finalisation – involved expert interviews. Respondents were those providing guidance on policy formulation and/or those responsible for implementation of laws, regulations, and policies at national, regional and district levels within the mining-sensitive space. Following ethical approvals, eight expert interviews were undertaken in Ghana between October and December 2021. Experts were selected from national (Accra), regional (Eastern region) and district (Atiwa West) levels through purposive sampling. Experts included three officers from the Minerals Commission (one at head office, and two at the regional office, Koforidua); one environmental officer from

the Environmental Protection Agency, who works both at the national and Eastern regional offices; one regional Lands Commission officer; two agricultural officers (one at Eastern regional office, and one at Atiwa West district office); and one officer from Atiwa West District Assembly. Atiwa West was selected as the district focus as it has seen a rapid recent increase in ASGM activities in an area that was previously largely agricultural.

Interviewees commented on ASGM informality and formalisation challenges and identified associated issues on policy coherence and institutional linkages between the mining sector and the other mining-sensitive sectors regarding ASGM governance and scored the extent of inter-sector policy coherence based on the criteria in Table 6.2. To ensure anonymity, information is not provided on the name, role or title of interviewees. Interviews were recorded with permission and transcripts were coded according to sectoral themes and policy priority areas analysed using thematic analysis. When audio recording was not ideal, e.g., noisy space due to being in a busy office, handwritten notes were taken.

The validation process involved comparing the QDA scores on the coherence between minerals and mining policy and other mining-sensitive policies with the scores provided by the interviewees (Table 6.5). This comparison aimed to identify similarities or differences and to provide clarifications and interpretations of the results to finalise the process, ultimately determining what they imply for the overall extent of coherence.

This study was limited to the state sector and its institutions, considering how government agencies developed and implemented policies and laws. Views from civil society and other non-governmental agencies are not captured, leaving this avenue open for future research.

6.4 Results

Section 6.4.1 presents findings regarding the analysis of legal framework of Ghana's ASGM sector, focusing on the various stages involved in the ASGM value chain, the institutions involved, and the linked roles, addressing research question one. Research question two is tackled under Section 6.4.2 and it offers an analysis of policy coherence between the mining policy and other mining-sensitive policies; and presents experts' views on policy coherence. Section 6.4.3 focusses on challenges to policy coherence and implementation issues in the ASGM sector, addressing research question three.

6.4.1 Mining laws, regulations and institutional arrangements regarding ASGM formalisation

Ghana has an extensive legal framework for the mining sector. Laws regulating Ghana's ASGM sector have evolved significantly since the first act in 1989 (Appendix A1). Presently, the Minerals and Mining Act, 2006 (Act 703) (as amended by the Minerals and Mining (Amendment) Act, 2015 (Act 900) and the Minerals and Mining (Amendment) Act, 2019 (Act 995)), alongside the Minerals Commission Act, 1993 (Act 450) provide the framework for regulating mining in Ghana (Ghana Government, 2019, 2015, 2006, 1993). They highlight state ownership of minerals in their natural states, various licensing schemes, and the powers of relevant regulatory institutions. The Ministry of Lands and Natural Resources (MLNR) and the Minerals Commission (MC) have primary responsibility for the mining industry in Ghana. The MC is 'responsible for the regulation and management of the utilisation of mineral resources and the co-ordination of the policies in relation to them' (Act 450, p.3).

Sections 81–99 of Act 703 exclusively cover small-scale mining, dealing with land acquisition and licensing procedures, composition and functions of district mining offices, obligations of miners, mercury distribution and use, and monitoring of operations by the MC. Ghana's law does not segregate artisanal mining from small-scale mining, as is common elsewhere (e.g., in Sierra Leone). Act 703 prohibits any person, even with a right of land ownership or land title, to search, explore, prospect, or mine for minerals unless the person has been granted a mineral right. The ownership of mineral rights and provision of ASGM support services are restricted to Ghanaian nationals, operating either as individuals or cooperatives (Act703; Act 995). Figure 6.2 summarises the ASGM license acquisition steps and highlights the different

institutions at various levels that prospective small-scale miners must deal with to secure a licence.

Section 90 provides for the MC to establish a 'District Office' in an area designated for mining, and to appoint a district officer to head the office. Under section 90 (3), the District Office is charged with compiling a register of existing and prospective small-scale miners, supervising, and monitoring their activities, providing training and assistance necessary for effective and efficient small-scale mining, facilitating the formation of small-scale miners' associations, and submitting reports and information on small-scale mining activities in the district to the Commission. Interviews with Eastern regional MC officials at Koforidua confirmed that MC has offices at district, regional and national levels, except that current district offices are inadequate in keeping with the rapid expansion of ASGM in the country. An officer clarified: "*We have* [district] *office in Akim Oda, and Akwatia, and there are plans to open new ones, another proposed for Kwabeng to help with monitoring and application of certification*." (MC officer 1, regional level).

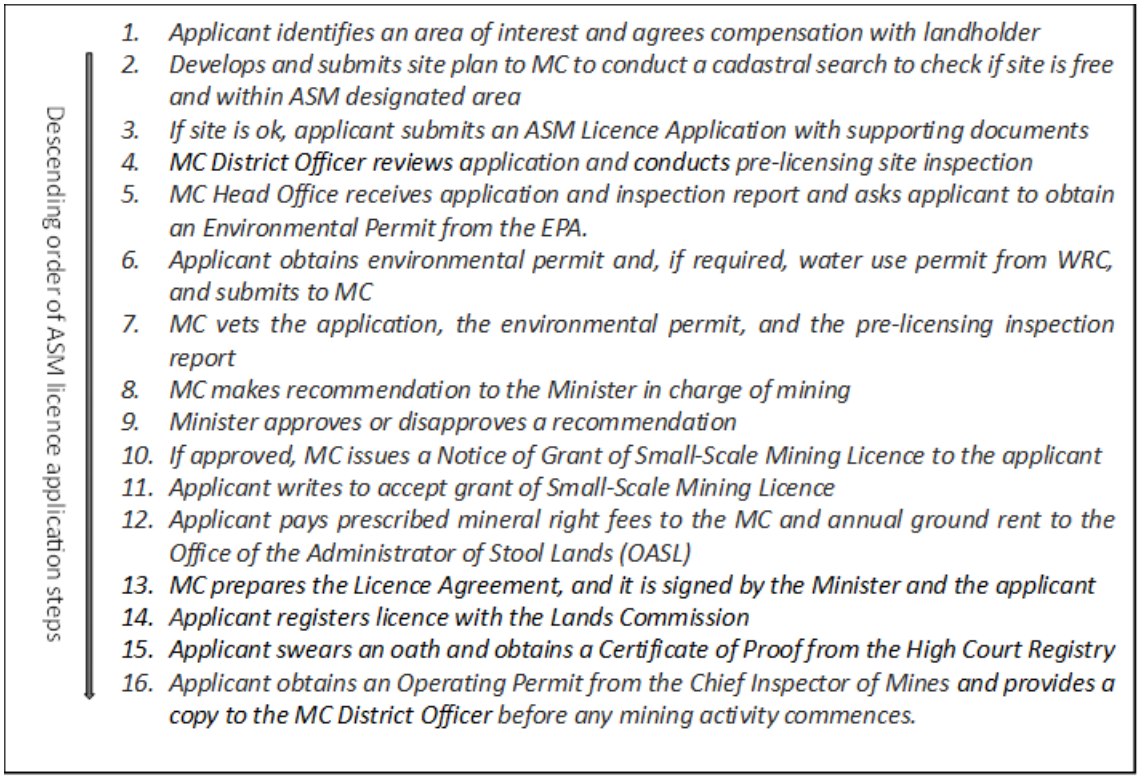

Fig 6.2 Procedures for Acquiring an ASGM Licence in Ghana.
Authors' construct, adapted from (Tychsen et al., 2017) and (MLNR, 2021).

6.4.1.1 Designated ASGM areas and land acquisition

The Minister of Lands and Natural Resources upon consultation with the MC may designate an area for small-scale mining operations of a specific mineral (Section 89 of Act 703). However, designation of ASGM areas has not been consistent across the country since 1989, as is evident in the Atiwa West District, where ASGM is active but with most miners operating without any properly designated wider area (Adranyi et al., 2023). Effective designation of ASGM areas depends on detailed geological surveys to estimate gold deposits and generate credible geological data. However, since ASGM was legalised in 1989, no annual budgetary allocation has ensured consistent, thorough geological surveys and studies for ASGM purposes (Minerals Commission, 2023a). The government is unable to boldly demarcate ASGM zones linked with appropriate geological data, which would make ASGM site acquisition more transparent and boost local investor confidence. Miners presently must find sites on their own and hope to strike gold after acquiring an ASGM license.

A prospective miner must negotiate and agree compensation with the landholder to commence the license application (Minerals and Mining (Compensation and Resettlement) Regulations, 2012 (Legislative Instrument (LI) 2175) (Ghana Government, 2012b). Where negotiating parties are unable to reach mutual agreement, the Lands Valuation Division of the Lands Commission (LC) will intervene, using state approved estimates to determine compensation payments. MC officers both at the national and regional levels confirmed that prospective miners and landowners could contact the LC during land acquisition compensation negotiations. However, a regional LC officer clarified that: ‘‘*Even though the Land Valuation Division* [of the LC] *is there to mediate and advise on compensation* [concerning ASGM]*, they don't receive regular requests for such services…inhabitants feel more comfortable discussing any disagreements using their traditional processes* [via traditional and community leadership]’’*.* The LC has presence only at national and regional levels, so the lack of district LC offices can make it difficult for landowners to access their services, stimulating informal negotiations in ASGM land acquisition.

6.4.1.2 License acquisition

Mineral rights are granted by the Minister of Lands and Natural Resources through issuing of licenses to Ghanaians aged 18+, who must secure an environmental permit from the

Environmental Protection Agency (EPA) and if necessary, a water use permit from the Water Resources Commission (WRC). Licenses are valid for five years and for an area no more than 10.2 ha (Section 82 (1) and Section 83 of Act 703).

Mining officials acknowledged the ASGM license acquisition processes ensured communications among mining, land, and environment institutions. The regional LC official confirmed that: ''*miners upon successful acquisition of license must contact the national LC office in Accra and register the license''*. The MC and LC operate under the same ministry (the Ministry of Lands and Natural Resources) making it easier for them to correspond. However, relevant agencies do not have arrangements enabling regular meetings to find solutions to ASGM's licensing problems. Regional MC officer 1 confirmed that: ''*We correspond to sectors like LC, EPA and WRC through letters...But we do not have a directive to require the different sectors including the agriculture to meet, discuss ideas and find solutions to challenges*.''

The EPA also confirmed that miners apply for environmental permits from them prior to ASGM commencement, but the EPA officer clarified that: *''As for EPA, it takes a lot of time before permits are granted. But if permits were processed within weeks, word of mouth would go out there that permits from EPA was easy, and this would encourage the illegal ones too to come to EPA for permits*.'' Currently, licenses and permits are only issued at national head offices in Ghana's capital, Accra.

6.4.1.3 Mine operation

The Inspectorate Division of the MC headed by the Chief Inspector of Mines, inspect the ASGM license, environmental permit and mining operating plan before issuing a mining operating permit. A mining operating plan includes mining and processing procedures; fuel and chemical handling processes; waste management processes; and site reclamation/restoration procedures. The operating permit is subject to annual renewal (Minerals and Mining (Health, Safety, and Technical) Regulations, 2012 (LI 2182)) (Ghana Government, 2012b); (Minerals and Mining Regulations, Explosives (LI 2177)) (Ghana Government, 2012c). The Inspectorate Division of the MC is to monitor the progress of mining and rehabilitation activities over the lifecycle of a mine based on the mining operations plan, and to enforce all mining regulations. Regional MC officer 1 in Koforidua explained that ''*Every*

month we go round to check activity [of the ASGM miners]. *We are very serious on them, if they violate, we can close them down*.''

Environmental permits for small-scale miners are valid for two years. Holders must submit annual environmental reports regarding ASGM operations (The Environmental Assessment Regulations (LI 1652)) (Ghana Government, 1999). The EPA is required to monitor mining activities and be satisfied with operations before permits are renewed. However, monitoring operations by MC and EPA were restricted due to limited available resources: ''*We have few personnel, cars, drivers etc. We need more people to do the job*'' (MC officer 2, regional level).

6.4.1.4 Gold trading

A person is presumed to be lawfully in possession of minerals until proven otherwise. Sale of a mineral acquired by a licensed ASGM miner is subject to rules and regulations prescribed by the Minister (i.e., currently licensed miners must sell to licensed dealers) (Section 97 of Act 703). Section 97-99 of Act 703, does not, however, explicitly prohibit licensed dealers buying gold from non-licensed ASGM miners. There are no laws or policies directing traders to undertake due diligence checks and keep specified records on miners/individuals from whom they buy gold. The MC licenses and registers prospective gold traders, but presently, regional and district MC officers are not authorised to supervise activities of gold traders and to keep them in check:

"Licenses are issued by the mincom [MC], *but all are done in Accra. So, if a new trader comes to the regional office, we do not accept the paper or receive any payments…For gold trading everything is done in Accra. You don't have to come here"* (MC officer 1, regional level).

A minerals and mining operations tax (a mineral royalty rate of 5%) used to be imposed on the total revenue earned by a person engaged in mineral operations (Minerals Commission, 2023b). However, ASGM operators' non-compliance prompted the government to replace it with a 3% withholding tax in 2019 on processed gold, at the point of export, through the government's Precious Minerals and Marketing Company (PMMC). ASGM operators, however, considered this rate too high so gold smuggling increased. In 2022, this caused the government to reduce the withholding tax to 1.5% on the sale of unprocessed gold, paid

before gold gets to the Precious Minerals and Marketing Company, where no more tax is paid at the point of export (Minerals Commission, 2023b). Beyond the tax incentive, however, there is no clear government-led guidance relating to gold sourcing enterprises that could limit exploitative tendencies.

6.4.1.5 Mine closure and land reclamation

Licensed ASGM miners are expected to undertake concurrent reclamation during mining and complete reclamation and revegetation of abandoned mined land within one month of terminating activities, to prevent accumulation of stagnant waters, and allow for productive reuse of mined lands. After reclamation, the Chief Inspector of Mines and the EPA must inspect the site and if satisfied, issue a rehabilitation certificate (Minerals and Mining (Health, Safety, and Technical) Regulations, 2012 (LI 2182) (Ghana Government, 2012b)). Appendix F details legislation, offences, and associated penalties linked to ASGM activities in Ghana.

In a performance audit report submitted to Ghana's Parliament in 2021, however, the Auditor-General revealed that the MC and EPA had failed to ensure that small-scale miners reclaimed mined sites to return them to their maximum beneficial value (as required by LI 2182 and LI 1652). The Inspectorate Division of the MC did not enforce the submission of operating plans before issuing operating permits, while the EPA did not administer the posting of reclamation bonds and failed to collect due amounts. Regulation 23 of LI 1652 mandates the EPA to ensure that prospective small-scale miners post reclamation bonds in the form of cash into an escrow account based on approved reclamation plans before they are issued permits. The audit report also stressed that monitoring carried out by the MC and EPA did not guarantee that small–scale miners complied with reclamation conditions and that the institutions failed to verify or certify reclaimed small-scale mining sites.

6.4.2 Policy coherence across mining-sensitive sectors regarding sustainable ASGM

Review of the various mining-sensitive policies (Table 6.3 and Table 6.4) broadly revealed 'partial coherence' between the minerals and mining policy of Ghana (hereafter referred to as mining policy) and the other policies (a score of 2 or above, but <3). The policies were characterised by differing timeframes and ages, alongside infrequent and delayed revisions. Some lack specific review dates and most are infrequently updated. This significantly hinders policy coherence. For formalisation, this means that efforts to regulate and support ASGM activities are inconsistent and often outdated, leading to challenges in effectively integrating ASGM into the formal economy and ensuring sustainable practices.

Table 6.3. Coherence of policy documents regarding key themes on sustainable ASGM development (score 3 = high coherence; 2 = partial coherence; 1 = limited coherence; 0 = no coherence).

Ghana	**Mineral and mining policy**	**Agriculture Policy**	**Land Policy**	**Water Policy**	**Environmental Policy**	**National development Policy**
Support for small-scale miners	N/A	(0) No specific information regarding support for ASGM miners.	(2) Supports equitable access and optimum usage for all land use types including mining. Recognises that every socio-economic activity is consistent with sound land use through sustainable land use planning in the long-term. No specific activities.	(3) Recognises adequate protection of water sources in mining areas and balancing competing demands of water between mining and communities. Details policy measures and actions.	(2) Contains statements on promoting equitable access to, and sustainable use of the natural and cultural resources, and ensuring environmentally sustainable lifestyles and activities to achieve sustainable development. Few plans listed.	(2) Recognises the need to facilitate sustainable use and management of natural resources to support the development of rural communities and livelihoods but lacks detailed support strategies for miners. Details some strategies.
Land use management	(2) Recognises a need to manage land use conflicts and guarantee the rights and interests of landowners and local communities regarding benefits accruing from the use of land during mining. Highlights some regulations that provide	(0) Recognises the importance of sustainable land management practices in agriculture and the security of land tenure. But no evidence of mining-agriculture	N/A	(3) Acknowledges the principle of coordinating water resources planning with land use planning. Provides a number of actions.	(2) Recognises the importance of integrating environmental concerns in development planning and land allocation. Details	(3) Recognises the need to promote efficient and effective land administration. Detailed strategies provided.

	detailed guidance on compensation issues.	land use planning and management. No plans or actions suggested.			management activities.	
Water management	(3) Recognises that activities of illegal miners pollute water bodies. Consents to the granting and enjoyment of water rights in connection with mining. Miners must obtain the requisite licence from the Water Resources Commission.	(1) Supports water conservation and irrigation systems to ensure availability of water for multiple uses. No plans and activities on protection of water bodies.	(2) Recognises the protection of water bodies and the environment. Provides some plans e.g., minimum of 100 metres off the high-water mark of water bodies should be declared as protected areas.	N/A	(3) Supports efforts to protect the various watersheds and buffer zones, tackle water pollution and resolve conflicts between the different users of water. Details management activities	(3) Highlights promotion of sustainable water resources development and management. Strategies provided.
ASGM-Agriculture connection	(0) Recognises the need to strengthen inter agency collaboration in the development of mineral resources, but no specific mention of collaboration with agricultural sector. No approaches or plans stated.	(0) Does not recognise a need for ASGM and agricultural sector alignment. No plans stated.	(1) Recognises inter-ministerial working groups to resolve user conflicts and harmonise land resource use among competing users. No activities provided.	(2) Recognises cross-sectoral issues related to water-use, including those on mining and agriculture. Details some policy actions.	(0) No explicit reference to inter-sector alignment between mining and agriculture. No plans detailed.	(1) Recognises the need to sustain agriculture and rural development. Provides detailed strategies, but no reference to inter-sector alignment between mining (ASGM) and agriculture. No plans detailed.

Gold sourcing	(2) Seeks to support improving miners' access to finance through fair market prices for minerals, trading of minerals through appropriate licensing, and control of illicit dealings. No strategies or intersectoral actions provided.	N/A	N/A	N/A	N/A	(0) No reference to inter-sector links between ASGM and development regarding gold sourcing and support systems needed. No detailed plans identified.
Land degradation /reclamation	(3) Notes that land use choices impact healthy coexistence between mining and other economic activities e.g., agriculture, and mining operations should restore mined-out lands to other viable socio-economic uses. Lists regulations that provide detailed strategies and activities.	(1) Recognises that artisanal mining causes environmental degradation but does not include specific strategies to deal with it.	(2) Land use for mining needs to conform with prescribed environmental conservation principles. Details some guidelines and actions.	(2) Recognises need to ensure adequate protection of water sources in mining and other industrial areas. Provides some policy actions.	(3) Recognises importance of mining but also its environmental challenges including land and water degradation. Provides several management activities.	(3) Outlines challenges in extractive sector. Supports sustainable mining and effective linkage of the sector to rest of economy. Provides strategies to be implemented.
Mean Score	**2.0**	**0.4**	**1.75**	**2.5**	**2.0**	**2.0**

Table 6.4 Coherence of policy documents (3 = high coherence; 2 = partial coherence; 1 = limited coherence; 0 = no coherence)

	Mineral and mineral, policy	Agriculture Policy	Land Policy	Water Policy	Environmental Policy	Development Policy
Minerals and Mining Policy of Ghana, 2014	**N/A**	1.2	1.9	2.3	2.0	2.0
Agriculture Policy, 2018	**1.2**	N/A	1.1	1.5	1.2	1.1
Land Policy, 1999	**1.9**	1.1	N/A	2.1	1.9	1.8
Water Policy, 2007	**2.3**	1.5	2.1	N/A	2.3	2.2
Environmental Policy, 2012	**2.0**	1.2	1.9	2.3	N/A	1.9
National development Policy, 2022	**2.0**	1.1	1.8	2.2	1.9	N/A

Table 6.5 summarises the policy coherence between mining policy and other mining-sensitive policies, based on the QDA score versus experts' views.

Table 6.5. Extent of coherence between minerals and mining policy and other mining-sensitive policies, based on score versus experts' views.

Policy areas	Level of policy coherence	
	Score	Experts' views
Mining vs Agriculture	Limited (1.2)	Limited
Mining vs Land	Limited (1.9)	Partial
Mining vs Water	Partial (2.3)	Partial
Mining vs Environment	Partial (2.0)	Partial
Mining vs National development	Partial (2.0)	Partial

6.4.2.1 Mining and land

There is 'limited coherence' between mining and land policies (score of 1.9). Generally, the two policies support inter-sector coherence regarding ASGM governance but plans and activities to achieve these are not comprehensive. This is perhaps due to how old the policies are (land policy, 1999; mining policy, 2014). The mining policy states that ''*government will continuously examine land use options and make a choice between mining and other forms of activity…*''(MLNR, 2014, p.43). To ensure efficient ASGM, the sector minister is tasked to "*Generate detailed geological information in designated areas for demarcation to artisanal and small-scale miners…"*(MLNR, 2014, p.15), but this is not supported with any detailed plans. The mining policy lists relevant land institutions to collaborate with, but without clear action plans on delivery of that collaboration. The land policy also generally acknowledges mining activities and the need to manage these alongside other land use activities, as reflected in one of its guiding principles: ''*…the principle of optimum usage for all types of land uses, including human settlements, industry and commerce, agriculture, forestry and mining, the protection of water bodies and the environment in the long-term national interest*'' (MLNR, 1999, p.5). Aspects of the land policy objectives that reflect support for ASGM activities include ensuring that socio-economic activities are consistent with sound land use through sustainable land use planning and enabling equitable access to and security of tenure of land. However, detailed action plans on achieving these objectives are not provided. The mining policy requires miners to pay compensation to landholders, but this is not explicitly mentioned in the land policy. Neither policy has provisions to provide a platform for regular engagement between the two sectors to review and address the concerns of landholders, miners, and related stakeholders.

MC and LC interviewees considered coherence between land policy and mining policy to be 'partial' (Table 5) which is only slightly different from the 'limited' coherence obtained in our policy coherence score. Both assessments generally reflect that coherence between the two policies is weak. While creating designated areas for ASGM activities is mentioned in the mining policy, the government has struggled to execute this, with many mining areas operating without government directive or knowledge. The Ministry of Lands and Natural Resources needs to engage with other ASGM-sensitive agencies, particularly the traditional council, so that land use conflicts are managed and strategies regarding the creation of ASGM

designated areas are coherent with the plans of other ASGM-sensitive sectors and stakeholders.

6.4.2.2 Mining and agriculture

The agricultural policy was the least coherent with the mining policy (limited coherence, score of 1.2). The mining policy recognises the need to pay attention to agriculture stating that: ''*Land use choices present several challenges in fostering a healthy coexistence between mining and other forms of economic activity, particularly agriculture and forestry. Mining operations are to be conducted in a manner that will restore mined-out lands to other viable socio-economic uses.*''(MLNR, 2014, p.43). Yet, there are no clear strategies specifying activities to engage with the agricultural sector for collaborative implementation. The agricultural policy makes no mention of ASGM governance and linking up with the mining sector to ensure ASGM complements rather than inhibits agricultural growth. Artisanal mining was only mentioned once as a practice that challenges the implementation of sustainable land management in agriculture. Neither the mining policy nor the agricultural policy specifies strategies to ensure the two sectors coordinate to provide beneficial ASGM-agriculture coexistence and support the sustainable development of ASGM.

MC officials confirmed their everyday activities do not involve formal working relationships with the agricultural sector at the national, regional nor district levels. However, considering the impacts of ASGM on agriculture, officials recognised the pressing need to coordinate mining governance processes with those in the agricultural sector. Efforts should include coordination during policy formulation and reviews to foster coherence and involvement of agricultural officers in mining issues. A regional MC officer noted:

''*There are district agricultural extension officers who get this information about mining and report to the district agricultural director, who also report to the District Chief Executive (DCE)*… [But], even *if reports get to the DCE* [who chairs the district mining committee], *how do you know that he takes it seriously? So, it is good idea to have a technical agricultural person on the committee who can speak to issues*.'' (MC officer 2, regional level).

A regional agricultural officer at the Ministry of Food and Agriculture in Koforidua likewise echoed the lack of policy drive to involve agricultural officers in ASGM governance, stating that:

''*The agricultural department is decentralised, and forms part of the district assembly structure. So, it can be expected that when mining is having an engagement with them* [district assembly] *and it has to do with agriculture, definitely the director of agriculture or programmes of agriculture will be involved. However, what is lacking is clear mandates, in laws and in policies, defining roles and responsibilities of agricultural officers that can help deal with ASGM issues*.''

He added that the agricultural department does not formally engage with the mining sector, stressing that: ''*...a very formal engagement between agriculture and maybe lands or those who are in charge of mining, I could speak for myself, I haven't really heard of something like that.*'' Similarly, an EPA officer shared: "*There is no agricultural department involved in the* [district mining] *committee meetings".* He also stated*: "We don't link with the agricultural department in carrying out our revegetation mandate*." This lack of communication and linkages between the mining and agricultural sectors reflects weak policy coherence. He explained that the institutional structures exist but strong policy drive and political will is lacking. Mining and agricultural officers also considered there to be 'limited' coherence between mining and agricultural policies, emphasising the general disjointedness in activities between the two sectors.

6.4.2.3 Mining and water

QDA findings also revealed 'partial coherence' between mining and water policies. The mining policy recognises illegal mining activity pollutes water bodies. Mining policy actions include the demand for small-scale miners to obtain a license from the Water Resources Commission to use water bodies for their activities. The water policy equally notes mining activities as a polluter of water sources and seeks adequate protection of water sources in mining areas and to balance competing demands for water between mining and communities. The water policy has ten 'focus areas', with some considering mining issues. Under Focus Area 4 - Water for Non-consumptive and Other Uses – objectives include ensuring water availability for mining operations and various industrial purposes (MSWR, 2007). Water policy measures include

requirements for industries, including mining operations, to develop and implement environmental management systems that account for the impact of their activities on water resources; and fully implement requirements relating to licensing of water uses (permits) and issuance of wastewater discharge permits. However, an EPA officer pointed out lapses in implementation efforts, stating: "*Discharge of waste into water bodies, we have numerous complaints and do follow up for emergency meetings to solve conflicts and bring peace among affected communities…. So, when we go monitoring, it is not just to find fault but to also teach them how to do the right things*." The water policy mentions the promotion of public-private partnerships to protect and conserve water resources but does not specifically mention the MC or any of the mining agencies. Both policies lack deliberate provisions regarding policy actions to ensure continuous inter-sectoral collaboration for regular review and upgrade in a collective approach to water resource management. Interviewees from MC and EPA also considered coherence between mining and water policies to be 'partial'. It can be argued that the wanton pollution of water bodies, as witnessed in Atiwa West, reflects a lack of policy coherence that would otherwise coordinate activities of the MC, EPA and WRC to govern the ASGM sector more effectively.

6.4.2.4 Mining and development

Coherence between the national development policy and mining policy is classed as 'partial'. The national development policy acknowledges the importance of the mining sector, emphasising that between 2017 and 2020, gold production increased by 10.2 % and those employed in large- and small-scale mining by 10.5 %. It also recognises challenges facing the sector including degradation, poor management of royalties and compensation, illegal mining, weak enforcement of laws and regulations, inadequate mineral revenue, and unaccounted flows of mineral revenues. The policy is detailed perhaps because it is more recent (2022), providing objectives and strategies that cover key areas, including mineral extraction, water resources management, environmental pollution, and land administration. Objectives include promoting sustainable extraction of mineral resources and ensuring effective linkages between the extractive industries and the rest of the economy. For each strategy, it also lists the relevant institutions that must collaborate to implement actions.

Provisions for key institutional reforms are nevertheless missing in both policies, including full decentralisation of the MC and collaboration with regional and district councils for the effective enforcement of the legal framework governing mining (including prevention of smuggling of minerals). The national development policy seeks to link mining (including ASGM) to relevant sectors for coordination, but there remains a lack of clear district, regional and national level targets regarding ASGM growth and its impact on development. The mining policy lists measures intended to enhance growth and opportunities in the small-scale mining sector such as: ''*improving access to finance for small-scale miners, and assistance to obtain fair market prices for their minerals by the control of illicit dealings.''* (MLNR, 2014, p.34-35). However, detailed directives on ways to achieve these measures are lacking. These measures are also not corroborated in the national development policy.

Both policies provide insufficient details on approaches to enhance the skills of ASGM miners and give no detailed strategies on the development of mining communities and districts based on revenue inflows from small-scale mining. Furthermore, there is a lack of coherence regarding sourcing of gold. While the mining policy acknowledges gold sourcing as a segment of the mining enterprise, the national development policy does not mention it. In both policies, there are no specific strategies on gold sourcing businesses, and no strategies on drastic reduction of financial leakages and illicit financial flows from ASGM revenue sources. The national development policy does not include suggestions on how to integrate ASGM into district level development plans.

According to the Atiwa West district officer: ''*there is no national policy drive directing district assemblies endowed with mineral resources on specific plans and programmes to implement to support sustainable ASGM practices that would contribute significantly to the development of the districts.''* Interviews revealed there were no MC, EPA, or LC offices in the district for miners to access. Inadequate presence of these state agencies at district level is common. Prospective miners interested in obtaining licenses must travel to regional/national centres. Miners who consider the travelling and associated costs as disincentives then easily drift into illegal, informal operation. The institutional framework for development at the regional level is the regional coordinating council, made up of all DCEs in a region, presiding members, and heads of government departments/agencies. Yet, MC officials confirmed that no policy directives require linkages and coordination between them and the regional coordinating

councils on a regular basis to ensure that ASGM is properly integrated in regional development programmes, nor is there any requirement to ensure that ASGM plans are coherent with other development plans for the region. The district official at Atiwa West and MC officials considered there was 'partial coherence' between the national development policy and the mining policy. This viewpoint corresponds with the 'partial coherence' obtained from the QDA score.

6.4.2.5 Mining and environment

'Partial coherence' was found between the mining policy and environmental policy in relation to land and water degradation due to mining. The mining policy recognises the importance of linking with the environmental sector to deal with land and water degradation, noting that: ''*Mineral activities can only commence after environmental and other permits have been obtained* [from the EPA]'' (MLNR, 2014, p.25). The environmental policy recognises ASGM as an important industrial activity but also notes the environmental challenges posed by mining, including land degradation, and water and air quality deterioration. The environmental policy's objectives concerning mineral resources include: safeguarding the long-term use of land in mining areas through implementation of environmental management plans; educating mining communities in environmental protection methods and use of abandoned mining areas; ensuring miners undertake appropriate mitigation and reclamation measures; and regularly reviewing mining laws to reflect emerging issues regarding restoration of mined land to the best improved level (MESTI, 2012, pg. 22)**.**

Management activities include linkages with the mining policy and fiscal regime, Environmental Impact Assessment guidelines and procedures, reclamation bonds, and the performance disclosure rating system. The environmental policy, however, does not mention the need to ensure the adequate presence of EPA district offices, nor does it set out how the offices would link with district offices of the MC and other relevant institutions for effective enforcement. Aside from provisions in both policies requiring prospective miners to engage with both the MC and the EPA to secure licenses and permits, there are no specific directives that require regular cross-sectoral engagement at district, regional or national levels. Thus, there is no clear pathway to foster effective connections between them and coordinate regular reviews of policies, procedures, and to air general concerns.

Similarly, interviewees from MC and EPA considered coherence between environment and mining policies to be 'partial', noting little deliberate inter-sectoral engagement on ASGM and existing policies not being implemented effectively. An EPA officer shared: *"There is lack of coordination among agencies"* acknowledging further that: "*Monitoring is key, because there are even permit holders who are mining wrongly and need checking routinely".*

6.4.3 Experts' insights on cross-sectoral challenges regarding policy implementation, coherence and informality

Interviewees identified various political, institutional, financial, regulatory, and sociocultural challenges in their respective sectors regarding policy implementation concerning ASGM governance, as are presented below.

6.4.3.1 Political influence

Interviewees stated that due to high interest in ASGM across the country, sometimes people visit them claiming to be associates of politicians and attempt to use those politicians' names to fast-track acquisition of licenses/permits or to be lenient on a licensed miner who has been non-compliant. An EPA official said that:

''…per our law, you have to work for 18 months and come for renewal [of the permit]*. But after getting the first permit, they* [some miners] *don't care of renewing it because they have political power. So basically, that is what we are facing in terms of political affiliation.''*

Interviewees were clear on their employment terms of reference and aware that corrupt practices are not countenanced. An EPA officer stated that: ''*If a staff takes bribe and it's found out, it is summary dismissal. You don't even face the disciplinary committee*.'' Thus, any potential political interference can be linked to weakness in regulatory enforcement and lack of effective supervision. Findings indicate that while some politicians can influence processes and outcomes, sufficient regulations guide the conduct of public workers within the ASGM space such that if institutions are strengthened, they could limit political interference. Additionally, lack of political will is a major contributing factor to policy incoherence and a key challenge to ensuring sustainable ASGM implementation. Political actors in charge of sectors must deliberately initiate reforms that ensure policy coherence across the various mining-sensitive sectors.

6.4.3.2 Institutional challenges

Interviewees across sectors confirmed that licenses and permits are issued only at national head offices in Accra, lamenting the time taken. An EPA officer stated that:

''…a challenge we have is [if] *someone trying to venture into ASGM, the person will get his permit signed at the head office, and that delays the processes….And head office too, we are all aware the place is very choked. They are working very tirelessly but they can't meet the timelines because of the job pile up...*''

Breaking away from this customary practice and opening more branches, decentralising application processes across sectors so applicants can apply and secure licenses/permits at district offices, is critical to promoting regulated ASGM, improving ASGM monitoring and checking the rise of illegal mining activities. Interviews also highlighted that the lack of coordination between sectors is due to a tradition of sectoral working, exacerbated by tight sectoral budgets and lack of clarity in policies on intersectoral working. Policy analyses also focus chiefly on sectoral goals, with little emphasis on cross-sectoral working dynamics, while policies lack information on intersectoral roles and responsibilities with clear pathways that would warrant functioning linkages across institutions in different sectors.

6.4.3.3 Financial challenges

Interviewees acknowledged that they have structured monitoring and evaluation procedures within their organisations. Routine monitoring to check that legal miners operate responsibly is vital, but monitoring is ineffective due to inadequate budget allocation. An EPA official stated: *''…the main challenge is we do not have the required resources to handle enforcement and monitoring. We lack logistics – the cars and funds needed to do the work. We have structured monitoring and evaluation plans but lack the resources to implement them.''* Lack of resources was also noted by MC officers.

Budgetary deficits impact how many offices serve the mining-sensitive institutions. Ghana has 16 administrative regions, divided into 261 districts. ASGM is happening in 13/16 regions, yet the MC only has 9 district offices. The EPA has regional and zonal offices and is not present in all mining districts. An effective coordinated system of ASGM governance requires adequate

financial injection to retool institutions at multiple governance levels, and to recruit and train more personnel across all the mining-sensitive sectors.

6.4.3.4 Regulatory challenges

Across the different sectors, officials revealed that policy directives and regulations regarding their roles and responsibilities were clear, and staff were confident of their operational duties. Reforms have led to some institutions adjusting their regulatory requirements to improve ASGM governance. An EPA officer said:

''*There is a reform in our permit conditions. At first the requirement for EPA permit was: mining lease, site plan, abandonment reclamation proposal. But about 2 years ago, due to conflict incidents witnessed in the past, we have added a compensational agreement. If there is a crop on the land, we require a full compensational agreement or proposal*.''

A major challenge revealed by MC and EPA officers was that most licensed miners usually have illegal miners operating next to their sites, which discourages licensed miners to return for permit renewals. Officials also stated that stakeholder meetings to discuss strategies to deal with evolving ASGM challenges only occur occasionally, often based on a political call, or through an operation organised by one of the sectors. These arrangements are not planned in policy for regular implementation, so, there are inconsistencies and that can be challenging.

Regulatory and policy reforms regarding ASGM governance are necessary but need to be undertaken across all mining-sensitive sectors in a synchronised manner to ensure meaningful improvement in ASGM governance. Irregular sector-specific adjustments are insufficient to meet expectations. More structured, regular coordination across sectors concerning reviews of regulations, policies, operations, and procedures is necessary. Meetings to deliberate on matters should be organised at national, regional and district levels so that lessons from these meetings can help inform policy reviews and reform institutional coordination.

6.4.3.5 Socio-cultural settings

Officials indicated that every institution desires a certain level of autonomy and does not entertain being told what to do by other institutions. But, where there are clear national

policy directives seeking coordination among institutions for good governance practices and backed with strong political will, officials were open to them and willing to comply. There was no mention of ideological stands or institutional interests that were inimical to institutional collaboration for ASGM governance. A regional agricultural officer said:

''We don't work in isolation. Through the structures of the local governance system, it ensures that. We go to the regional level, there is the regional coordinating council. So, all the various platforms are there. So, we just need a strong policy drive towards curbing this bane or stopping the issue of illegal mining. There shouldn't be a problem at all.''

Provision of satisfactory salaries, transparent and traceable working processes, together with more effective supervision channels across the various mining-sensitive sectors would significantly improve working conditions.

6.5 Discussion

6.5.1 ASGM formalisation challenges across its value chain

Our research revealed a broad legal framework governing Ghana's ASGM sector across its value chain, covering aspects such as establishing designated mining areas, land acquisition, licensing procedures, mine operations, gold trading, and mine closure/rehabilitation. However, significant gaps and governance challenges exist. For instance, strategies for designating ASGM areas are not comprehensive, licensing procedures are complex and not decentralised to meet miners' needs, and a clearly defined framework for responsible gold sourcing is almost non-existent. These issues result in delays in licensing (also see Kumah, 2022), inadequate gold sourcing mechanisms, and ineffective monitoring. Consequently, many miners resort to informal operations, negotiating with landowners and mining illegally. The lack of capacity among regulators to effectively monitor mine operations and land reclamations, coupled with the increasing involvement of landholders and customary authorities in informal land transactions, further exacerbates formalisation challenges. Similar difficulties are found in Sierra Leone (Maconachie and Conteh, 2021). Licensed gold traders in Ghana can potentially legally buy gold from both legal and illegal miners, compounding illicit financial flow risks (also see: Hunter (2020). Laws ensuring rigorous due diligence in gold trading and effective monitoring are lacking. The current legal framework is inadequate for supporting a formalised ASGM sector and needs reform.

These findings align with broader formalisation challenges in SSA. ASGM formalisation in SSA faces numerous barriers, including complex bureaucracies, high costs for securing permits, and insufficient designated mineralised areas for prospective licensees (Hilson et al., 2021), as evident in countries like Zimbabwe (Spiegel, 2015), Liberia (Van Bockstael, 2014), Niger (Hilson et al., 2019), and Senegal (Persaud et al., 2017). The process of acquiring ASGM licenses involves navigating multiple government agencies, often requiring national office approval, with associated travel, fees, and personal expenses exceeding the capacity of most rural artisanal miners (Hilson et al., 2022).

6.5.2 Links between ASGM formalisation and policy coherence challenges

ASGM is a significant income source for many mining communities in SSA, but its integration into formal economic and policy structures faces considerable challenges, particularly regarding policy coherence. While formalisation is essential for improved livelihoods and environmental sustainability, inconsistent and fragmented policies across different sectors create substantial obstacles. Our analysis reveals that coherence between mining policy and other mining-sensitive sector policies is largely partial and weak. Conflicts between mining policy and other sectoral policies, such as land, agricultural, environmental, and development policies, lead to inefficiencies. For instance, the mining policy may support ASGM activities, but agricultural policies often fail to support farmers affected by mining, resulting in environmental degradation and reduced agricultural productivity. In Ghana, ASGM activities have polluted water bodies and degraded farmlands, leaving farmers without support (Forkuor et al., 2020).

Weak institutional coordination further complicates effective ASGM governance. Collaboration between various governmental agencies at national, regional, and district levels is essential but often lacking. In Ghana, Act 703 mandates that local District Assemblies be notified of any ASGM licensing processes within their jurisdictions, yet their roles and capabilities towards ASGM formalisation are not well-defined or supported. This inconsistency hampers the ability of district council officers to support licensed ASGM operations, leading to informal practices that evade regulation and oversight.

The literature highlights that ASGM is not fully incorporated into national development and poverty alleviation strategies in many SSA countries (Hilson and Maconachie, 2017; Hilson and McQuilken, 2014). This lack of integration means the potential of ASGM to contribute to economic development and poverty reduction is not fully realised. ASGM can provide crucial income for rural households, which can be reinvested into agriculture and other productive activities. However, without coherent policies supporting such synergies, the benefits of ASGM remain limited and unevenly distributed.

Customary land tenure and local governance structures further complexify ASGM formalisation. Customary landowners often engage in informal ASGM or negotiate land sales with miners, bypassing official regulatory frameworks due to unfavourable small-scale and large-scale mining policies (Hilson et al., 2020; Nyame and Blocher, 2010). This informal engagement leads to land grabbing, conflicts over land use, and environmental degradation, undermining formal governance efforts. Policies that do not consider customary land rights and local power dynamics are likely to face resistance and non-compliance, exacerbating the challenges of ASGM formalisation.

To address these issues, comprehensive and coherent policies that integrate ASGM into broader national development plans are needed. These policies should promote the sustainable coexistence of ASGM with other land-based livelihoods, such as agriculture and supply of clean potable water. Designating specific areas for ASGM, supported by detailed geological surveys, could help tackle land use conflicts, manage environmental impacts, and improve mining efficiency. In 2019, the Ghanaian government introduced the Community Mining Scheme to help communities form cooperatives and engage in local mining, but this revealed a disconnect between the mining sector and local development institutions. District Assemblies with mineral-rich lands recognising the potential benefits of the scheme, have taken the initiative and proactively led their communities in applying for ASGM licenses from the Minerals Commission (Hilson et al., 2022). Enhancing local governance structures and involving District Assemblies, agricultural officers, chiefs, and landholders in the formalisation process can strengthen the link between the mining sector and local development initiatives and thereby support decentralisation efforts towards ASGM formalisation.

Effective governance pathways are crucial for achieving policy coherence. This requires strong political will and coordinated efforts across multiple levels of government. Policies should facilitate permit acquisition at the district level, promote responsible environmental practices, and support the livelihoods of local communities. Governments can create a more enabling environment for ASGM formalisation if they collaborate to designate ASGM areas, regularly update geological maps, and improve institutional coordination. Addressing the challenge of policy coherence requires integrated and coordinated policies that consider the diverse impacts of ASGM on local economies, environments, and communities. Collaboration between different sectors and levels of government, and recognition of the importance of

critical non-state interests such as customary land rights, can create a more effective framework for ASGM formalisation.

6.5.3 Policy implementation structures and institutional coordination mechanisms

Our research demonstrates that Political, institutional, financial, and sociocultural barriers constrain regulatory and policy implementation efforts in ASGM. Although the literature advocates decentralising ASGM license applications to district levels (e.g., Dondeyne and Ndunguru, 2014; Kumah, 2022). This approach remains insufficient as miners still need to visit national offices for additional permits. Effective ASGM formalisation requires a coordinated effort among government institutions at national, regional, and district levels. The OECD's framework for policy coherence emphasises cross-sectoral and whole-of-government approaches, leveraging existing structures for better coordination (Zeigermann, 2018).

Integrating ASGM into national development programmes is essential (Nilsson and Persson, 2017), yet often hindered by a lack of political will and challenges in implementation, such as inadequate funding for agencies like the Minerals Commission and EPA. Despite the creation of numerous institutions for mineral resource governance, there is a lack of capacity to implement coherent policies across sectors and levels of governance. Ministries and government departments operate in silos, resulting in poor coordination, especially post-licensing. This issue is widespread in SSA, as noted by Fold et al. (2014), who suggested mechanisms to incentivise ASGM formalisation in Tanzania and Ghana. Our findings indicate that beyond enacting laws, policies must address the entire ASGM value chain and be supported by sufficient resources.

Achieving policy coherence and effective policy implementation requires strengthening institutions and providing mechanisms for improved vertical and horizontal coordination and collaboration among mining-sensitive sectors (Ranabhat et al., 2018). Less economically developed countries, particularly in SSA, face significant challenges due to weak and limited-capacity agencies. Our study identifies new strategies to address these barriers, emphasising the need to integrate ASGM with other sectors such as agriculture and development, establish and coordinate institutions for a more formalised and sustainable ASGM, and develop inter-agency and inter-ministerial approaches, building partnerships with non-state stakeholders

to create formal platforms for knowledge sharing related to ASGM. Addressing institutional and capacity challenges is crucial for sustainable ASGM practices. While this study focused on state institutions, future research should include non-state stakeholders to enhance policy coherence.

Our findings revealed that barriers to policy coherence are primarily due to internal circumstances such as poor coordination of policy development and implementation processes between ministries and agencies, rather than entrenched factors linked to ideas or interests (Shawoo et al., 2023). Strong political will is essential, requiring a re-examination of how governmental goals are conceptualised. Social norms, and other political factors influencing policy processes and outcomes also need to be re-examined. Mapping stakeholder preferences and power distributions, along with frequently revising sectoral policies to address emerging ASGM challenges, are critical steps. These insights are applicable across SSA. For example, in Zambia, ASGM formalisation allowed state control but did not benefit operators, highlighting the need for more support and strong political will (Siwale and Siwale, 2017). Political leadership commitment is essential for policy coherence (OECD, 2018).

6.6 Conclusion

Existing studies have reviewed regulations and policies within the mining sector. The novelty of our study lies in exploring policy coherence across sectors predominantly impacted by ASGM activities. This paper examined Ghana's laws and regulations concerning the ASGM value chain and assessed the coherence of policies in mining-sensitive sectors. These analyses provided a useful backdrop to better understand the challenges to ASGM formalisation. The findings revealed a broad legal framework governing various aspects of the ASGM value chain. However, the laws are insufficiently detailed in certain areas, such as gold sourcing, and overly complex and unsuited to miners' needs in others, such as licensing processes. Additionally, a significant challenge is the effective and consistent implementation of laws and regulations. Findings also indicated that coherence between Ghana's mining policy and sectoral policies for agriculture, water, land, environment, and development is generally 'partial'. Weak policy coherence is reflected in a lack of effective inter-sectoral coordination in ensuring sustainable practices along the ASGM value chain. The current legal framework and degree of policy coherence are inadequate for ensuring effective ASGM formalisation and requiring reform. Moreover, ASGM governance is not truly decentralised across the different sectors. Barriers such as lack of political will to push ASGM integration and policy coherence, lack of resources to run institutions, and limited office networks to efficiently implement laws and policies, mean there is incoherent policy implementation across the mining-sensitive sectors. There are few incentives to motivate miners to enter mining through formal channels to advance their livelihoods. Connected financial leakages and illicit financial flows are not vigorously tackled due to ineffective due diligence checks and monitoring mechanisms. The study overall contributes to our broad understanding of ASGM formalisation by emphasising that legal reforms and policy coherence across ASGM-sensitive sectors are critical to achieving sustainable ASGM, and to ensure that ASGM governance is integrated across all relevant sectors and institutional structures.

Acknowledgements

We thank all the interviewees who provided vital insights that enabled the writing of this paper.

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Chapter 7. Discussion

7.1 Overview

Globally, ASGM is often perceived as more profitable than other rural livelihood activities, prompting a growing number of individuals to engage in it either as a primary source of income or as part of diversified livelihood strategies (Hilson and Hu, 2022). However, the largely informal nature of ASGM creates significant challenges for sustainability. This chapter brings together the SLA, livelihood trajectories, formalisation and policy coherence, the first of its kind, to provide an in-depth understanding of the barriers and opportunities within ASGM, particularly informal ASGM, and identifies policies and governance strategies that offer potential to improve the sustainability of ASGM. It draws insights from the findings presented in Chapters 4, 5, and 6, and situates them within the broader literature. Informality complicates efforts to ensure secure livelihoods, foster beneficial agriculture-ASGM interlinkages, and achieve policy coherence. Weak governance structures and inadequate regulation further exacerbate environmental degradation, social conflicts, and economic uncertainty for miners and stakeholders in the ASGM sector, further hindering sustainable ASGM. Despite these challenges, this chapter argues that ASGM has the potential to be sustainable through appropriate formalisation and governance strategies. It connects the thesis's key findings to its central aim and objectives, emphasizing policy and governance implications that could promote formalisation and improve the sustainability of ASGM.

7.2 Objective 1: Identify and analyse livelihood trajectories linked to ASGM in new frontier communities, with a view to informing policy interventions that support the development of sustainable rural livelihoods

ASGM is seen as a pathway for poverty alleviation and rural development in many developing regions by diversifying livelihoods, increasing household income, and stimulating support services (Baffour-Kyei et al., 2021; Hilson and Garforth, 2012; Ofosu et al., 2020). Findings in this thesis support this broad view as ASGM emergence offered job opportunities, asset acquisition and triggered the emergence of various ASGM support services, boosting local economies (Chapters 4 and 5). The findings also support the growing consensus in the literature that the ASGM sector is heterogeneous and complex, driven by both poverty-related and profit-oriented dimensions, with varying opportunities and resources shaped by power imbalances (Maconachie and Conteh, 2021; Van Bockstael, 2019, 2014).

While existing studies highlight ASGM's potential to generate employment and promote livelihood diversification within communities, mainly based on snapshot field observations (Arthur et al., 2016; Baah-Ennumh et al., 2020; Baffour-Kyei et al., 2021; Obiri et al., 2016; Osumanu, 2020; Pedersen et al., 2021; Pokorny et al., 2019) this thesis took a different approach. It used a combined SLA and livelihood trajectory framework to show that ASGM's impact on households is unevenly distributed. It identified three distinct livelihood trajectory groups – consolidating, fluctuating, and marginalised – demonstrating that while some groups advance toward development, marginalised groups often move towards poverty and risk becoming trapped in poverty cycles. The study further revealed that livelihood trajectories in ASGM-impacted communities are shaped by household characteristics, resource access, and broader social, economic, environmental, and institutional factors (Chapter 4), with different livelihood groups facing unequal exposure to ASGM-related opportunities and barriers. Such disparities in access and asset use reinforce existing power asymmetries within communities, as ASGM intersects with other factors like limited financial access, climate variability, land tenure challenges, and market constraints (Section 4.3.1). Applying this framework provided insights into the complex interactions driving livelihood changes in farming communities

experiencing ASGM, showing how underlying factors intersect with ASGM to shape power asymmetries in emerging mining areas. By highlighting ASGM's role in driving uneven development, the framework revealed ASGM's dual potential to promote or hinder diverse livelihood pathways. This understanding is crucial in informing sustainable mining practices, as ASGM growth may exacerbate inequalities, deepen social divisions, and threaten community cohesion over time, especially in new frontier farming communities.

As outlined in Chapter 1, sustainable ASGM in this thesis refers to practices, policies, and initiatives designed to ensure that ASGM contributes positively to economic development, social well-being, and environmental protection in a way that is sustainable over the long term. However, the unequal distribution of ASGM's impacts, highlighted through the livelihood trajectory analysis, poses significant barriers to the sector's sustainability. The restricted access of some groups to the economic benefits of ASGM limit the ability of communities as a whole to achieve long-term development. Without equitable distribution of benefits, ASGM could lead to conflict over resources and competition for land, further destabilising communities. This inequity, combined with the environmental degradation caused by unregulated ASGM activities (see Chapter 5), hinders the sector's sustainability and its potential to contribute to long-term poverty alleviation.

My findings extend current scholarship in this area. For example, Hilson and Hu (2022) analysed the livelihood trajectories of those engaged in ASGM activities, finding that while poverty led these actors into ASGM, ''the livelihood trajectories of these people reveals that many have managed to overcome challenging work conditions and position themselves to use ASM as a 'platform for wealth creation." (p. 1). Their findings, however, did not reveal whether such opportunities and trajectories were available or accessible to all, regardless of their varied social backgrounds. New insights in this thesis show that given the heterogeneity of actors in the ASGM sector, while some may have the capability and prevailing favourable conditions to advance their ASGM livelihoods and create wealth, others may not. The thesis identified various conditions influencing these disparities (see Sections 4.3 and 4.4). These findings highlight the need for interventions that promote inclusivity within the ASGM sector, ensuring that opportunities are created and accessible to different livelihood groups and that new barriers are not created.

Chapter 5 revealed that informal ASGM practices are widespread, involving both local artisanal miners and urban entrepreneurs, who bring in advanced machinery to undertake small-scale mining. Whether operating legally with permits or illegally, miners engage in informal approaches regarding land acquisition, mining operations, and site closures, often neglecting or inadequately reclaiming land. ASGM activities with sophisticated machinery are typically short-lived, as miners prefer easily accessible alluvial gold deposits in low-lying areas or near water bodies, making their operations transient; they move frequently to maximise profits by seeking new deposits. This mobility results in temporary employment for locals, who become redundant as companies relocate, undermining sustainable development trends even in consolidating or fluctuating livelihood groups. Consequently, these informal, transient practices hinder skill and financial resource transfers to the local community, leaving many unable to acquire sophisticated machinery to engage in ASGM independently once external miners have departed. These practices also leave behind little in terms of long-term development or infrastructure on a consistent basis across communities.

Numerous factors were found to influence informal ASGM practices (Chapters 4 and 5). Existing customary norms can often worsen inequalities within communities. For instance, certain customary landowners, leveraging traditional land tenure rights, may negotiate informal land deals with miners, sometimes even leasing out active farmland against the wishes of tenant farmers. Such practices directly harm the livelihoods of these tenant farmers and exacerbate local socio-economic disparities. Mensah (2021) similarly cautions about the inherent risks associated with traditional institutions regarding the perpetuation of inequalities in ASM communities. This thesis posits that to ensure ASGM operates as a sustainable livelihood activity that positively impacts different livelihood groups, the various drivers that underpin inequality require identification and redress.

A key challenge at the national and international levels is to re-cast ASGM as a legitimate significant and sustainable rural livelihood that fits within a range of pre-existing rural poverty alleviation agendas (Hilson, 2016; Hilson and McQuilken, 2014). Existing literature point out that ASGM is not fully incorporated into national development programmes and poverty alleviation strategies, especially in SSA (Hilson and Maconachie, 2017; Hilson and McQuilken, 2014) and evidence in this thesis (chapter 4, 5, and 6) confirms this assertion. This challenge

is mainly due to the informality of the ASGM sector which is widespread across SSA (Bansah et al., 2018; Spiegel, 2015; Van Bockstael, 2014). Ghana's existing policies and laws do not grant District Assemblies (local authorities) permission to collect revenue from miners to support district development projects, missing vital revenue generation opportunities.

Given the challenges posed by ASGM's informality, formalisation of the sector, through targeted policies and regulatory approaches, is essential to ensure that ASGM is undertaken equitably and sustainably, with benefits distributed more fairly among all community members and environmental protections in place to safeguard the future. Without formalisation, the sector remains a missed economic opportunity for both communities and governments, with profits often captured by a small elite or informal middlemen rather than being distributed equitably. Policies to advance ASGM sustainability need to bring ASGM operators into the formal economy and relevant legal frameworks. This would subsequently support rural economic development, ensure good working conditions, address the underlying power asymmetries that result in unequal access to ASGM's benefits and ensure that miners are protected from exploitation.

The growing recognition of the profit- and poverty-driven dynamics behind ASGM requires governments across SSA and globally, to formalise the ASGM sector and develop targeted policies and regulatory frameworks that suit the needs of the different actors in the ASGM sector. These policies should carefully balance economic interests with commitments to environmental protection and social responsibility, with a focus on addressing the root causes of poverty, including investing in rural development. It should also determine how effectively varied groups of individuals can engage with and benefit from ASGM.

Over the years, organisations like the UN and World Bank and other international partners have supported SSA countries in efforts to formalise ASGM. In July 2023, for example, the UK's Foreign, Commonwealth and Development Affairs partnered with Ghana's Ministry for Lands and Natural Resources to launch the UK-Ghana Gold Mining Programme (MLNR, 2023). This three-year initiative seeks to address illegal small-scale mining in Ghana's Western, Ashanti, and Savannah Regions by boosting community resilience, promoting regulatory reforms, and supporting law enforcement efforts. The UK government has pledged £3.9 million, and UK experts will collaborate with a Ghanaian technical team to implement the

programme. While initiatives like this have seen some successes, particularly in training mining sector personnel, significant challenges persist in encouraging miners to embrace formalisation and practice sustainable ASGM. In Ghana's case, many of these initiatives have limited involvement from the local authorities, who could otherwise play a vital role in co-owning projects with other government agencies like the Minerals Commission to achieve broader community impact. Without the active involvement of local authorities and community leaders who are essential to effecting change at the grassroots level, projects often miss the opportunity to align their goals with on-the-ground realities, community priorities, and interests of various livelihood groups, reducing the likelihood of sustained success against illegal mining. Local institutions often lack the necessary resources and expertise to continue these initiatives independently. Without a clear transition plan for local authorities to assume control after programmes conclude, any progress made in addressing illegal mining may not endure. Strong political will to ensure that international interventions, policies, and laws are not only well-designed but also effectively enforced, to pave the way for a more sustainable ASGM practices is important.

The findings in Chapter 4 point out the significance of people's agency in decision making and illustrates how livelihood trajectories evolve with the emergence of ASGM. It also shows that while asset acquisition at the household level from ASGM is important, it alone cannot lift rural households out of poverty. Structural changes in an external context relating to socio-cultural, economic, political, and biophysical variabilities are necessary to facilitate this transition. This highlights the need for targeted policies to address the growing inequalities stemming from ASGM emergence and to provide interventions that address the specific needs of different livelihood groups within ASGM communities. Sustainable ASGM should entail inclusive growth that benefits all members of the society. Neglecting any livelihood group can perpetuate social injustice and lead to social unrest, conflict, and ultimately undermine the stability and sustainability of ASGM operations.

7.3 Objective 2: Investigate ASGM's impact on natural and physical livelihood capitals and interactions with agriculture, in order to understand policy implications for a positive co-existence of sustainable agriculture and ASGM

As noted in Chapter 2, existing literature reveals that interactions between ASGM and agriculture vary, portraying the two either as complementary or competitive (Mkodzongi and Spiegel, 2019; Pijpers, 2014). This thesis, using the SLA framework to examine these interactions at household, community and institutional levels, demonstrates that these relationships are not mutually exclusive, and both can occur simultaneously. This is a key novelty of the study, offering new perspectives on the interconnectedness between ASGM and agriculture.

Findings in Chapter 5 highlight that ASGM's impact on natural and physical capital in relation to agriculture is mixed. At the household level, those engaged in ASGM acquired physical and natural assets, such as cement houses, land plots for housing, motorcycles, and household necessities like mobile phones, televisions, and radios. However, ASGM activities also led to environmental degradation, resulting in the loss of farmland and poorly reclaimed mined lands, making them unsuitable for farming (Chapter 5). At the community level, ASGM's contributions to communal assets were minimal, with its activities instead exacerbating the degradation of farmlands, forests, and waterways, and damaging infrastructure such as farm roads and bridges (Section 5.3.1), adversely affecting livelihoods and sustainability.

In exploring interactions between ASGM and agriculture, the findings reveal instances of mutual benefit at the household level, enabling resource sharing (e.g., land and labour) and diversification of income sources (Section 5.3.1). This aligns with existing literature, which shows beneficial interactions between ASGM and agriculture at the household level (Chigumira, 2018; Hilson, 2016; Hilson and Garforth, 2012; Kamlongera, 2011; Maconachie, 2011; Mkodzongi and Spiegel, 2019; Okoh and Hilson, 2011). For example, income from mining is often used to purchase fertilisers and invest in farm mechanisation (Hilson, 2016), supporting livelihood improvements among households engaged in both sectors. However,

these positive household-level effects were undermined by long-term costs at the community level, such as the degradation of farmland, water resources, and forests. Unmet promises of land reclamation by both legal and illegal miners have left community members feeling dismayed and shortchanged, as residents are unable to independently fund those reclamation. These long-term costs can weaken the development of local communities, especially those dependent on agriculture and natural resources for their livelihoods. Economically, this can mean reduced agricultural productivity and income, degradation of ecosystem services essential for farming leading to costly human interventions and rising expenses for environmental remediation and restoration. Such financial burdens can intensify poverty and food insecurity, placing further strain on communities and hindering sustainable development. ASGM and agriculture were found to lack a sustainable and mutually beneficial relationship at both household and community levels, underscoring the need for proactive interventions and effective policies to mitigate ASGM's social and environmental impacts.

Applying the SLA, this study identified key factors driving unsustainable informal ASGM practices, including traditional customs, land tenure issues, financial struggles among farmers, negative attitudes of miners and gold traders, political influence, ineffective policies, and weak law enforcement. This informality in ASGM has led to widespread informal land transactions and land grabbing, contributing to tensions over land tenure (Section 5.3.2). The persistent pursuit of land by miners, coupled with customary landowners' readiness to negotiate informal agreements, exacerbates competition over land use among miners, farmers, agribusinesses, and local communities. This dynamic reflects the increasing pressure on land resources driven by the expansion of ASGM activities and the demand for agricultural land.

Tenant farmers, who acquire land informally through customary systems, become vulnerable with little recourse when landowners lease their farms to miners (Chapter 4). Such land tenure insecurity may discourage tenant farmers from making long-term investments such as adopting new technologies and infrastructure or improving soil fertility thereby reducing agricultural productivity. Added stress from tenure uncertainty may also distract farmers from focusing fully on their work. Tensions have arisen over the lack of proper reclamation of land after mining. However, landowners struggle to seek redress because of the informal

nature of land transactions with miners, which often lack documentation (Chapter 5). Unresolved conflicts can strain relationships between landowners and miners, creating obstacles to sustainable ASGM. Conflicts also emerge when miners encroach on farmlands without regard for property rights or required permissions. Such conflicts cause disruptions to livelihoods and can result in financial losses for miners and landowners alike.

These observations highlight that informal ASGM, especially with advanced technology, poses significant barriers to ASGM sustainability. The observations add to other social and environmental challenges linked to informal ASGM noted in other SSA countries including Sierra Leone (Maconachie and Conteh, 2021); Côte d'Ivoire (Van Bockstael, 2019), Liberia (Van Bockstael, 2014) and Tanzania (Kitula, 2006). Mwakesi et al. (2020), for instance, report that in Kenya, the lack of an appropriate regulatory system to support sustainable mining has led to an uncontrolled influx of migrants into mining areas. While small-scale mining has helped households meet daily needs, it has not enabled equitable asset accumulation. Furthermore, abandoned pits and inadequate land reclamation have reduced agricultural land, lowered crop yields, and decreased living standards, highlighting the unsustainable nature of small-scale mining for community livelihoods.

This thesis, therefore, argues that informal ASGM involving sophisticated methods, if left unregulated, is unlikely to support sustainable ASGM, where activities positively impact economic development, social well-being, and environmental protection over the long term. Thus, within this context, promoting sustainable ASGM requires transparency, fairness, and inclusivity in land use and resource allocation to prevent conflicts and promote harmonious coexistence between ASGM and agriculture.

Despite the close interconnection between the agricultural and ASGM sectors, Ghana's policy and governance frameworks do not adequately reflect this through integration. There is a lack of institutional coordination between the mining and agricultural sectors at district, regional, and national levels, as evidenced in Section 5.3.1.3. Policies in each sector have traditionally been developed independently, without formal mechanisms for collaboration. Consequently, interactions between sectors have evolved informally without any purposeful policy interventions. As a result, any observed complementary relationship is fragile and transient,

and the benefits of ASGM are insufficient to offset its associated long term harmful impacts (see Section 5.3.1).

Rural development challenges in SSA are complex, including issues such as inadequate infrastructure, market remoteness, and low agricultural productivity (Pedersen, 2021). Climate-induced limited and erratic rainfall, land degradation and related poor soil fertility, and extensive erosion disrupt traditional farming cycles and further constrain options for increasing agricultural output (Antwi-Agyei et al., 2013; Stringer et al., 2020). In this context, diversifying livelihoods beyond farming becomes crucial for supplementing smallholder agricultural production across various agricultural systems in SSA and worldwide (Banchirigah and Hilson, 2010; Ellis, 2000). As ASGM expands into farming areas, bringing both significant local economic benefits and associated social and environmental challenges, this thesis argues for formalising the ASGM sector to enable sustainable practices. It contends that governments must understand the complexities of ASGM, balancing its benefits and costs through policies that promote coexistence with agriculture within national development frameworks. Achieving this requires cross-sector collaboration among policy-making institutions to establish shared objectives and regular government-led coordination through platforms like district assembly and community forums.

Ghana's current legal framework on mining also does not guarantee landowners direct benefits from minerals mined on their land (Chapters 5 and 6). Some landowners are even pressured into leasing their land to miners. For these reasons, the drive for direct benefits, especially among customary landowners, has fuelled informal ASGM growth (Section 5.3.2). ASGM laws need updating so they are not focused solely on state interests but also integrate customary land tenure rights, that address landowners' concerns through compensation or benefit-sharing schemes. Ghana's mining laws mandate negotiation and compensation between legal miners and landowners before mining begins, based on the economic value of the land's current use. However, the regulations governing compensation processes are not comprehensive, failing to address potential post-mining land impacts, and often impractical, as they lack designated district-level agencies, such as the Lands Commission, to implement them effectively. This results in inconsistent payments across communities (see Chapter 5). Similar systems, such as surface rents in other countries, also face challenges; for example, in

Sierra Leone, chiefs have been accused of irregularities in approving mining operations (Maconachie and Conteh, 2021). Therefore, there is an urgent need for regulations that ensure fair compensation and/or benefit schemes including considering potential post-mining land-use issues faced by land users. This is critical to address the growing prevalence of informal land transactions that drive informal ASGM.

Promoting sustainable mining practices that intersect positively with farming can help curb the human-induced land degradation across Africa (Adenle et al., 2020). In SSA, where 60% of the population relies on land for their livelihoods (Adenle et al., 2020), land degradation directly impacts wealth and well-being for many. A key form of land degradation in SSA is the persistent loss of biomass, resulting from complex interactions between social and natural processes over time and across regions (UNCCD, 2016), with findings in Chapter 5 showing that informal ASGM often leads to deforestation and biomass loss. For this reason, devising strategies to address ASGM-related land degradation is thus critical for sustainable land-based initiatives and enhancing the ability of land to support diverse livelihoods. This approach also aligns with operationalising and setting national Land Degradation Neutrality (LDN) targets, which are crucial elements in implementing the LDN framework – a scientific guide to achieve a balance between what is taken from the land and what is given back (Cowie et al., 2018).

7.4 Objective 3: Examine Ghana's current legal and regulatory framework and analyse intersectoral policy coherence concerning ASGM governance, with a particular focus on formalisation

7.4.1 Legal framework review

This thesis has revealed many challenges linked to informal ASGM (chapter 4 and 5) that undermine sustainable ASGM efforts and argues in support of formalising the sector to promote sustainable ASGM. Formalising ASGM is often cited as the first step toward developing the sector (Hilson et al., 2021; Martinez et al., 2021; Siegel and Veiga, 2009) because informality often excludes ASGM from local, regional, or national sustainable development plans (Maconachie and Conteh, 2021).

Currently, Ghana's mining laws cover the ASGM value chain but lack comprehensive guidelines and adequate governance structures. Persistent issues include limited designation of ASGM areas, complex licensing processes, and inadequate gold sourcing mechanisms (Chapter 6). The ASGM licensing process involves multiple agencies, such as the Minerals Commission, Land Commission, and the Environmental Protection Agency, most requiring final approval from national offices. This makes the process prohibitive for rural miners, who often lack the resources to navigate the bureaucracy and associated fees. ASGM licensing and permitting fees can be significant (GH¢20,696 ($1380) (Table 7.1) which is discouraging for many miners (Hilson et al., 2022).

Table 7.1 Costs associated with ASGM licensing in Ghana

Government agency	Item	Amount in Ghana Cedis (USD)
Minerals Commission	Licensing application form	GH¢1050 ($70)
	Licensing processing fees	GH¢2246 ($150)
	Operating permit fees	GH¢3400 ($227)
	Annual mineral rights fees	GH¢1800 ($120)
Environmental Protection Agency	Processing fees for environmental impact assessment	GH¢1000 ($67)
	Permit fees	GH¢5000 ($333)
Water Resources Commission	Water Use Permit processing fee	GH¢600 ($40)
	Permit fees	GH¢5000 ($333)
Lands commission	Gazetting land documents	GH¢600 ($40)
Total		GH¢20,696 ($1380)

Source: adapted from Hilson et al. (2022).

While multi-agency coordination is necessary (as discussed regarding the agriculture sector in Chapter 5), simplifying this process by establishing district-level offices empowered to issue licenses could make formalisation more accessible. Presently, as observed in Chapter 6, institutional deficiencies, including insufficient district offices, resource constraints, and corruption, hinder effective law enforcement and erode public trust. These dynamics can facilitate illicit activities and regulatory capture, perpetuating informality. Strengthening governance mechanisms to build institutional capacity, enforce laws, and promote accountability is essential to addressing ASGM's environmental and socio-economic impacts.

The thesis emphasises the diversity of ASGM actors (also see Maconachie and Conteh, 2021; Hilson and Hu, 2022), but Ghana's laws treat ASGM as homogeneous, overlooking artisanal miners' unique needs and constraints. Act 703, for instance, applies uniformly across the sector, assuming all miners have equal access to resources and networks. This oversight compels many artisanal miners to operate outside the legal framework. Furthermore, the government has not adequately recognised ASGM as a "platform of wealth creation" (Hilson and Hu, 2022, p.94) that could support impoverished actors in developing sustainable practices and advancing as entrepreneurs. Tailored policies, with incentives encouraging formalisation, are critical for advancing sustainable ASGM.

This study reinforces the point made in various studies that, across SSA, ASGM laws are often bureaucratic and costly (Hilson and Maconachie, 2020) lack adequate support mechanisms (Hilson et al., 2014) and oversimplify the sector. Consequently, formalisation efforts stall, perpetuating informality. In this sense, insights can be drawn from countries like Burkina Faso and Sierra Leone, which separate artisanal mining from small-scale mining requirements, enabling tailored governance for each group (ACET, 2017).

The thesis further reveals that Ghana's legal framework emphasises punitive measures to deter illegal mining but lacks supportive provisions like capacity building, financial support, and training for sustainable practices (see Section 6.3.1). Although Ghana is a leading gold producer, the government's preoccupation with compliance to gain control of ASGM activities and generate public revenue, while failing to provide clear benefits to ASGM operators, has pushed many miners toward informal practices. The absence of clear strategies to develop the ASGM sector through the legal framework to move it towards sustainability, risks putting miners on the edge through constant scrutiny of their activities for compliance alone. This challenge is not unique to Ghana as similar issues have been observed in Peru for instance (Martinez et al., 2021; Veiga and Fadina, 2020). Without sufficient legal and economic support, some miners may achieve economic gains but not through sustainable methods.

The Ghanaian government's Minerals Development Fund, established in 1993 and legally reinforced by Act 912 in 2016, aims to distribute mining royalties to support the development of mining communities, local authorities and mining institutions (Hilson, 2020). It has occasionally provided loans to ASGM cooperatives, although funding has been inconsistent and inadequate. This issue mirrors similar underfunded initiatives across SSA. In Zambia, the government disbursed $5,000 loans to ASM operators in the late 2000s and another $43,962 to fourteen miners in 2013, but these amounts were deemed insufficient for their needs (Siwale and Siwale, 2017). To strengthen ASGM, governments should allocate stable funding to entities like the Minerals Development Fund and maintain accessible district-level offices. While ASGM miners risk dependency on external funding, continuous support and sustainable business models can encourage long-term independence.

Section 6.3.1.4 revealed that, like in other parts of SSA and Peru (Martinez et al., 2023), miners often rely on informal gold sourcing, selling to local middlemen due to limited access or lack of incentive to sell to formal buyers. This informality restricts miners from realizing the full

value of their gold and encourages illicit activities. Weak gold sourcing systems, as identified in this study, can enable rogue traders to exploit miners, facilitate smuggling, and deprive nations of valuable development capital. Ghana's Precious Minerals Marketing Company has formalised ASGM gold trading, yet purchases gold from both formal and informal miners across districts and communities (Hilson and Hilson, 2015). However, due to the government's lack of financial support for miners, middlemen step in to fill this gap, offering critical funding but often requiring miners to sell their gold exclusively to them in return. This arrangement also targets marginal rural miners, who already face challenges in accessing central trading locations (Dondeyne and Ndunguru, 2014; Thomas et al., 2019).

The current legal framework does not adequately address the diverse needs of ASGM actors, including individual miners, cooperatives, and small-scale mining companies. Even if amended, government institutions currently lack the resources to fully support the sector and address the needs of hundreds of thousands of ASGM miners (Section 6.3.1). Changes in the framework should prioritise sustainable ASGM, with district-level structures coordinating alongside grassroots organisations, like miners' associations, to enhance communication, knowledge-sharing, and community empowerment. These associations could also facilitate market access, reduce corruption, and advocate for improved policies, promoting sustainable livelihoods.

As mentioned in Chapter 2, scholars have argued that designating ASGM areas could ensure sustainable coexistence with other land-based livelihoods. It can address many of ASGM's social and environmental challenges. While Ghana's legal provisions allow for the creation ASM-designated areas, collaboration between the government and customary landowners in this process is not explicitly mandated (Chapter 6). With about 80% of the land owned by customary authorities, excluding them from mineral access decisions poses significant formalisation challenges. Additionally, geological mapping and surveys, essential for identifying viable mining areas, have been inconsistently funded since ASGM legalisation in 1989, resulting in lack of adequate data and forcing miners into trial-and-error site selection. This political ambivalence toward geological assessments is a common issue across SSA (e.g., see Siwale and Siwale (2017) for a case in Zambia). Currently, many miners are hesitant to obtain licenses because they lack confidence in the licensing procedures' ability to guarantee the presence of gold deposits at their prospective sites. Engaging customary landowners in

mining decisions, along with conducting geological assessments and mapping ASGM sites, could greatly increase miners' willingness to apply for licenses and operate within designated zones. It can also manage ASGM expansion with minimal impact on other livelihoods. In doing this, however, mapping initiatives must address potential risks, such as stakeholder resistance over land rights or economic concerns. Engaging landowners, communities, and stakeholders early in the process can build trust and boost support for geological surveys.

7.4.2 Formalisation challenges, interventions, and need for policy coherence

Since its inception, Ghana's ASGM formalisation programme has consistently been shaped by top-down governance, largely controlled by senior government officials in Accra, with minimal efforts to reinforce decentralised, operator-friendly initiatives. Despite the millions of dollars provided by the World Bank and other donors to support ASGM, including projects under the Mining Sector Development and Environment Project (1995-2001) and the Natural Resource and Environmental Governance (NREG) Development Policy Operations (2008–2011), formalisation has struggled to deliver significant change (Hilson et al., 2022).

Recent funding commitments have raised hopes for a positive impact on ASGM operators. In 2020, the World Bank launched the Africa Environmental Health and Pollution Management Program (P167788), from which Ghana received US$8715,596 to reduce mercury exposure at pilot sites and strengthen capacity to regulate its use in the ASGM sector (Hilson et al., 2022). Additionally, the U.S. Department of State (USDOS), funded Promoting Mercury-Free Mining in Ghana (Pro-MFM) project, managed by international NGOs Solidaridad and Pact from 2020 to 2023. It aimed to reduce mercury in the ASM sector by promoting alternative technologies, educating miners, and highlighting the business benefits of mercury-free mining (Solidaridadnetwork, 2023). In 2021, the World Bank launched a further $60 million ASM Formalisation Project with Ghana’s Ministry of Lands and Natural Resources to strengthen government oversight, promote responsible entrepreneurship, and promote sustainable livelihoods in galamsey communities (World Bank, 2021a). Despite these efforts, these projects do not highlight the need for joined up governance processes. They fail to foster collaboration across key governmental agencies, sectors, and non-state institutions,

undermining the potential for a more cohesive formalisation process that truly offers potential for sustainable ASGM.

Another critical initiative, the Ghana Landscape Restoration and Small-Scale Mining Project (GLRSSMP), was launched in August 2022. This six-year, $103.36 million project is a partnership between the World Bank and Ghana's Environmental Protection Agency (EPA) and Ministry of Lands and Natural Resources, merging the ASM Formalisation Project with the Landscape Restoration Project. The project seeks to strengthen integrated landscape management, formalisation of ASM and increase community benefits in degraded savannah and cocoa landscapes (World Bank, 2021b). Furthermore, in February 2023, Ghana's EPA launched the five-year, $6.35 million PlanetGOLD project, funded by the Global Environmental Facility, to reduce mercury use in ASGM, boost financial inclusion, and support the transition to formal economic activities. With $44.8 million in co-financing from Ghana and partners like the United Nations Development Program (UNDP), it aligns with Ghana's Minamata Convention commitments (PlanetGOLD, 2023).

Despite these extensive initiatives and funding streams, challenges persist in Ghana's ASGM formalisation efforts. These projects often operate in sectoral silos, with little emphasis by government on cross-sector or inter-ministerial collaboration. The inconsistent coordination among agencies, indicates a lack of coherence in ASGM-related policies. To promote sustainable ASGM, key sectors and institutions must collaborate, address challenges collectively, including ensuring timely training of officers and data sharing between implementing agencies.

In Ghana and elsewhere the largest obstacle to the ASGM's formalisation is land tenure and access to mineral rights (Hilson et al., 2022). Ghana's Minerals & Mining Policy of Ghana, 2014 and the ASM Framework, 2015 (Chapter 6) acknowledge the need to identify and demarcate areas suitable for small-scale mining to promote efficient operations. This requires institutional collaboration involving customary landholders. However, the Minerals Commission's focus on large-scale mining has led to expanded concessions, leaving artisanal and small-scale miners with limited access to viable land (Hilson and Hilson, 2015). As a result, many artisanal miners work on land under concession to large companies, and sometimes in restricted areas. This institutional bias raises concerns about the Commission's commitment to supporting ASGM operators and creates significant obstacles for international agencies like

the World Bank and the UNDP, which, under their projects, aim to promote innovation and efficient technology in the ASGM sector. While there is general agreement among stakeholders that the "Designated Area" approach is a good policy tool (Hilson et al., 2022), the Commission's reluctance to expand access to viable land for small-scale miners undermines efforts by international agencies, diminishing the impact of these projects.

Additionally, a critical element for the success of these projects is establishing a decentralised ASGM governance structure, with trained local personnel as mining experts in their districts and communities. However, the administration of Ghana's mining sector remains overly centralised in Accra, with district officers lacking authority to make independent decisions. While Ghana has positioned District Assemblies as the centrepiece of decentralisation, they have, from the outset, been largely excluded from decision-making processes related to Small-Scale Mining License applications. As Hirons (2014) observes, the District Assemblies' role has been 'restricted to communicating and endorsing applications for small-scale mining concessions' (p. 25), not shaping ASGM policy or enforcing sustainable practices at the local level. Beyond the politicisation of District Assemblies' role in the ASM sector, which has led to inconsistent management approaches, their formal involvement is further restricted by a lack of autonomy to coordinate with other ministries. Although the Minerals Commission and EPA have had their authority somewhat deconcentrated under decentralisation, neither the District Assemblies nor the District Offices of these institutions have the power to implement collaborative programmes without central permission. This restricts the influence of local government authorities over local land-use change and forces them to operate in a highly fragmented institutional environment. Lack of district-level autonomy and the resultant sense of powerlessness has a great tendency to undermine the achievements of all of these projects, as their successes is closely linked to the effective decentralisation of the sector.

As stated in Chapter 2, for decades, the Ghanaian government has on occasions, deployed the security forces to help curb informal and illegal mining escalations. In recent times this occurred via Operation Vanguard and Operation Halt II. Despite high-profile raids and machinery destruction, and sometimes rounding up of foreign miners, these operations have not achieved lasting success to rid the ASGM sector of informality and illegality. Informal miners often regroup and continue operations, demonstrating their resilience and shared drive for economic improvement. The failure of these operations reflects the limitations of a

military approach to curbing illegal ASGM. Furthermore, corruption allegations involving bribery of some of these security forces undermine the efforts of these operations.

Chapters 4 and 5 have highlighted the plight some locals have suffered due to foreign involvement in ASGM but also underscore the significant economic contributions made by foreign miners in the local areas. Despite operating illegally, these foreigners bring crucial financial investment, technology, and employment opportunities. Studies by Hilson et al. (2014) and Hilson & Hilson (2015) reiterate this position and show how foreigners introduce technologies, such as excavators, that increase efficiency and reduce operational times from weeks to days. The foreigners' financial resources provide loans to local miners, stimulate gold production, and boost local economies through heightened trade and job creation. As such, the government's focus on removing foreign operators through task forces has largely failed to curtail their presence, partly because the government does not address the broader context of their involvement. Foreigners have become perhaps indispensable in many ASGM communities, often serving as the primary source of finance and technology. Residents including influential actors, such as traditional chiefs, who often own the land and grant informal mining permits, realise that the removal of foreign miners risks exacerbating local economic hardship and so defy government directives and continue to collaborate with foreign miners. Addressing the root cause of this type of informality requires the government to move beyond designing legislation and to partner with credible private organisations to provide essential financing and technological support that miners urgently need. Doing this alongside arresting and prosecuting the financiers and sponsors behind illegal mining would limit informal and illegal ASGM practices.

In addition to military-led operations, the government's Community Mining Scheme (CMS) introduced in 2019 to promote local participation and integrate miners into the formal ASGM sector has not been widely implemented across Ghana and it has yet to meet its potential, and informality still pervades the ASGM sector (see Chapter 5). The CMS presents a vital opportunity to decentralise ASGM governance in Ghana, and provide a structured, locally-driven approach to licensing and formalisation. Since its introduction, District Assemblies have viewed it as a rare opportunity to create employment for residents and regularise mining in their communities. Many District Chief Executives have supported miners' applications to the Minerals Commission by covering licensing fees, including environmental and water

permits (Hilson et al., 2022). This support reduces two major barriers to ASGM formalisation: high costs and complex bureaucracy faced by miners. Local ownership of CMS could help end the rent-seeking behaviour prevalent in Accra, where licensing delays and added fees often undermine formalisation. Despite this promise, the Minerals Commission has retained centralised control over licensing, missing a critical opportunity to decentralise. As a result, rent-seeking behaviour, added costs, and bureaucratic delays remain burdensome for miners. Involving District Assemblies in the coordination and administration of the CMS would create a decentralised platform crucial for formalising Ghana's ASGM sector, as emphasised by a district official in an interview (Chapter 6). This shift to district-level approach could also reduce the bias favouring large-scale mining operations. For CMS to succeed, it requires broader, consistent implementation and firm support for local authorities. Without these changes, ASGM in Ghana will likely remain informal and unregulated and thus continue to be unsustainable.

Section 6.3.2 revealed that irrespective of ASGM's interconnectedness with several sectors of government, policy coherence between mining and other sectors sensitive to ASGM activities (land, agriculture, water, environment, and development) is weak. Yet, modern public policymaking now involves numerous policy domains, scales of implementation, and stakeholders (Nilsson et al., 2012), underscoring the importance of policy coherence. Limited coordination among ministries and agencies hinders effective formalisation supporting sustainable ASGM activities. While scholars have called for streamlined licensing in the mining sector at the district level (Adu-Baffour et al., 2021), this approach is insufficient. A key novelty of this thesis is the argument that streamlined licensing and permitting must extend across all agencies involved in ASGM. This research highlights that policy incoherence, characterised by weak institutional collaboration and inconsistent policy design and implementation, remains a major barrier to sustainable ASGM. As ASGM intersects with several government sectors, it requires coordinated cross-sectoral action to manage potential contradictions, conflicts of interest, and trade-offs, and to avoid duplication, and wasted resources. How ASGM is conceptualised fundamentally shapes its transition from informality to formalised, sustainable practices. Lack of coherence arises when policymakers prioritise different visions and actions (Shawoo et al., 2023). Adopting cross-sectoral approaches would challenge traditional governance structures characterised by sectoral silos that hinder collaboration.

Understanding the drivers and constraints of policy coherence, especially at the cross-sectoral level, is crucial to promoting a more sustainable ASGM sector.

At the policy level, certain elements have the potential to support or constrain ASGM policy coherence. Horizontal policy coherence issues arise when there is a failure to ensure alignment between different policy domains or to adequately consider the connections between systems that are part of the ASGM sector, such as those uncovered for the agricultural sector in this thesis. Such misalignment creates conflicts and unsatisfactory trade-offs. Similarly, vertical coherence for ASGM policy requires aligned actions across local, national, and international levels within specific policy-making domains, such as ASGM and development, alongside coordination among stakeholders at different scales, including miners, gold traders, landowners, and related institutions. Strengthening both horizontal and vertical policy coherence is critical for aligning objectives and adopting integrated strategies that support sustainable ASGM practices. Sustainable ASGM depends on policies that integrate perspectives from relevant sectors like land, mining, agriculture, and environment, supported by coordinated efforts across governments, non-state institutions, and international donors to mitigate significant social, environmental, and economic impacts. Although, ASGM's role in rural development is well-documented, as many miners combine it with other livelihood activities (Cartier and Bürge, 2011; Ofosu et al., 2020) its success and sustainability rely on the coherent design and implementation of cross-sectoral policies. However, this is currently hindered by a lack of strong political will (Chapter 6). Without such approaches, addressing the complex challenges of sustainable ASGM remains difficult.

For over three decades, donors have urged policymakers in Ghana and other SSA countries to formalise ASM. However, the rationale for this push remains largely speculative. Since most ASM operations in the region remain unlicensed, it has been difficult to convincingly argue that formalisation would benefit all stakeholders involved. This may explain why, as noted by the United Nations Economic Commission for Africa (UNECA), many experts assert that it has become a “cliché to present formalisation as a silver bullet for challenges faced within ASM, whether environmental, financial, social or technical” (UNECA, 2017, p.6).

However, when ASGM formalisation is approached as a process initiated through licensing and permitting, its potential to transform ASGM activities into sustainable livelihoods in SSA

and other developing regions could become evident. Martinez et al. (2023) share similar views from an ASGM study in Peru. Singo and Seguin (2018) describe this formalisation process as encompassing several elements, such as “the introduction of legal and regulatory frameworks, providing legal access to minerals, information about geological data, organising miners into flexible and dynamic organisations, and providing access to capital, equipment, and technical assistance” (p.7). The United Nations Environment Program (UNEP) offers a more detailed perspective, particularly regarding gold mining (UNEP, 2012):

“The process of formalization includes the development or adaptation of mining (and other) laws or policies to address the challenges of ASGM. A well-designed formalization process generates the enabling conditions for accountability within the sector so that it can ultimately be integrated into the formal economy. Formalization can only be successfully achieved if programmes and public policy deal with the different dimensions of ASGM activities simultaneously and in an integrated way. Legalisation is just one dimension of the process of formalization” (p. 2).

The emphasis on “enabling conditions” underscores the critical role of government involvement in realising formalisation. This thesis outlines strategies in the next section that can be implemented in ASGM formalisation processes to promote more sustainable practices in the sector.

7.5 Strategies for sustainable ASGM across its value chain

7.5.1 Overview of strategies for sustainable development of ASGM

Overall, the strategies presented in Table 7.2 based on the results in Chapter 4-6 provide a comprehensive framework to promote sustainable ASGM. By implementing these strategies in a coordinated manner across sectors, institutions, and stakeholders, mining countries could promote environmental protection, social development, and effective economic growth.

Table 7.2 Strategies for formalisation and sustainable development of ASGM

Strategy	Description	Results chapters providing evidence in support of the strategies	Barriers and challenges to strategy implementation
1. Creation of designated ASGM areas	Allocate resources to invest in comprehensive geological studies aimed at mapping designated areas for ASGM.	Chapters 4, 5 and 6	Lack of economic information on the costs of implementing comprehensive geological studies can cause lack of budgetary allocation. Difficulty lies in securing funding and resources for comprehensive geological studies due to mostly limited funding options in developing countries. Land is mostly customarily and privately owned, and landowners and associates may interfere with surveys due to perceived threats concerning land ownership, access to resources, and their economic interests.
2. Streamlining of ASGM licensing	Streamline ASGM licensing procedures by reforming legal frameworks, land tenure rights, and access to financial services, making it easier and encouraging miners to obtain licenses and operate legally. Achieving this, however, would warrant addressing underlying issues such as corruption, bureaucracy, and limited access to resources.	Chapter 6	Resistance from entrenched interests or bureaucratic inertia may impede efforts to reform existing licensing procedures and legal frameworks. Some states may simply lack the capacity to allocate sufficient budgets towards providing credit facilities to miners in support of licensing. Miners may be reluctant towards the licensing process due to lack of trust towards government.
3. Access to finance and markets	Facilitate access to finance and markets for ASGM through microfinance initiatives, investment schemes, and market linkages. To ensure that these initiatives reach vulnerable mining communities, initiatives and schemes should be designed considering the specific needs and realities of the ASGM communities.	Chapters 4, 5, and 6	Some states may lack the financial capacity to allocate adequate annual budgets towards providing sufficient finances and credit facilities to miners. ASGM activities are often perceived as high-risk by traditional financial institutions and may make it difficult for governments to convince them to offer loans or investment capital to miners plus miners may struggle to provide sufficient collateral for loans. Underdeveloped financial systems in some ASGM regions may hinder the availability of microfinance initiatives and investment schemes tailored to the needs of small-scale miners. Remote locations of ASGM operations may pose logistical challenges in accessing markets for selling mined minerals, limiting opportunities for market linkages. Regulatory barriers and bureaucratic hurdles may impede the establishment of microfinance initiatives and investment schemes tailored to ASGM needs.

Table 7.2 continued

Strategy	Description	Results chapters providing evidence in support of the strategies	Barriers and challenges to strategy implementation
4. Strengthen institutional coordination and ASGM integration	Develop and enforce regulations and policies that facilitate coordination among sectors and institutions, integrating ASGM into a broader developmental framework to promote sustainable economic growth, ensure environmental sustainability, and uphold fair labour practices.	Chapters 5 and 6	Resistance from vested interests, bureaucratic inertia, and conflicting agendas among stakeholders may obstruct efforts to develop and enforce regulations that integrate ASGM into broader developmental frameworks. Involvement of multiple stakeholders with varying interests, including miners, local communities, government agencies, and industry players, can complicate efforts to achieve consensus and coordination in policy development and implementation. Limited financial resources, technical expertise, and institutional capacity may pose challenges in effectively implementing and enforcing regulations related to ASGM.
5. Technical assistance and training	Provide regular technical assistance, training, and capacity-building programmes to improve mining techniques, safety practices, and environmental management in ASGM. Strategies to improve the design, implementation, and monitoring of capacity-building initiatives should be tailored to the specific needs and contexts of the ASGM operators and communities.	Chapters 4, 5 and 6	Many ASGM operations are in remote and difficult-to-reach areas, posing logistical challenges in delivering regular technical assistance and training programmes to miners. ASGM communities often experience high turnover rates among miners, making it challenging to provide continuous training and capacity-building programmes to a consistently changing workforce. Miners may be reluctant to adopt new mining techniques, safety practices, and environmental management measures due to entrenched traditional methods, lack of awareness, or perceived economic trade-offs. Inadequate support from government agencies, NGOs, and other institutions may impede efforts to sustainably implement and maintain technical assistance and training programmes in ASGM communities.
6. Community engagement and benefit-sharing	Involve miners, local communities, and traditional authorities in decision-making processes and ensure equitable sharing of mining benefits through community development projects and revenue-sharing schemes. Ensuring inclusive, transparent, and equitable processes is essential for achieving sustainability.	Chapters 4 and 5	Conflicting interests among stakeholders, including miners, local communities, government authorities, and mining companies, may hinder efforts to reach consensus on revenue-sharing schemes and community development projects. Miners, local communities, and traditional authorities may lack the capacity, resources, and expertise to effectively participate in decision-making processes and negotiate equitable sharing of mining benefits. Unequal distribution of power and influence among stakeholders may affect the interests of miners, local communities, and traditional authorities in decision-making processes related to mining activities.

Table 7.2 continued

Strategy	Description	Results chapters providing evidence in support of the strategies	Barriers and challenges to strategy implementation
7. Support for agriculture and alternative livelihoods	Invest in sustainable agricultural livelihoods and economic opportunities for ASGM communities to diversify local economies and promote the coexistence of ASGM with other livelihoods. However, this approach should be integrated with broader development strategies that address underlying social, economic, and environmental challenges faced by ASGM communities	Chapters 4 and 5	Inadequate infrastructure, such as irrigation systems, transportation networks, and market access, may impede agricultural development in ASGM communities, limiting the potential for diversifying local economies. ASGM communities may lack access to financial resources and credit facilities needed to invest in agricultural inputs, equipment, and technology, which can hinder the transition to sustainable agricultural livelihoods. Limited access to markets for agricultural products, due to remoteness or lack of market infrastructure, may constrain the economic viability of agricultural livelihoods in ASGM communities. Cultural norms, social structures, and community dynamics may influence the acceptance and adoption of coexistence of ASGM and agricultural livelihoods.
8. Promotion of responsible supply chains	Implement systems to track and certify responsibly sourced artisanal and small-scale gold, promote transparency and ethical practices in supply chains, and pay premiums to incentivise sustainable ASGM practices by miners. Considering the complexities involved, collaboration among stakeholders is crucial.	Chapter 6	Inadequate infrastructure, such as reliable internet connectivity and transportation networks, may hinder the establishment and operation of tracking and certification systems in remote ASGM areas. Due to vested interests of middlemen, ASGM gold may pass through multiple intermediaries before reaching the market, making it challenging to trace its origin and ensure transparency and ethical practices throughout the supply chain. Implementing tracking and certification systems requires significant financial resources and technical expertise, which may be prohibitive for ASGM stakeholders, particularly small-scale miners/traders. ASGM miners may not be interested to adopt tracking and certification and ethical practices, making it difficult to enforce compliance. Limited demand for responsibly sourced ASGM gold and reluctance among buyers to pay premiums for certified gold may undermine the economic incentives for miners to adopt sustainable practices. Building trust among stakeholders, including miners, buyers, and consumers, in the credibility and reliability of tracking and certification systems is essential but may be challenging due to historical distrust and scepticism.

Table 7.2 continued

Strategy	Description	Results chapters providing evidence in support of the strategies	Barriers and challenges to strategy implementation
9. Research and innovation in ASGM	Invest in research and collaboration to develop new technologies and best practices for sustainable ASGM, including alternative mining methods and environmental remediation.	Chapters 5 and 6.	Securing funding for research and collaborative initiatives in ASGM can be challenging, particularly in developing countries where resources may be scarce, and competing priorities exist. Engaging ASGM communities in research and collaborative efforts to develop sustainable practices is essential but may require building trust and addressing competing interests within the communities. ASGM operations vary widely in scale and geographic location, making it challenging to develop technologies and practices that are universally applicable and scalable across different contexts. Ensuring that new technologies and best practices are culturally appropriate, economically viable, and aligned with local priorities and traditions is essential for their successful implementation in ASGM communities.
10. International collaboration and support	Engage in international collaboration to share knowledge and resources and advocate for best practices for promoting sustainable ASGM development, including addressing migration challenges. However, initiatives should be contextually appropriate and sensitive to the needs and priorities of ASGM communities. Collaboration should be based on mutual respect, trust, and shared objectives for achieving sustainable development.	Chapters 4,5, and 6	Political tensions and conflicts between countries may hinder cooperation and collaboration on international initiatives for ASGM development, limiting opportunities for sharing knowledge and resources. Some countries may lack the institutional capacity and infrastructure to effectively engage in international collaboration and implement best practices for sustainable ASGM development. Limited financial resources and competing development priorities may constrain countries' ability to allocate funding for participation in international collaboration and capacity-building initiatives. Concerns about data security and intellectual property rights may impede the sharing of knowledge and information on ASGM practices and challenges, hindering collaborative efforts to address common issues. Variations in national priorities, policies and regulations governing ASGM can create barriers to harmonising best practices and standards across countries, complicating efforts to promote sustainable development.

			Competition for resources and market share in the global gold industry may create mistrust among stakeholders and hinder cooperation on international initiatives for ASGM development. Power imbalances between developed and developing countries, as well as between government authorities, mining companies, and local communities, may undermine efforts to ensure equitable participation and benefit-sharing in international collaboration on ASGM development.

7.5.2 Creating designated ASGM areas

Although the concept of ASGM zoning has been advocated (Corbett et al., 2017; Maconachie and Conteh, 2021; Nyame and Blocher, 2010) as a means to mitigate land degradation associated with unregulated ASGM, and minimise conflicts with other land uses, there is no consensus on how to implement it. Given the expanding ASGM sector and the need for effective creation of ASGM-designated areas, as shown by the results in Section 6.3.1.1 (also see Chapters 4 and 5), this thesis suggests that governments should consult and engage with all stakeholders, including relevant state agencies, traditional authorities, landowners, and small and large-scale miners, to ensure that their interests and concerns are considered in the designation process. A clear legal and regulatory framework that defines the criteria for designating ASGM areas needs to be developed, outlining the rights and responsibilities of stakeholders and establishing mechanisms for monitoring and enforcement. Governments must collaborate with relevant institutions to conduct thorough geological surveys and mapping on an ongoing basis to identify areas with significant gold deposits suitable for small-scale mining. This approach could greatly help address insecurity of tenure often faced by miners.

Geological surveys, despite their importance, come with inherent risks and challenges that must be addressed. In the case of Ghana, mining policies prohibit ASGM activities within forest reserves. Therefore, geological surveys would primarily focus on non-forest reserve areas, which are mainly customarily and privately owned lands. As a result, landowners and related stakeholders may resist or interfere with these survey efforts due to concerns about land ownership, access to resources, or perceived threats to their economic interests. This resistance can significantly hinder the progress of mapping initiatives. Addressing these risks requires careful planning and robust stakeholder engagement. Involving landowners, local communities, and relevant stakeholders from the outset can make it possible to acknowledge rights and interests, build trust, address concerns, and garner support for geological survey activities.

Creation of ASGM-designated areas requires setting aside funding on an annual basis for geological surveys. However, securing funding for these surveys presents a challenge for governments, given their inclination to prioritise large-scale mining activities. In the context

of Ghana, as would be the case in many SSA countries, the government is not heavily engaged in direct financing of large-scale mining activities. Private large-scale mining companies often bear the responsibility of financing exploration endeavours to identify and assess gold reserves, as well as fund the extraction processes. Nonetheless, without significant governmental efforts towards geological assessments and the designation of ASGM zones, realising the aspirations of sustainable ASGM practices will prove challenging to attain. Finally, governments should utilise zoning and land-use planning techniques to designate ASGM areas while minimising conflicts with other land uses, such as agriculture, conservation areas, water availability, infrastructure, rural-urban development, and proximity to communities. Achieving conflict minimisation requires adequate multi-sector impact assessments to be carried out.

7.5.3 Acquisition of mining plots

The desire of many customary landowners to gain direct benefits from mineral extraction has driven the growth of informal ASGM, as evidenced in Section 5.3.2.2. Governments must prioritise the consideration of customary land tenure rights and the interests of customary landowners in ASGM development processes. Involving landowners in the governance process can help reduce associated economic, social and environmental problems, such as lack of landowners' direct participation in gold revenue sharing, and land grabbing, by establishing agreed-upon processes for land access. Sharing ASGM benefits with landowners and customary authorities is critical for ensuring sustainable and equitable ASGM development within communities. Landowners and customary authorities can share ASGM benefits by encouraging them to engage in joint ventures with ASGM operators, partnering with formal miners to undertake mining activities, thereby sharing the profits generated. Landowners can also form cooperatives to undertake ASGM independently. Additionally, governments can facilitate revenue-sharing agreements between customary landowners and ASGM operators, ensuring that a portion of the revenue generated from ASGM activities is allocated to the community. The results from Section 5.3.2.3 indicate that miners currently exhibit inconsistencies in executing development projects within communities, and the funds allocated to traditional leaders by miners are not consistently directed towards community development initiatives. These agreements should encompass various economic benefits such as royalties, employment opportunities, infrastructure development, and social

programmes, contributing to local development. Negotiations should prioritise community benefit-sharing and be welcomed by mining associations, potentially mitigating the gold rush mentality associated with ASGM (Mkodzongi and Spiegel, 2019).

Furthermore, governments should promote the idea of large-scale mining companies engaging in contracts with ASGM miners, allowing ASGM miners to work on parts of concessions that are not economically viable for large-scale mining or are abandoned, without having to navigate the entire ASGM licensing process independently. In this model, ASGM miners would operate under mutually negotiated agreements and report to a large-scale company (see Chapter 4 for an example). While some scholars view this approach as untenable and short-sighted (Hilson et al., 2020), including it as one of the strategies to access mineable lands could alleviate pressure. Governments should ensure that contracts are designed to limit the risk of large-scale miners exploiting ASGM miners.

Involving local communities in decision-making processes and ensuring they receive a fair share of the benefits from mining activities can help alleviate poverty and improve livelihoods; reduce inequalities within and among communities; and contribute to building trust between mining companies, governments, and local communities, fostering for a more sustainable ASGM sector.

7.5.4 License acquisition for ASGM operations

Governments should streamline ASGM license application procedures by facilitating coordination among the relevant government agencies involved in the process, thereby reducing bureaucratic obstacles and paperwork. To optimise these efforts, governments should decentralise state agencies responsible for ASGM regulations and establish district-level offices equipped with knowledgeable personnel from various relevant agencies, such as mining, land, agriculture, environment, and local councils, to provide tailored support to diverse artisanal, and small-scale miners throughout the license acquisition process. This approach should prevent the sidelining of any pertinent state agency or department, as observed in this study in Chapter 5 regarding agriculture. Implementing an online application system where feasible can further streamline the process, enhance accessibility for miners, and provide transparency where applicants can track the progress of their applications. Training and capacity-building efforts may be necessary to ensure that governmental staff are

equipped to manage the new system effectively and to ensure that it is integrated with existing government databases and systems. With this approach, low literacy levels among miners should be considered, ensuring that adequate support is readily available for those who require assistance.

7.5.5 Financial access for developing ASGM operations

One of the critical factors essential to ensuring sustainability in ASGM is enhancing access to credit for licensed miners (Siwale and Siwale, 2017). Chapter 6 revealed the inadequacy of Ghana's mining policy concerning the funding of small-scale miners, as it fails to provide comprehensive strategies or explicit plans. It is imperative for governments to establish tailored funding models and allocate dedicated funds for ASGM that are accessible only to formal miners. Examples are cited from Namibia and Mozambique, where government funds have been successfully used to support ASM (Siegel and Veiga, 2009). This is critical considering that investors and funding firms are often hesitant to finance ventures that are not well established or not deemed commercially viable in the mining industry. The informal nature inherent in many ASGM operations presents significant apprehensions for banks regarding loan default. Unlike conventional mining companies that furnish banks with comprehensive geological studies and reserve projections as evidence of their ability to repay loans, the vast majority of those engaging in ASGM lack such geological information or reserve estimates. This absence of geological certainty poses a major risk for both miners and financial institutions. Addressing these funding challenges is crucial to improving productivity and promoting economic sustainability among miners.

In addition to providing funding options, governments should streamline ASGM processes and facilitate more individuals and institutions to appropriately participate or invest in ASGM through any of the following routes: individuals and institutions can obtain mining licenses and engage directly in ASGM, invest in established ASGM companies to become shareholders, invest capital in exchange for monetary returns with agreed interest rates, participate in metal streaming by investing a specific amount and receiving payment in gold bars, or offer ASGM support services such as hiring and maintenance of machinery.

Improved access to finance and markets can help lift ASGM miners and their communities out of poverty by providing opportunities for income generation and economic empowerment.

Better access to finance and formal markets can enable ASGM miners to invest in their operations, improve working conditions, support innovation and investment in infrastructure within the ASGM sector, and participate more fully in the economy. It is also imperative to improve financial management skills among miners to ensure prudent use of mining earnings for sustained advantages. All these are critical for promoting sustainable ASGM.

7.5.6 Partnerships for ASGM development

A significant way to promote sustainable mining among miners is to collaborate with relevant stakeholders to establish model mining centres, acting as training hubs for miners, focusing on sustainable mining methods. In 2018, the Ghanaian government provided sustainable mining training to 1300 small-scale miners at the University of Mines and Technology (UMaT, Tarkwa) to equip miners with the best practices in the industry. This step was taken in response to the increasing irresponsible practices of ASGM operators. Such training initiatives must be guided by policy frameworks that enable public institutions to collaborate with relevant private entities and ensure the provision of consistent and appropriate training opportunities for miners (Wireko-Gyebi et al., 2022). However, the findings in Chapter 6 indicate that currently the government has not established regular training opportunities for miners.

Ghana's mineral and mining laws require the establishment of district mining committees to oversee ASGM-related issues within districts. While this is a commendable practice that mineral-rich nations in the Global South should adopt, careful consideration must be given to the composition of these committees. Representation by key institutions across all sectors affected by mining activities is necessary to create transparent governance systems for ASGM. Miner associations, local customary authorities, landholders, and governmental bodies should be engaged in policymaking processes to decentralise ASGM governance across all relevant sectors. Evidence from Chapters 4, 5, and 6 indicate that this is not currently the situation. Decentralised structures, as observed in the Zimbabwean context, have proven more effective than centralised approaches (Spiegel, 2015). The responsibilities of these committees should encompass resolving civil complaints stemming from ASGM operations in communities. A carefully crafted district mining committee that is adequately resourced and empowered, with strong linkages to farmer groups, miner groups, and other community-

based associations, can help deal with the numerous economic, social and environmental challenges linked to ASGM.

There have been reports of the influx of migrant miners from other regions and neighbouring countries which impose additional strain on local resources and infrastructure, as shown in Chapters 4 and 5. This trend is prevalent across SSA (Siwale and Siwale, 2017). A way to address this issue requires governments working in tandem with neighbouring countries to tackle cross-border immigration challenges related to mining activities. This may involve intelligence sharing, coordinated border patrols, and joint initiatives to manage migration flow. This may pose challenges that need to be addressed, including diverse interests and priorities among nations, limited funding, international politics, and a lack of trust in sharing data. Enhancing border controls also requires effective collaboration among the mining sector, immigration and security agencies, and local governments to monitor and regulate the movement of individuals into areas with significant mining activities. Engaging and encouraging community members to report suspicious activities and providing them with the resources necessary to participate in enforcement efforts are essential. A key deterrent measure for governments is strengthening regulations and enforcing regular inspection mechanisms.

Partnerships offer valuable opportunities for ASGM miners to enhance their operations and adopt responsible practices. Governments can collaborate with international organisations, such as the Artisanal Gold Council, Better Gold Initiative, Planet Gold, and USAID, to provide technical support and training programmes. These initiatives can help miners develop business management skills, improve community relations, utilise clean technology, ensure worker safety, and adopt sustainable gold commercialisation practices. International collaboration can also play a pivotal role in building strong institutions within ASGM-participating countries, encouraging multi-stakeholder partnerships and robust support networks. Cooperation among governments, businesses, civil society, and international organisations can therefore strengthen governance frameworks and enhances sustainability efforts in the ASGM sector. Effective governance of the ASGM sector depends on strong institutional coordination, which requires cooperation among governments, regulatory agencies, civil society organisations, and the private sector.

Additionally, technical assistance and training programmes are essential to build ASGM miners' skills, improve capabilities in areas that can promote decent work conditions, support economic growth, and encourage industry innovation. This can also bring about resource efficiency and waste reduction, aligning ASGM operations with sustainable production patterns. Alongside technical assistance, research and innovation are also critical in advancing safer, more efficient mining technologies, supporting sustainable practices, and improving working conditions. By increasing productivity and reducing environmental impacts, research-driven advancements can stimulate economic growth while safeguarding miners and their communities.

7.5.7 Sustainable gold sourcing

Chapter 6 indicated a lack of robust governance framework for gold sourcing. To promote sustainable gold-sourcing practices, governments must collaborate with miners, licensed traders, other ASGM industry stakeholders, relevant state organisations, such as mineral departments and customs, and international bodies to establish and enforce robust regulatory frameworks. Public-private partnerships can enhance due diligence efforts by leveraging resources and expertise. These frameworks require individuals and companies involved in ASGM and gold trading to conduct due diligence along the supply chain and to identify and mitigate risks. Implementing transparent gold-sourcing systems and traceability initiatives can track gold from the mine to the market, and promote sustainable sourcing. Integrating government gold-buying offices into decentralised ASGM regulatory offices can facilitate easy access for miners to obtain fair prices, resources, and guidance on market information to effectively engage with formal market channels (Zvarivadza, 2018). Alternatively, governments can spearhead the establishment of mining banks that provide subsidised loans to formal miners and purchase gold directly from them at fair prices. These concerted efforts could strengthen formal gold-sourcing mechanisms, improve miners' access to legitimate buyers, and build trust in formal market processes. Enhancing transparency, reducing bureaucratic barriers, and offering incentives to transition away from informal markets are the key to developing a more sustainable ASGM sector.

Private gold-sourcing certification schemes, such as Fairmined and FairTrade Gold, introduced in regions such as Latin America, aim to offer miners competitive prices and incentives for

responsible mining practices (Martinez et al., 2023). However, the findings in Chapters 4 and 6 suggest that such initiatives alone may not fully achieve their goals, as many miners would struggle to meet the requirements. Scholars note that stringent certification standards of the schemes may only be attainable by medium-scale miners, leaving smaller and less organised miners unable to meet requirements (Hilson, 2014; Hilson et al., 2016). Ghana's current legal frameworks do not cater to the needs of various miners, making it difficult for them to acquire licenses and access funding to improve ASGM activities. To effectively promote responsible mining, close collaboration between private schemes and government efforts is crucial, providing funding, technical assistance, and incentives to miners. This approach could enable miners to operate under decent working conditions, generate profits, pay fair wages, adequately compensate landholders, contribute to community development, and conduct proper land reclamation.

Furthermore, designing appropriate taxation mechanisms for the ASGM sector is crucial for promoting compliance among miners, limiting informal gold sourcing and smuggling, and ensuring fair and sustainable revenue generation. Tax rates should consider the economic capacity of ASGM miners and the challenges that they face. Blanket tax rates may disproportionately burden small-scale miners. For instance, Ghana reduced the withholding tax on unprocessed gold to 1.5% to encourage compliance among ASGM miners, but this could be tailored such that rates for artisanal miners is lower than those for small-scale mining companies. For instance, countries such as Mongolia tax ASGM based on miners' status as independent workers. Taxation policies should be transparent, ensuring accountability in the collection and utilisation of revenue to build trust and encourage voluntary compliance among miners.

This study has emphasised that sustainable ASGM hinges on effective connections between mining operations and gold trading mechanisms. Updating and enforcing strict regulations to support transparent and responsible sourcing, along with incentivising compliance, can greatly enhance ASGM sustainability. This could also mean promoting responsible supply chains, which involves ensuring sustainable production and consumption patterns, reducing waste, and enhancing resource efficiency throughout the supply chain. Responsible supply chains often prioritise fair labour practices, providing decent working conditions and economic opportunities for workers involved in the production process. Responsible supply

chains can encourage innovation in production processes and infrastructure development to enhance sustainability and efficiency in the sector.

7.6 Scope for further research

This thesis recommends further research in five areas. First, this research delved into livelihood trajectories focusing on ASGM communities in new frontier areas. Subsequent research could expand this investigation to include both new frontier and established ASGM communities, comparing livelihood trajectories to identify any significant differences, if they exist, and examine the underlying reasons for any such disparities. Second, the thesis highlighted the importance of integrating landowners and traditional authorities into ASGM governance to promote sustainable ASGM development. Future research could focus on soliciting the perspectives of landowners and customary authorities regarding their interests and expected benefits from minerals extracted on their lands. This new insight can aid in devising nuanced benefit-sharing or compensation schemes embedded in collaborative ASGM governance structures. Third, this thesis emphasised the importance of creating ASGM zones/designated areas through thorough geological surveys to advance the cause of sustainable ASGM practices. Future research could focus on identifying and engaging with the diverse array of stakeholders essential to consult during the ASGM zone designation process. This research would seek to understand stakeholders' perspectives on the feasibility and outcomes of establishing such zones, along with analysing their rights, interests, concerns, and expectations. Such comprehensive research would deepen understanding of ASGM zoning dynamics, facilitating more informed decision-making processes. Fourth, the thesis has found inconsistency in government funding for the ASGM sector. Further studies are needed to delve deeper into the dynamics surrounding government funding of and support to ASGM. These investigations should aim to unravel existing processes or the lack thereof regarding governmental financial support. Understanding the current mechanisms, if any, is crucial in identifying gaps and areas for improvement. Uncovering the underlying challenges and complexities can enable policymakers and stakeholders to work towards establishing more robust and equitable funding mechanisms that support sustainable ASGM. Fifth, this study’s investigation into gold sourcing was confined to analysing the journey of gold from mine sites to urban centres and national hubs. Future research could broaden its scope to encompass

the intricacies of gold export sourcing processes. This could involve examining the establishment and operation of gold refineries within gold-producing countries and analysing the associated challenges. Understanding the dynamics of gold export sourcing processes is crucial for comprehensively assessing the global gold trade and its impacts. Exploring these aspects in further detail can provide valuable insights into the broader implications of gold trade and refining activities on local economies, environmental sustainability, and global supply chains. It can also inform policymakers, industry stakeholders, and communities about potential strategies to optimise the gold value chain while mitigating associated risks and challenges.

Chapter 8. Conclusion

ASGM is often recognised for its potential to contribute significantly to development. However, despite the sector's expansion, this potential remains largely untapped, as ASGM operations continue to remain largely informal. While many studies have considered the impact of ASGM activities on the environment and its socio-economic contribution, there remains inadequate understanding regarding the drivers of the sector's informality and the policies and governance strategies required to promote sustainable ASGM practices including their integration into broader development plans. Using Ghana as a case study, with a focus on agricultural communities that are newly engaged in mining, this thesis aimed to advance the understanding of the challenges to sustainable ASGM. Three objectives were set: i) to identify and analyse livelihood trajectories linked to ASGM in new frontier communities, with a view to informing policy interventions that support the development of sustainable rural livelihoods; ii) to investigate ASGM's impact on natural and physical livelihood capitals and interactions with agriculture, in order to understand the policy implications for positive co-existence of sustainable agriculture and ASGM; and iii) to examine Ghana's current legal and regulatory framework and analyse intersectoral policy coherence concerning ASGM governance, with a particular focus on formalisation.

Using a mixed method, multi-scale approach, this thesis employed field-based participatory research and consultative studies and document reviews. The study involved application of combined Sustainable Livelihoods Approach (SLA) and livelihood trajectories framework in objective one. The SLA was also applied in objective two, while the concept of policy coherence was applied in objective three. Fieldwork was conducted in the Atiwa West District, and Koforidua using environmental field surveys, transect walks, questionnaires, focus group discussions, and stakeholder interviews to address objectives one and two. Objective two also involved a review of policies and laws. Objective three was fulfilled through a review of laws, regulations, policies, and selected reports; qualitative document analysis for policy coherence investigation; and expert interviews. Questionnaire and field survey data were analysed using descriptive statistics and statistical test with thematic analysis of the interviews and focus group data. To address the research questions comprehensively, this study operated at multiple scales (household, community, and institutional) to investigate the intersections

between ASGM and agriculture within the SLA framework and examined cross-sectoral challenges across governmental levels (district, regional, and national). Despite its complexity, this approach facilitated insights across scales, illustrating how changes at one level impacted outcomes at other levels. By integrating insights from various scales, a holistic perspective was gained, aiding the identification of effective and contextually appropriate policy interventions. This multi-scale approach provides a robust framework for investigating complex social, institutional, and governance challenges associated with ASGM development and informing decision-making processes.

One of the key challenges revealed through this approach is the sector's persistent informality and its far-reaching consequences. Confining ASGM operators to the informal economy has given rise to an industry with a significant environmental footprint, coupled with working conditions that are often insecure, unsafe and resulting in unequal socio-economic impacts among local residents. Yet, as this thesis highlights, these issues stem primarily from informality itself. Failure of the government to make available adequate essential support services for permit holders means most miners are not motivated to become formalised.

By focusing narrowly on the "negatives" of ASGM, such as environmental degradation and unlicensed activity, and addressing these concerns with punitive measures, host governments fail to sufficiently appreciate the sector's substantial "positives," including wealth creation and employment opportunities. This approach does a disservice to citizens, especially in SSA, one of the world's most impoverished regions. Despite its current challenges, ASGM has the potential to serve as a critical platform for economic development, with minimal negative environmental and social impacts, if adequately supported and undertaken sustainably.

Transforming ASGM into a sustainable enterprise, one that effectively manages pollution, reclaims mined land, and addresses its social challenges, must begin with formalisation. Yet, as this thesis has discussed, formalisation remains elusive in SSA, with Ghana serving as a case in point. In Ghana, as in other parts of the region, limited recognition of landowners' and other stakeholders' interests, along with insufficient engagement in designating properly mineable ASGM areas, has resulted in inadequate land availability for miners. Combined with cumbersome bureaucratic licensing systems, these challenges have hindered ASGM miners from transitioning to the formal sector. This lack of formalisation is partly due to government

policies that prioritise mechanised, large-scale mining driven by foreign investment. It is also because policymakers and donors persistently attempt to reshape ASGM into something it is not, overlooking the unique characteristics of the sector and its operators.

Findings highlight a significant disconnect between the Government of Ghana's perception of ASGM, as a sector dominated by entrepreneurs, and the reality of an industry driven largely by poverty. The legal and policy frameworks reflect this disconnect, as evidenced by the use of the term "small-scale mining" while omitting "artisanal." This terminological choice underscores a lack of recognition of the realities of informal ASGM operations. Introduction of the Community Mining Scheme appears to be an attempt to bridge this gap, but its implementation faces numerous challenges, including unclear coordination of institutions, limited support structures, and inadequate stakeholder engagement.

Until this disconnect is addressed and more "operator-friendly" policies are implemented, informal ASGM activity will likely continue to grow unchecked, both in SSA and other developing regions. Promoting sustainable ASGM practices through formalisation is not merely a desirable policy goal but an essential step toward unlocking the sector's potential while mitigating its negative impacts. Properly formalised, ASGM could transition from a source of environmental degradation and informal labour into a model that balances economic growth with social and environmental responsibility.

8.1 The impacts of artisanal and small-scale gold mining on rural livelihood trajectories

Using an innovative integrated SLA and livelihood trajectories framework in a mixed quantitative and qualitative method assessment, this thesis has provided important insights into livelihood trajectories that emerge following ASGM emergence in new frontier communities. The findings presented in Chapter 4 illustrated that ASGM can provide broad positive livelihood outcomes and increased livelihood options. However, differential household capacities to respond to associated changes linked to ASGM's emergence result in differential trajectories — consolidating, fluctuating, and marginalised – reflecting the varied pathways followed by rural households. Some households were able to improve their livelihood trajectory but there were fewer desirable consequences for others, which can

amplify over time with interactions with concurrent developments and external socio-economic, political, and environmental factors. Findings show that ASGM is dynamic and connected to broader land uses that are likely to experience increasing change. This highlights the urgent need for well-targeted policies and sustainable livelihood strategies in farming communities where ASGM is emerging to provide effective linkages between rural livelihoods, agriculture, and mining and address any growing inequalities in livelihood trajectories posed by ASGM's emergence.

8.2 Joined-up governance for more complementary interactions between expanding artisanal small-scale gold mining and agriculture

In several SSA nations, the relationship between ASGM and agriculture has been established; however, opinions vary depending on whether it is complementary or competitive. Some scholars argue for complementarity (e.g., Chigumira, 2018; Hilson, 2016; Hilson and Garforth, 2012; Kamlongera, 2011; Maconachie, 2011; Mkodzongi and Spiegel, 2019; Okoh and Hilson, 2011), while others posit competition (e.g., ACET, 2017; Ferring et al., 2016; Hausermann et al., 2018; Snapir et al., 2017). Based on the sustainable livelihoods approach, Chapter 5, utilising a mixed-method multi-stage research design across the household, community, and institutional levels, revealed empirical evidence indicating the coexistence of both complementary and competitive relationships when ASGM intersects with agriculture. The findings characterise and explain the nature of ASGM's interactions with agriculture at the household, community, and institutional levels and the drivers underpinning those interactions.

The complementary relationship between ASGM and agriculture primarily benefits individuals and households. This finding is consistent with the existing literature, suggesting that ASGM enables livelihood diversification, leading to increased income opportunities for certain farmers in Ghana (Hilson and Garforth, 2013), Zimbabwe (Chigumira, 2018), and Malawi (Kamlongera, 2011). However, these studies provide limited insights into the specific characteristics of farmers that can exploit the potential of ASGM for livelihood and income generation. Evidence from Chapters 4 and 5 reveals that not all farmers can take advantage

of the alternative livelihood and income opportunities offered by ASGM. Many farmers are unable to do so because of factors such as age or lack of resources, including land and finances, whereas households with greater resources tend to benefit more. The physically demanding nature of ASGM operations limits engagement in it as a supplementary or alternative livelihood option for younger, more capable farmers. Conversely, elderly individuals may participate primarily as sponsors, requiring land ownership or financial means. Some farmers fitting this profile have been identified, possessing substantial cocoa farm acreages and social and institutional connections, including informal access to family lands that they can lease to ASGM miners. The economic benefits associated with ASGM are particularly advantageous for younger people, contributing to entrenched social differentiation based on factors such as age, occupation, and wealth. Notably, the construction of modern residences is a significant outcome for individuals engaged in ASGM and those receiving cash compensation for land sold for mining activities. However, favourable outcomes are more prevalent among the youth involved in small-scale mining activities.

The competitive relationship between ASGM and agriculture occurs primarily at the communal level, resulting in negative impacts within the community. Chapters 4 and 5 reveal the significant challenges related to accessing land, water, and labour for agriculture stemming from ASGM activities. These challenges include both voluntary and coercive dispossession of farmlands and leaving the land unreclaimed. Moreover, there is a notable migration of casual labour from farming to mining due to the economic incentives of the mining sector. Additionally, pollution and degradation of farmlands, water sources, and farm roads have severely affected food crop farming, particularly affecting vegetable farmers' ability to irrigate their crops. These findings are consistent with prior studies (Boadi et al., 2016; Hausermann et al., 2018), further reinforcing the negative externalities associated with ASGM-agriculture interactions.

Consequently, while ASGM generates short–term income at an individual and household scale for some, such benefits are outweighed by the long–term costs of ASGM at the community scale, linked to the aggregate degradation and loss of agricultural lands, pollution of waterways, and destruction of key communal physical assets without providing alternatives. The relationship between ASGM and agriculture is unsustainable, because

irresponsible itinerant ASGM creates tension between miners and farming communities, with miners generally not undertaking community development projects. This thesis identifies poverty, agricultural challenges, land tenure arrangements, the interests of landowners and traditional authorities, the mindset of miners and gold traders, ineffective government policies, lax law enforcement, and allegations of corrupt practices, including politicians, as crucial factors that influence the relationship between ASGM and agriculture. These factors drive informal ASGM operations, with farmers pursuing it. This finding aligns with those of other studies (Afriyie et al., 2016b; Hausermann et al., 2018; Hilson and Garforth, 2013, 2012; Hilson and Potter, 2003) emphasising the significance of both the immediate and underlying factors in shaping this relationship.

An analysis of the interactions between ASGM and agriculture at the institutional level revealed a lack of direct connections between them, irrespective of the interactions between ASGM and agriculture in communities. This highlights a systemic gap in governance and coordination, as these two sectors are not considered simultaneously. Despite the presence of independent government institutions in each sector at the district, regional, and national levels, their interrelations are not supported by regulations or policy directives. This indicates the clear absence of political determination to ensure effective coordination between the two sectors. This absence of institutional coordination, as detailed in Chapter 5, hinders efforts to address the adverse impacts of mining on agricultural land and communities, which can perpetuate the cycle of environmental degradation and socio-economic vulnerability. This absence of coordination could have broader implications, including ramifications for the sustainable development of rural livelihoods and outcomes related to food security. Without intervention, ASGM and agriculture are far from complementary rural poverty-reducing activities. Consequently, there is an urgent need for more joined–up governance both across the sectors and between formal and informal (traditional) institutions.

8.3 Artisanal and small-scale gold mining governance and cross-sectoral policy coherence

ASGM crosscuts multiple sectors, requiring an integrated approach to governance across its value chain. Empirical evidence in Chapter 6 provides an innovative policy coherence

assessment across mining-sensitive sectors (mining, agriculture, land, water, environment, and development) and examined the legal and regulatory framework across ASGM's value chain in framing sustainable ASGM actions. This approach provided useful insights and findings show a broad legal framework covering ASGM's value chain and linked sectoral institutions. However, some sections such as licensing processes have received more attention than other areas, such as the creation of designated areas and gold sourcing processes. The legal framework is detailed in terms of punitive measures towards ASGM operators for non-compliance. However, strategies for providing a supportive environment, including financial, technical, and related assistance, are inadequate and vague. Miners are required, as a matter of necessity to manoeuvre multiple governmental sectors and departments to acquire licenses and permits. Nonetheless, certifications are only provided at the national level and not at the district level, making the process complex across both horizontally and vertically. The legal framework considers all ASGM miners as one homogenous group, simply referring to the sector as 'small-scale mining'. Consequently, most artisanal miners with limited access to resources and networks are constrained to meet the legal requirements. The critical difficulty lies in effective and consistent implementation of laws and regulations. ASGM governance is not truly decentralised across the different sectors.

The findings also indicate that coherence between Ghana's mining policy and sectoral policies for agriculture, water, land, environment, and development is generally partial, causing limited intersectoral coordination and ineffective monitoring in ensuring sustainable practices along ASGM's value chain. Key challenges for policy coherence include a lack of political will to integrate ASGM governance into other sectors, highly siloed ministries/departments, deficient institutional distribution and networks, and inadequate resources for policy implementation across the mining-sensitive sectors. There is an urgent need for political actors to promote policy coherence across mining-sensitive sectors, where related institutions can consider the divergent interests of stakeholders and map out options, including trade-offs that ensure multiple sectoral collaborations to promote sustainable ASGM practices and development. Currently, there are few incentives to motivate miners to undertake sustainable mining to improve their livelihoods. Additionally, the associated risks of financial leakages and illicit financial flows in gold trading are not vigorously tackled due to existing ineffective due diligence checks and monitoring mechanisms. This thesis contributes to our broad

understanding of ASGM governance mechanisms by emphasising that legal reforms and policy coherence across ASGM-sensitive sectors are critical to achieving sustainable ASGM practices and development and to ensure that ASGM governance is integrated across all relevant sectors and institutional structures. Consequently, governments need to actively establish cross-sectoral planning processes through cross-ministerial structures, strengthen institutions to develop integrated ASGM governance, and boost policy coherence across national, regional, and district/local levels, as well as across sectors.

8.4 Academic contribution of thesis

As outlined in Chapter 1, sustainability in the mining sector is debated in the literature, with some scholars arguing that sustainability is incompatible with the mining sector due to the depletion of finite resources and significant social and environmental impacts (Parameswaran, 2016; Whitmore, 2006), while others argue that sustainability can be undertaken in mining (Jenkins and Yakovleva, 2006; Gorman and Dzombak, 2018), including in the ASGM sector (Hilson, 2002; Azapagic, 2004). Sustainable ASGM was defined as referring to practices, policies, and initiatives aimed at ensuring that ASGM activities contribute positively to economic development, social well-being, and environmental protection in a manner that can be maintained over the long term.

This thesis posits that ASGM can potentially be sustainable through the design and implementation of appropriate policies and governance strategies. This thesis is the first to bring together SLA, livelihood trajectories, policy coherence and formalisation to provide an in-depth understanding of the barriers and opportunities within ASGM, particularly informal ASGM, and to identify policies and governance strategies that offer potential to improve the sustainability of ASGM. This thesis advances the understanding of sustainable ASGM underscoring that this can be observed through key interconnected pathways: improved livelihoods, enhanced formalisation efforts, and strengthened policy coherence/linkages. In doing so, it identifies strategies within these pathways that address the sector's challenges and shows that improvements in these areas offer potential to jointly contribute to achieving sustainable development of ASGM (Chapter 7). These points are elaborated further below in reference to the three objectives underpinning this thesis.

First, by using a novel integrated SLA and livelihood trajectories framework in a mixed quantitative and qualitative method assessment, this thesis has provided important new insights into livelihood trajectories that emerge following ASGM emergence in new frontier communities. The impact of ASGM on different livelihood groups are unequal and results in varied livelihood trajectories, revealing the different factors that influence the different trajectories that evolve. Differential household capacities to respond to associated changes linked to ASGM's emergence result in differential trajectories — consolidating, fluctuating, and marginalised – reflecting the varied pathways followed by rural households. Some households were able to improve their livelihood trajectory but there were fewer desirable consequences for others, which can amplify over time with interactions with concurrent developments and external socio-economic, political, and environmental factors (Chapter 4). Although the literature has long recognised livelihoods as dynamic, a significant proportion of contemporary research has focused on examining livelihoods as an outcome, providing snapshots of the livelihood context (Baah-Ennumh et al., 2020; Pokorny et al., 2019) and neglecting how livelihoods are produced and evolve over time. The approach taken in this thesis reveals that ASGM is dominated by informal practices, which brings about inequitable impacts among various livelihoods groups in communities. This lack of equal distribution restricts inclusivity and hinders equitable development among different groups in the community, rendering the ASGM operations unsustainable. This thesis, therefore, argues that informal ASGM involving sophisticated methods, if left unregulated, is unlikely to support sustainable ASGM. This finding that ASGM impacts livelihood groups inequitably means marginalised households are most likely to face heightened vulnerability. However, understanding the diversity among ASGM actors, the evolving nature of livelihood activities, and the varied impacts of ASGM on livelihood groups is crucial in appreciating local nuances, and in guiding the formulation of appropriate, targeted policies that can address ASGM sustainability challenges. Sustainable ASGM should positively impact economic development, social well-being, and environmental protection for all livelihood groups, over the long term.

Second, existing literature shows that ASGM frequently intersects with agriculture in rural areas in complex ways that can be complementary or competitive (Mkodzongi and Spiegel, 2019; Pijpers, 2014). This thesis is the first to apply the SLA to examine ASGM and agriculture

interactions at household, community and institutional levels, and it finds that the complementary and competitive relationships are not mutually exclusive, and that both can occur simultaneously. This is a key novelty of the study, offering new perspectives on the interconnectedness between ASGM and agriculture. The findings reveal instances of mutual benefit at the household level, enabling resource sharing (e.g., land and labour) and diversification of income sources (Section 5.3.1). This aligns with existing literature, which shows beneficial interactions between ASGM and agriculture at the household level (Chigumira, 2018; Hilson, 2016; Hilson and Garforth, 2012; Kamlongera, 2011; Maconachie, 2011; Mkodzongi and Spiegel, 2019; Okoh and Hilson, 2011). For example, income from mining is often used to purchase fertilisers and invest in farm mechanisation (Hilson, 2016), supporting livelihood improvements among households engaged in both sectors. However, these positive household-level effects were undermined by long-term costs at the community level, such as the degradation of farmland, water resources, and forests. By applying the SLA, this thesis identified key factors driving unsustainable informal ASGM practices, particularly in new frontier areas, which include traditional customs, land tenure issues, financial struggles among farmers, negative attitudes of miners and gold traders, political influence, ineffective policies, and weak law enforcement.

At the institutional level, findings revealed a lack of institutional linkages between the ASGM and agricultural sectors. ASGM thus interacts with agriculture in communities but in governance the two are not considered simultaneously. Consequently, this thesis has shown that interactions between the two sectors have evolved informally without any purposeful policy interventions. As a result, any observed complementary relationship is fragile and transient, and the benefits of ASGM are insufficient to offset its associated long term harmful impacts. The finding shows that without intervention, ASGM and agriculture are far from complementary rural poverty-reducing activities, requiring more joined–up governance both across the sectors and between formal and informal (traditional) institutions. A key proposition of this thesis is that sustainable and mutually-beneficial interactions between agriculture and ASGM activities on the ground require interactive linkages among relevant state and non-state institutions within the agricultural, mining, as well as other key sectors such as land and local authority, functioning within an effective dynamic legal and regulatory setting to enforce responsible ASGM as well as sustainable agricultural activities.

The novel use of the SLA in a mixed-method, multi-scale approach in the thesis in studying the interactions between ASGM and agriculture across multiple levels thus adds value to the literature by unravelling the intricate interplay between socio-economic, environmental, institutional, and regulatory factors that shape the dynamics of the interactions. Gathering insights at different governance levels, alongside among different actors in the communities, helped to factor in and consider power relations that underpin resource utilisation, and which undermine sustainability in the ASGM sector. Informal ASGM overall does not interact well with agriculture and cannot bring about sustainable coexistence between the two livelihood activities. Sustainable ASGM should manifest in positive impacts on and positive coexistence with other livelihoods.

Third, while previous studies on formalisation have reviewed legal framework concerning ASGM (Adu-Baffour et al., 2021; Kumah, 2022; Hilson et al., 2021), these have largely been limited to licensing and/or mining processes. To the best of my knowledge, this thesis is the first to examine the legal framework targeting the value chain of the ASGM sector, focusing on: ASGM area designation, land acquisition, ASGM license acquisition, ore extraction and processing, gold trading, and mine closure and reclamation (Section 6.3). This thesis contributed a new angle to the ASGM formalisation challenges, revealing that the legal framework is insufficiently detailed across the various stages of the value chain and not consistently suited to operators' needs, posing implementation challenges (Section 6.4). By this approach of focusing on ASGM value chain, the thesis revealed deep systemic issues rather than the isolated challenges often stated in existing literature, emphasising that the persistent shortcomings of formalisation policies are rooted in complex and interrelated factors. It thus provided a useful backdrop to better understand the challenges to ASGM formalisation. This thesis contributes to the formalisation literature by revealing that identifying and addressing interconnected challenges in the ASGM sector, such as those within the value chain, is critical for overcoming systemic barriers to sustainable ASGM.

The novelty of this thesis also lies in exploring policy coherence across sectors predominantly impacted by ASGM activities. Existing studies have focused on reviewing regulations and policies within the ASGM sector (Adu-Baffour et al., 2021). The analysis of policy coherence between ASGM and other sectors sensitive to mining activities provides a deeper understanding of why informality persists despite formalisation efforts. Addressing ASGM

issues without considering its effects on other sectors that sustain rural livelihoods risks overlooking potential negative impacts on these activities. Effective ASGM governance requires integration across multiple sectors. This thesis highlights that understanding how ASGM policies interface with policies in mining-sensitive sectors (mining, land, agriculture, environment, water and development), is vital to enhancing ASGM formalisation outcomes, as well as promoting sustainable ASGM.

Findings indicated that coherence between Ghana's mining policy and sectoral policies for agriculture, water, land, environment, and development is generally 'partial'. Weak policy coherence is reflected in a lack of effective inter-sectoral coordination in ensuring sustainable practices along the ASGM value chain. The current legal framework and degree of policy coherence are inadequate for ensuring effective ASGM formalisation and need reform. Moreover, ASGM governance is not truly decentralised across the different sectors. Barriers such as lack of strong political will to push ASGM integration and policy coherence, lack of resources to run institutions, and limited office networks to efficiently implement laws and policies, mean there is incoherent policy implementation across the mining-sensitive sectors. While scholars have called for streamlined licensing in the mining sector at the district level (Adu-Baffour et al., 2021), this approach is insufficient. A key novelty of this thesis is the argument that streamlined licensing and permitting must extend across all agencies involved in ASGM. This thesis highlights that policy incoherence, characterised by weak institutional collaboration and inconsistent policy design and implementation, remains a major barrier to sustainable ASGM. As ASGM intersects with several government sectors, it requires coordinated cross-sectoral action to manage potential contradictions, conflicts of interest, and trade-offs, and to avoid duplication, and wasted resources.

8.5 Policy implications of the study

Collectively, the findings presented in this thesis (Chapters 4–6) have implications that need to be carefully considered by policymakers to promote sustainable development of ASGM in a way that supports sustainable rural livelihoods, facilitates harmonious coexistence between sustainable agriculture and ASGM, and integrates ASGM into broader development frameworks in Ghana and SSA more widely. Chapter 7 highlights the main policy options or strategies that were identified, including the following:

1. Creation of designated ASGM areas
2. Streamlining ASGM licensing
3. Access to finance and markets
4. Strengthening institutional coordination and ASGM integration
5. Provision of technical assistance and training
6. Community engagement and benefit-sharing
7. Support for agriculture and alternative livelihoods
8. Promoting responsible supply chains
9. Research and innovation
10. International collaboration and support

In Ghana, these recommendations should be initiated through the Minerals Commission, serving as a focal point within the Ministry of Lands and Natural Resources, and fostering close collaboration with other pertinent departments and ministries, such as the Lands Commission, Environmental Protection Agency, Water Resources Commission, and essential non-state institutions, such as traditional councils. Furthermore, these recommendations should be ingrained within relevant ministries, including the Ministry of Food and Agriculture, the Ministry of Finance, and the Ministry of Local Government and Rural Development. To ensure seamless integration into the national developmental agenda, it is advisable for the Ministry of Lands and Natural Resources to receive support from the National Development Planning Commission. These recommendations also have broader significance and applicability within the SSA context, wherein governments can encourage comparable departments and ministries in other SSA nations to collaborate and coordinate efforts to undertake the recommendations. This collaborative approach can contribute to advancing sustainable development of ASGM across the SSA region.

While the findings and recommendations presented in this thesis hold broader relevance, it is imperative to not overlook the socio-cultural context in which the study was conducted. Consequently, caution is warranted when extrapolating the findings and policy recommendations given the diverse contextual factors influencing ASGM livelihoods globally. For instance, the prevalence of customary land tenure systems in Ghana, where the majority of land is owned and administered traditionally, mirrors the situation in many other SSA countries (Maconachie and Conteh, 2021; Mensah, 2021). Therefore, recommendations

advocating for government collaboration with customary landowners in establishing ASGM zones possess wider applicability within the SSA context. Nevertheless, this recommendation may require adjustments in jurisdictions where the government predominantly owns land. Consequently, when assessing the suitability of these recommendations in other jurisdictions, especially beyond SSA, thorough consideration of existing socio-economic, cultural, and regulatory frameworks becomes imperative.

8.6 Concluding remarks

Overall, this thesis contributes significantly to the understanding of the complex dynamics surrounding the development of ASGM. By delving into the intricate interaction of various drivers, actors, and institutions, it offers valuable insights into the complexities inherent in ensuring sustainability within this sector. In effect, this thesis argues that establishing a comprehensive formalisation approach for sustainable ASGM should be viewed as a long-term and dynamic process, one that adjusts to the changing realities faced by miners and communities. It requires the coordinated support and collaboration from stakeholders at all levels including governments, companies, and donors, to promote responsible practices and sustainable livelihoods for miners by addressing the economic, social, and environmental aspects of mining. It should evolve from legal compliance to empowering miners to transition into responsible, regulated, and profitable ASGM-based enterprises across the value chain. By offering tangible incentives to miners and gold traders, such as access to financial support, technical assistance, and market opportunities, authorities can encourage compliance with legal frameworks and regulatory standards while promoting sustainable mining practices. Furthermore, focussing on policy coherence for effective institutional coordination and stakeholder engagement should be a critical component of a holistic governance framework for the ASGM industry. By involving a diverse array of stakeholders including miners, local communities, non-state institutions, government agencies, and private sector actors, in decision-making processes, policymakers can ensure that the interests and concerns of all parties are adequately considered and addressed. This inclusive approach fosters mutual trust, promotes transparency, and facilitates the co-creation of sustainable ASGM strategies that prioritise sustainable livelihoods and safeguard the interests of local communities and the environment. A coordinated and holistic approach to ASGM formalisation can promote

the integration of ASGM within broader developmental objectives, which has the potential to strengthen agriculture, diversify rural livelihoods, and expand livelihood options for local communities, ensuring that ASGM contributes positively to local and regional development.

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Appendices

Appendix A: Chapter 3

Appendix A1. Household questionnaire, alongside Participant information sheet, Consent form, and Privacy Notice

PARTICIPANT INFORMATION SHEET AND PRIVACY NOTICE

My name is Enoch Adranyi, and I am a PhD research student at the University of York, UK, working on a project entitled 'Implications of artisanal and small-scale gold mining on agriculture and rural livelihoods in Ghana'. I am interested in learning about farming and mining in your village and how these activities affect local livelihoods.

You have been randomly selected to participate in a survey if you wish to be involved.
Your data will be anonymised and no personal information that allows you to be identified will be processed as part of the research. This helps us to keep information confidential. Before the survey I will ask your consent to participate. If you decide you want to be involved in the research, you will not be paid or compensated, and the survey will last for around 45 minutes.

At the end of the survey, I will ask if you are willing to take part in a follow-up interview at which point, I will ask for your name and phone number. This is only to allow me to contact you later and will not be analysed as part of the research. Once data collection has been completed in your village, your name and phone numbers will be deleted. We are therefore caring for your personal data as carefully as we would be required to do so in the UK. Your responses in any follow up data collection will also be anonymised.

Any data you provide will be accessible to only me and my supervisors. The data will be analysed and presented in a PhD thesis and related publications. All data collected will be deleted five years after the final publication.

My university also requires me to tell you a bit more about what happens to your data, how it will be handled, and any other rights. Do you want me to read out these to you?

Yes ☐ No, I'm ok ☐

If you have any questions regarding the project, you are encouraged to ask them before the survey starts. Afterwards, if you have further questions or concerns about your participation, please contact the researcher (Enoch Adranyi) whose details are on the contact card you are provided with.

Thank you for taking part in this project.

Please complete this consent form (can be done by the researcher where verbal responses provided):

I/we have received and read the Participant Information Sheet, or got it explained to me/us. ☐

I understand my/our participation [household] in the interview is entirely voluntary and I/we understand that I/we am/are free to withdraw at any stage of the survey whiles the research is being carried out in this village. ☐

I/we give permission for the researcher to take photos, videos and audio recordings and use them in the project. ☐

I/we understand that data files from interviews will be kept for 5 years following the final publication of the work. ☐

I/we understand that data will be anonymised and that I/we will not be identifiable in any written reports unless I/we choose to do so. ☐

I/we give consent for the anonymised and analysed data to be used in publications, including in both print and electronic format. ☐

I have had the chance to ask questions about my participation in the study and the ☐

answers provided have addressed any concerns.

I understand that my name and telephone number will not be analysed as part of the research a ☐ that it will be deleted once data collection is complete in my village

Please note that a decision to withdraw or not to take part will not affect participation in future studies.

I have read or have had someone read all of the above, asked questions, received answers regarding participation in this study, and I verbally give consent for me to participate in this study. I have not waived any of my rights. ☐

Start of Block: Consent form

Skip To: Survey reference If PARTICIPANT INFORMATION SHEET My name is Enoch Adranyi, and I am a PhD research student at the U... = Yes, I/we consent

Skip To: End of Survey If PARTICIPANT INFORMATION SHEET My name is Enoch Adranyi, and I am a PhD research student at the U... = No, I/we do not consent

Survey reference Please key this survey's reference (NB: reference is made up of enumerator's first name's initial+village's name initial+rank of the survey)

_____

End of Block: Consent form

Start of Block: Demographics

Q1 What is your gender?

- ○ Male (13)
- ○ Female (14)
- ○ Prefer not to say (16)

Q2 Please indicate your age category from the options below. All interviewees must be 18 years or above

- ○ 18-24 (1)
- ○ 25-34 (2)
- ○ 35-44 (3)
- ○ 45-54 (4)
- ○ 55-64 (5)
- ○ 65-74 (6)
- ○ 75 or older (7)

Q3 How long (in years) have you lived in this community?

_____

Q4 Are you local or do you come from somewhere else?

- ○ Indigene (1)
- ○ Migrant (state home region/country below) (2)

_____

- ○ Other (3)

Q5 How would you describe the status of your home?

- Own (1)
- Renting - Private tenant (2)
- Family home (3)
- Other (4)
- Prefer not to say (5)

Q6 Which type of house do you live in?

- house roofed with zinc/aluminium sheets or slate (1)
- house roofed with thatch or related material. (2)

Q7 How would you describe your marital status?

- Single (1)
- Married (2)
- Divorced (3)
- Separated (4)
- Co-habiting/Partner (5)
- Widowed (6)

Q8 Are you the head of the household (household is defined by those who eat from the same pot)?

- No (1)
- Yes (2)

Skip To: Q10 If Are you the head of the household (household is defined by those who eat from the same pot)? = Yes

Q9 If no, who is the head of the household?

- ○ Husband/male partner (1)
- ○ Wife/female partner (2)
- ○ Other (specify) (3) _____
- ○ not applicable (4)

Q10 Where is the head of the household permanently residing (> 50% of the time)?

- ○ In this village/With me (1)
- ○ Another village (2)
- ○ Another town/city (3)
- ○ Another country (4)

Q11 What is the highest level of education completed by the household head?

- ○ None (1)
- ○ Primary school (2)
- ○ Junior high school (middle school) (3)
- ○ Senior High school/A-level (4)
- ○ Other vocational/technical training college (5)
- ○ Bachelor's degree or equivalent (6)
- ○ Higher degree or equivalent (7)
- ○ Other (e.g., non-formal education) (8)

Q12 How many people currently live in your household?

- ☐ Male adults (>18years) (1) _____
- ☐ Female adults (>18 years) (2) _____
- ☐ Male children (< 18 years) (3) _____
- ☐ Female children ((4) _____
- ☐ Total (5) _____

End of Block: Demographics

Start of Block: Wealth ranking

Q13 Which of the following sources do your household engaged in as means of making a living? Please assign percentage income to each of the activities you undertake.

☐ Cash crop cultivation (e.g., cocoa, oil palm, citrus) (1)
_____

☐ Arable crop cultivation (e.g., maize, plantain, cassava, vegetable, etc) (2)
_____

☐ Livestock (3) _____

☐ Forest resource exploitation (non-timber - e.g., hunting, harvesting of leaves, climbers & others) (4) _____

☐ Gold Mining (small-scale) (5)
_____

☐ Other small-scale mining (diamond, kaolin, sand, aggregates, etc) (6)
_____

☐ Professional (large-scale mining employee, clerical officer, teacher/gov't worker, religious worker, etc) (7) _____

☐ Waged labour (e.g. farm employee, aquaculture employee, construction labourer, other) (8) _____

☐ Industry (e.g manufacturing /processing, e.g., saw milling, basket weaving, wood carving, corn milling, palm oil produce, etc) (9)
_____

☐ Trading in agricultural produce (cocoa buyer, other farm produce, fish etc) (10)
_____

☐ Service (e.g. shop, taxi/driver, food vending/ restaurant, rental, artisanship etc.) (11)
_____

☐ Fishing (from natural waters) (12)
_____

☐ Aquaculture (pond owner) (13)
_____

☐ Retiree on pension (14)

☐ Migration/remittances (15)

☐ Other (16) _____

Q14 How many of the following items did your household own or harvested in the previous agricultural season?

- ☐ bag of cocoa (1) _____
- ☐ bag of oil palm (2) _____
- ☐ bag of citrus/orange (3) _____
- ☐ bag of cashew (4) _____
- ☐ bag of maize (5) _____
- ☐ bag of plantain (6) _____
- ☐ bag of cassava (7) _____
- ☐ bag of yam (8) _____
- ☐ bag of rice (9) _____
- ☐ bag of cocoyam (10) _____
- ☐ bag of beans (11) _____
- ☐ Pineapple (12) _____
- ☐ bag of vegetable (13) _____
- ☐ bag of fruit (14) _____
- ☐ Cattle (15) _____
- ☐ Sheep and goat (16) _____
- ☐ poultry (17) _____
- ☐ other (18) _____

Q15 Could you please answer yes or no to whether you own any of the following items?

	Click to write Column 1	
	Yes (1)	No (2)
TV (1)	○	○
Radio (2)	○	○
Mobile phone (3)	○	○
Internet in the home (4)	○	○
Car/truck (5)	○	○
Motorbike/motor tricycle (6)	○	○
Bicycle (7)	○	○
Motor boat (8)	○	○
Manual boat (9)	○	○
Crop sprayer (10)	○	○
Other (11)	○	○

Q16 Which of the items do you need in order to pursue your activity that generates the most income?

- [ ] TV (1)
- [ ] Radio (2)
- [ ] Mobile phone (3)
- [ ] Internet in the home (4)
- [ ] Car/truck (5)
- [ ] Motorbike/motor tricycle (6)
- [ ] Bicycle (7)
- [ ] Motor boat (8)
- [ ] Manual boat (9)
- [ ] Crop sprayer (10)
- [ ] Other (11)

Q17 How easy it is to feed your household and provide educational support?
Very easy =1, to very difficult = 5

- ○ very easy (1)
- ○ somewhat easy (2)
- ○ moderate (3)
- ○ somewhat difficult (4)
- ○ very difficult (5)

Q18 In the event where a member of your household requires hospital treatment how easily could you arrange transport and other resources needed to care for the member? Very easy =1 to very difficult = 5

- ○ Very easy (1)
- ○ somewhat easy (2)
- ○ moderate (3)
- ○ somewhat difficult (4)
- ○ very difficult (5)

End of Block: Wealth ranking

Start of Block: Main content

Q19 If you are a farmer, which type of farming do you mainly practice? If not, please move to 33.

- ○ arable cropping (1)
- ○ cash cropping (2)
- ○ both (arable & cash) (3)
- ○ livestock (4)
- ○ mixed (livestock & crop) (5)
- ○ Other (6) _____
- ○ Not applicable (7)

Skip To: Q33 If If you are a farmer, which type of farming do you mainly practice? If not, please move to 33. = Not applicable

Q20 How long have you been engaged in farming?

- ○ <2 years (1)
- ○ 2-5 years (2)
- ○ 6-10 years (3)
- ○ 11-20 years (4)
- ○ >20 years (5)

Q21 What kind of tenure arrangement do you hold over the farmland? Select all that apply.

- ☐ owner (inherited) (1)
- ☐ owner (private purchase) (2)
- ☐ owner (gifted) (3)
- ☐ rented (4)
- ☐ share cropping (5)
- ☐ caretaker (6)
- ☐ other (7) _____

Q22 What is the size of the farmland your household regularly cultivate (average cultivated land for the past 3 years in acres)?

- [ ] Arable crop (1) _____
- [ ] Cash crop (2) _____
- [ ] Both (cash and food) (3) _____
- [ ] Livestock (4) _____

Q23 If you are into cash crop farming, how many acres of land do your household cultivate for any of the following crops? Please key actual figure and select correct range too.

- [ ] Cocoa (1) _____
- [ ] oil palm (2) _____
- [ ] citrus (3) _____
- [ ] rubber (4) _____
- [ ] other (5) _____

Q24 Do you engage the services of paid labourers on your farm(s)?

- ○ No (1)
- ○ Yes (2)

Q25a Do you have access to credit or loans for your agricultural activities?

- ○ No (1)
- ○ Yes (2)

Skip To: Q26 If Do you have access to credit or loans for your agricultural activities? = No

Q25b If yes, from which source(s)?

- ☐ 1. Private enterprise (1)
- ☐ 2. Bank (2)
- ☐ 3. Government (3)
- ☐ 4. Non-governmental organisation (4)
- ☐ 5. Community-based organisation (5)
- ☐ 6. Family/friend (6)
- ☐ 7. other (7) _____

Q26 Has your farmland ever been degraded or lost through ASGM activity? If no, please go to question 31.

- ○ No (1)
- ○ Yes (2)

Skip To: Q31 If Has your farmland ever been degraded or lost through ASGM activity? If no, please go to question 31. = No

Q27 If yes, what is the approximate size of farmland that was degraded through ASGM?

- [ ] arable crop (1) _____
- [ ] cash crop (2) _____
- [ ] both (cash & arable) (3) _____
- [ ] fallow field (4) _____
- [ ] livestock (5) _____
- [ ] other (6) _____

Q28 If you are into cash crop farming, how many acres of land was approximately degraded through ASGM activities? Please select as many as applicable

- [ ] Cocoa (1) _____
- [ ] oil palm (2) _____
- [ ] citrus (3) _____
- [ ] rubber (4) _____
- [ ] other (5) _____

Q29 How did the miners acquire your farmland?

- [ ] purchase from farmer (1)
- [ ] purchase from landowner (2)
- [ ] resource exchange/barter trade (3)
- [ ] forceful access/invasion (4)
- [ ] other (5) _____

Q30 How has your farmland been affected? (select as many as applicable)

- [ ] Loss of farmland resulting from actual mining (1)
- [ ] Degraded portions due to informal routes created by miners (2)
- [ ] Degraded portions due to temporal accommodation pitched by miners (3)
- [ ] Overflow of polluted water into farmland (4)
- [ ] Destruction of crops (5)
- [ ] forceful harvesting of crops for use by miners (6)
- [ ] Other (7) _____

Q31 In your estimation, to what extent has ASGM impacted your access to farm labour? Please state in percentage.

- ○ increased by (1) _____
- ○ decreased by (2) _____
- ○ no change (3)
- ○ not sure (4)

Q32 To what extent has the cost of hiring farm labourers changed due to the rise of ASGM? Please state in percentage.

- ○ increased by (1) _____
- ○ decreased by (2) _____
- ○ no change (3)
- ○ not sure (4)

Q33 How has the price of food been impacted since the rise of ASGM began? Please state in percentage.

- ○ increased by (1) _____
- ○ decreased by (2) _____
- ○ no change (3)
- ○ not sure (4)

Q34 Do you encounter any problem in terms of the following due to ASGM activities and at what level of impact? 1 = very low impact, 5 = very high. select all that is applicable. (Please select one option per line).

	Very low (1)	Low (2)	Medium (3)	high (4)	Very high (5)
Conflicts with landowners (1)	○	○	○	○	○
cost of input equipment/chemicals/Seeds (2)	○	○	○	○	○
Poor accessibility of roads to farm (3)	○	○	○	○	○
Conflicts with ASGM miners (4)	○	○	○	○	○

Q35 How would you score the importance of each of these factors in terms of their influence on conflicts between agriculture and ASGM? 1 = very low influence, 5 = very high. (Please select one option per line).

	Very low (1)	Low (2)	Medium (3)	High (4)	Very high (5)
Leadership issues in the community (1)	○	○	○	○	○
Land tenure systems/arrangements (2)	○	○	○	○	○
Behaviour of landowners (3)	○	○	○	○	○
Attitudes of the small-scale miners (4)	○	○	○	○	○
Behaviour and influence of politicians (5)	○	○	○	○	○
Behaviour of gold traders/ 'middlemen' (6)	○	○	○	○	○
Lack of support from local assembly &government agencies (8)	○	○	○	○	○
Ways mining policies are being implemented (10)	○	○	○	○	○

Q36 If applicable, how many members of your household undertake ASGM activities, what are their ages and how long have they been involved? If not applicable, please move to 45.

- [ ] <18 (1) _____
- [ ] 18-30 (2) _____
- [ ] 31-40 (3) _____
- [ ] 41-50 (4) _____
- [ ] >51 (5) _____
- [ ] Not applicable (6)

Skip To: Q45 If If applicable, how many members of your household undertake ASGM activities, what are their ages... = Not applicable

Q37 In which manner is the ASGM operation carried out?

- [ ] ASGM only on permanent basis (1)
- [ ] ASGM mainly with some farming elsewhere (2)
- [ ] Shifts between farming and ASGM seasonally in the community (3)
- [ ] Just as investor (do not physically take part) (4)
- [ ] other (5)

Q38 If you are into mining on permanent basis, what was your previous job?

- ○ farming related activities (1)
- ○ non-farm activities (2)
- ○ Not applicable (3)

Q39 If applicable, which ways do you get access to credit/loans for your mining activities?

- [ ] family/friends (1)
- [ ] bank/other financial institutions (2)
- [ ] private persons in ASGM/'middlemen' (3)
- [ ] private business (4)
- [ ] NGOs (5)
- [ ] community-based organisations (6)
- [ ] other (7)
- [ ] not applicable (8)

Q40 How easy is it for miners to acquire requisite lands for ASGM activities in your community? 1 = very easy, 5 = very difficult.

- ○ very easy (1)
- ○ Somewhat easy (2)
- ○ moderate (3)
- ○ Somewhat difficult (4)
- ○ very difficult (5)

Q41 Approximately how much revenue (gross income) does your household generate from ASGM each year?

- ○ revenue (1) _____

Q42 What factors influence miners not to reclaim mine sites or be environmentally compliant? (not at all = 1 to very high = 5) (Please select more than one if applicable).

	Not at all (1)	Low (2)	Moderate (3)	High (4)	Very high (5)
Money (cost) (1)	○	○	○	○	○
Time and effort (2)	○	○	○	○	○
Lack of abilities/skills (3)	○	○	○	○	○
Lack of knowledge/awareness (4)	○	○	○	○	○
Attitudinal issues (bad mindset) (5)	○	○	○	○	○
Other (6)	○	○	○	○	○

Q43 About what percentage of your household ASGM earnings is used to support farming each year?

_____

Q44 How much of your household farming revenue, if any, is used to boost ASGM activities in each year? please provide the percentage.

_____

Q45 How willing are you to hire or sell your farmland to ASGM entrepreneurs, because of the monetary proceeds?

- ○ Not at all (1)
- ○ Uncertain (2)
- ○ Somewhat willing (3)
- ○ Willing (4)
- ○ Very willing (5)

Q46 Have you ever had your land reclaimed properly after ASGM activity?

- ○ No (1)
- ○ Yes (2)
- ○ Not applicable (3)

Skip To: Q49 If Have you ever had your land reclaimed properly after ASGM activity? = No

Q47 When mine sites are properly reclaimed, what effects do they have on agriculture production afterwards?

- ○ enhance productivity (1)
- ○ decrease productivity (2)
- ○ no change (3)
- ○ not sure (4)
- ○ not applicable (5)

Q48 How would you score the importance of each of these factors in terms of their influence on co-existence between agriculture and ASGM? 1 = very low, 5 = very high. (Please select one option per line).

	Very low (1)	Low (2)	Medium (3)	High (4)	Very high (5)
Leadership in the community (1)	○	○	○	○	○
Land tenure arrangements (2)	○	○	○	○	○
Positive attitude of landowners (3)	○	○	○	○	○
Positive attitudes of the miners (4)	○	○	○	○	○
Behaviour and influence of politicians (5)	○	○	○	○	○
Support from local assembly & government agencies (7)	○	○	○	○	○
Support from gold traders (8)	○	○	○	○	○
Ways policies are being implemented (10)	○	○	○	○	○
other (11)	○	○	○	○	○

Q49 How would you estimate the overall impact of ASGM on the way your household make a living? (a lot less = 1; to a lot more = 5)

- ○ A lot less (1)
- ○ A little less (2)
- ○ No change (3)
- ○ A little more (4)
- ○ A lot more (5)

Q50 Overall, what level of impact has ASGM activities had on availability of markets/economic activities to your household?

- ○ A lot less (1)
- ○ A little less (2)
- ○ No change (3)
- ○ A little more (4)
- ○ A lot more (5)

Q51 If applicable, to what extent have ASGM's revenue enabled you to support education needs of your household? (not at all = 1; very high = 5) Select all that apply.

	Not applicable (1)	Low (2)	Moderate (3)	High (4)	Very high (5)
primary education (1)	○	○	○	○	○
secondary education (2)	○	○	○	○	○
tertiary education (3)	○	○	○	○	○

Q52 Have your household members acquired any new skills or knowledge as a result of the surge in small-scale gold mining activities?

- ○ No (1)
- ○ Yes (2)

Q53 To what extent have ASGM's revenue enabled you to cater for the health needs of your household? (not at all = 1; very high = 5)

- ○ Not applicable (1)
- ○ Low (2)
- ○ Moderate (3)
- ○ High (4)
- ○ Very high (5)

Q54 Which ways have ASGM activities affected the health conditions of your household? Select all that apply.

- [ ] headaches (1)
- [ ] fever (2)
- [ ] malaria (3)
- [ ] respiratory diseases/coughs (4)
- [ ] skin rashes (5)
- [ ] kidney failure (6)
- [ ] other (7) _____
- [ ] none (8)

Q55 Which of the following assets have you acquired as a result of significant contribution from ASGM income (more than 50% of the cost was covered by ASGM income)? Select all that apply.

- ☐ TV (1)
- ☐ Radio (2)
- ☐ Mobile phone (3)
- ☐ shop (4)
- ☐ Car/truck/van (5)
- ☐ Motorbike/motor tricycle (6)
- ☐ Bicycle (7)
- ☐ Motor boat (8)
- ☐ Manual boat (9)
- ☐ House (10)
- ☐ Land for building (11)
- ☐ farmland (12)
- ☐ Other (13) _____

Q56 To what extent has the rise of ASGM impacted your participation in any of the following associations or networks? A lot less=1, a lot more=5

	A lot less (1)	A little less (2)	No change (3)	A little more (4)	A lot more (5)
Farmer association (1)	○	○	○	○	○
Local mining association (2)	○	○	○	○	○
Local traders/artisans/service providers association (5)	○	○	○	○	○
Faith based organisation (6)	○	○	○	○	○
Community social support group (7)	○	○	○	○	○
Community-based NGOs (8)	○	○	○	○	○
Other (10)	○	○	○	○	○

Q57 What kind(s) of non-farm livelihood activities have you begun or plan to start as a result of ASGM surge in your community?

- [ ] Transport (1)
- [ ] Food vending (2)
- [ ] Trading – selling of physical items (3)
- [ ] Finance/lending (4)
- [ ] Communication/mobile phone services (5)
- [ ] Artisanship – mason, woodwork & carving, welding, steel bender (6)
- [ ] Real estate/renting houses (7)
- [ ] Other (8) _____
- [ ] none (9)

Q58 How confident are you that your household are able to keep ASGM miners away from mining your farmland? 1= not at all; 5 = very confident.

- ○ Not at all confident (1)
- ○ Not confident (2)
- ○ Somewhat confident (3)
- ○ Confident (4)
- ○ Very confident (5)

Q59 If you have been or were to be affected by ASGM e.g., through farm invasion, how likely are you to get support through the following association and networks? 1 = not at all; 5= very high.

	Not at all (1)	Low (2)	Medium (3)	High (4)	Very high (5)
Family and friends (1)	○	○	○	○	○
Farmer association (2)	○	○	○	○	○
Local mining association (3)	○	○	○	○	○
Local traders/artisans/service providers association (5)	○	○	○	○	○
Faith based organisation (6)	○	○	○	○	○
Community social support association (7)	○	○	○	○	○
Local traditional council (9)	○	○	○	○	○
Local district assembly/other Government agencies (10)	○	○	○	○	○
International NGOs (12)	○	○	○	○	○

Q60 For those undertaking mining activities only: how willing are you, under the following circumstances, to undertake measures to ensure responsible mining (Select more than one if applicable) (not at all = 1; very willing = 5)

	Not at all (1)	Uncertain (2)	Somewhat willing (3)	Willing (4)	Very willing (5)
If my colleagues were doing the same (1)	○	○	○	○	○
If there was a subsidy or incentive (2)	○	○	○	○	○
If legal requirements were being enforced (3)	○	○	○	○	○
if existing legal requirements were modified to suit our circumstances (4)	○	○	○	○	○
If my household was to be badly impacted by ASGM in the future (5)	○	○	○	○	○
If it would reduce the interest rates of the credits I take (6)	○	○	○	○	○

Q61 What changes will you like to see regarding the ASGM activities in your community?

- ○ No change/do nothing (1)
- ○ stopped outright (2)
- ○ progressively replaced with alternative livelihoods (3)
- ○ Kept but modified to co-exist with other livelihood options (4)
- ○ other (5) _____

Q62 Are you willing to participate in future aspects of the research and provide your contact details?

- ○ No (1)
- ○ Yes (2)

End of Block: Main content

Explanation of the University of York's Privacy Notice (Data Protection information)

This Privacy Notice tells you about your rights and what to expect when you participate in the follow-up interviews/exercises after the survey. The University of York is the Data Controller, and we are required to inform you about the kind of data we gather, what happens to the data, and when it is destroyed.

What is our legal basis for processing your data?

The university aims to advance learning and knowledge through teaching and research. Research will only be undertaken where ethical approval has been obtained, where there is a clear public and/or scientific interests and where appropriate safeguards have been put in place to protect data. In line with ethical expectations and to comply with confidentiality, we will seek your consent to participate where appropriate.

What data is required and how do we use your data?

If you are willing to take part in a follow-up interview/exercise, please provide me with your name and phone number (if available) to enable the researcher to contact you later. Your responses in the interviews/transect walk will be anonymised - no identifiable information will be processed. Once data collection process has been completed in your village, the

personal data (name and phone numbers) will be destroyed. This is to inform you that we are trying to care for your personal data as carefully as we would be required to do so in the UK.

How do we keep your data secure?

Please be assured that your contact details will be properly and safely secured in a password protected file on an encrypted computer; it will be accessible to the researcher (Enoch) only.

How long will we keep your data?

Please note personal data obtained (i.e. name and phone number) will be destroyed as soon as data collection in the village is completed. Also, anonymised data files from interviews and transect walks will be kept for 5 years following the final publication of the work, after which they will be deleted.

What rights do you have in relation to your data?

You have a right of access to your data, a right to rectification, erasure (in certain circumstances). You also have a right to withdraw consent (where this applies). However, please note that, as data in this study will be anonymised, it will not be possible for you to exercise these rights after data processing point. This is because it will not be possible for us to identify your record once it has been anonymised. As such, if you have any concerns, please ensure you speak to the researcher before the data collection is completed in your village.

Right to Questions and Complain

If you have any questions about this privacy notice or concerns about how your data is being processed, or if you wish to exercise your rights in relation to your data, please contact the researcher (Enoch) on 05993687775.

If you have further questions, the University's Data Protection Officer can be contacted at dataprotection@york.ac.uk.

If you are unhappy with the way in which the University has handled your personal data, we ask you to contact us in the first instance, so that we can try to put things right.

LIST OF RESPONDENTS FOR FOLLOW-UP INTERVIEWS

Village_____ Date_____

	Questionnaire ref	Name of respondent
1		
2		
3		
4		
5		
6		
7		
8		
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12		
13		
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32		

Appendix A2. Focus group discussion template

Focus group discussions (FGDs)

Questions:

1. How do ASGM and agriculture interact at the moment?

2. What circumstances affects these interactions, and which is most important?

3. Group exercise for participants.
Using post it notes, please submit your ideas on how ASGM has affected the following areas in the community since 2010:

sectors	effects
Environment	
Physical assets like roads and water	
Jobs and finances	
Health and education	
Population composition and quantity	
Family, organizational membership, and social networks	

(NB: A bigger version of the table above will be developed, and participants asked to put their ideas on post it notes and stick to each section, and discussion held afterwards.)

9. What actions have farmers undertaken when farmlands are invaded by miners?

10. What local measures, if any, have farmers adopted to reclaim/restore degraded lands?

11. What shifts, if any, have taken place in farming methods to adapt to ASGM insurgence?

12. Which groups have offered support in dealing with undesirable ASGM impacts?

13. What kinds of reforms could help co-existence of ASGM and agriculture be more sustainable?

Appendix A3. Oral history template

Oral history interview

Introduction:

This interview seeks to explore main livelihood activities that you undertook, from the past to the present and to find out any changes that have occurred and the factors that led to those changes.

Therefore, please note the format of the interview is such that I will first ask questions about the 1990s, then the mid 2000s and finally the present.

Interview Questions:

1. Please describe your main livelihood activities during the early to mid-1990s (*before ASGM boom in the community*) and why you chose those activities?

2. Can you tell me about any credits/loans/subsidies, if any, that you accessed around that time?

3. Can you tell me about the availability and quality of labour for hire around that time?

4. Can you please tell me about the environment, its quality and how it influenced your livelihoods in the mid 1990s?

5. Can you tell me about the state of the roads and physical infrastructure in the mid 1990s?

6. Tell me about your social networks and linkages in the 1990s– who did you depend on when the going got tough?

7. How have your livelihood activities changed from the mid 1990s until the mid 2000s and why?

8. How have livelihood activities changed since 2010 (*after ASGM boom in the community*) and what were the main reasons for these changes?

9. How has the rise of mining impacted your current livelihood activities (the advantages and disadvantages for you)?

10. Can you see any new and emerging livelihood options in your community?

11. What would you require to harness those opportunities?

12. What barriers and limitations hinder you from achieving your desired livelihood outcomes?

Appendix A4. Environmental inventory checklist

Environmental inventory checklist (for mine sites on farmland)

A. FUNDAMENTALS	**Notes**
Date	
Village	
Type and size of farmland	
Type of ASGM	
GPS coordinates for ASGM site	
estimated age of ASGM site	
Topography/slope	
SAMPLING	
Size of mined area (length * breadth)	
Number of shafts/adits (n) (for underground); average circumference =(∑π*diameter)/n	
Size of pit/volume of ponds (for surface mines) = $\pi r^2 h$ (estimate diameter visually; depth of pit/pond – measure using dip stick, where possible or estimate visually)	
Nature of route to mine site	

B. GROUND CONDITION AND SITE FEATURES		
Machinery & equipment used	Quantity	Description

Any chemicals or reagents used for operation (e.g., mercury, cyanide, acid etc.)	Estimated consumption	Description
Water use & disposal pattern during processing		
Source of water (e.g., river, stream, bore hole, pond, etc.)	Means of wastewater discharge	Discharge points (e.g., into river, stream, wetland, farm etc).

Appendix A5. Transect walk - farmland degradation assessment (environmental visual assessment)

1. Farmland areas impacted by ASGM

Degradation types	Description
Physical degradation	
Extent of bare ground, deforested spaces, health status of vegetation - healthy/stunted growth/sparse?	
Crusting, sealing, compaction/inhibited aeration, subsidence/terrain deformation, others?	
Number and sizes of mine waste – heaps of soil, excavated pits, ponds, waterlog, litter etc.? condition of pits, heaps stable?	
water erosion, runoff/ loss of topsoil; wind erosion/ overblowing,	
Chemical degradation	
Signs of soil contaminated by mercury, cyanide, diesel, kerosene, petrol, grease, gasoil, etc?	
Signs of acidification, nutrient losses (erosion), e.g., stunted grass growth/wilting grass? Signs of salinization/alkalinization, leaching?	

Contaminated water/ponds – flowing/stagnant, silted, turbid, oil-film on surface, water colour, signs of dead fishes and other animals, other. status of water for irrigation purposes?	
Biological degradation	
Loss of biodiversity, decline in soil organic matter, soil-borne pathogens, emission of greenhouse gases, loss of soil carbon sink capacity, loss of soil structure	
Nature of reclamation or restoration	
Is it vegetation, soil, water, habitat etc? Method used – earthworks machinery, local farm implements, natural regeneration? revegetation full or partial?	

2. Any further information regarding general ground condition and features on the farmland

Appendix A6. Key informant interviews template

Key informant interviews template

1. How have livelihood activities changed since 2010 (*after ASGM boom in the community*) and what were the main reasons for these changes?

2. How has the rise of mining impacted your current livelihood activities (the advantages and disadvantages for you)?

3. Can you see any new and emerging livelihood options in your community?

4. What would you require to harness those opportunities?

5. What barriers and limitations hinder you from achieving your desired livelihood outcomes?

Appendix A7. Stakeholder interviews template

Stakeholder interview template

1. What key challenges confront your department/agency due to the rise of ASGM and when did they first emerge? Can you rank them?

    Consider prompting for each of:
    political and institutional challenges;
    economic and resourcing challenges;
    legal challenges;
    and social/cultural challenges.

2. Within your jurisdiction, what roles are expected of your agency to play concerning ASGM, as well as its links with agriculture?

3. Is there a dedicated liaison person? (need to find out more about the institutional structures/processes of interaction here)

4. What challenges do you face in carrying out your responsibilities concerning ASGM?

5. What is the nature of your budgetary support in carrying out these engagements? Is it sufficient?

6. Could you please explain the nature of interactions, if any, that exist between you and other organisations (e.g., mining department, the District Assembly, EPA, Lands Commission, Agriculture, Water Resources Commission, and local NGOs) in handling issues concerning ASGM, and how effective are they/any existing working framework?

7. What reforms would help address the challenges listed in 1 (including to help support the coexistence of ASGM and agriculture)?

    political and institutional challenges;
    economic and resourcing challenges;

legal challenges;
and social/cultural challenges.

8. Any policy coordination/coherence between your sector and other sectors (mining, development, environment, lands, Agriculture, Water) concerning ASGM? For instance, do people from agriculture department sit on decision panels over mining permits or consulted during the process, and vice versa?

9. What is the level of coherence between mining policy and your sector's policy (mining, development, environment, lands, Agriculture, Water)? Please select a score _____ a) high b) partial c) limited d) none.

Appendix B: Chapter 4. Indicators used to group households based on data collected during household surveys.

Component	Indicators	Description	Data range or categories
Financial capital	Gross annual agricultural income (number of bags of cocoa harvested; number of bags of cassava harvested)	Financial assets enable households to respond to change, acquire physical assets and strategize to develop	Item
Physical capital	Number of transportation assets	Different transportation assets provide livelihood options when opportunities materialize and can be sold in times of need.	Item
	Number of communication assets	Having communication gadgets enables easier and quicker access to vital information relevant to their livelihoods	Item
	Ownership of house	Allow households to consolidate income, due to not needing to pay rents, plus generate more income if able to rent	1. owner, 2. renting, 3. family home
Natural capital	Tenure arrangement held over agricultural land	Type of land tenure enables livelihood planning, loans to be secured or land sold/leased if desired/needed.	1. owner (inherited); 2. owner (private purchase); 3. owner (gifted); 4. Rented. 5. share cropping; 6. caretaker; 7. other
	Size of agricultural land held	The size of agricultural field is related to the amount of financial assets that can be generated (AS). The larger the area, the better.	1. < 5, 2. 5 – 10, 3. 11 – 15, 4. 16–20, 5. >20 acres (2.5 acre=1ha)
Human capital	Highest educational level achieved	Education level attained provides an indication of human capital (L), increasing capacity to exploit a broader range of opportunities.	1.none, 2. primary 3. Junior secondary/middle school, 4. senior secondary
	Able to afford children's education	Level of capacity to pay education related fees of wards indicates the level of financial assets a household wield	1.very easy, 2. easy, 3. moderate, 4. difficult, 5. very difficult
	Able to afford health check	To afford treatment of illness shows household ability to restore/maintain its human capital, which is necessary for engagements in livelihood options	1.very easy, 2. easy, 3. moderate, 4. difficult, 5. very difficult.
Social capital	Membership of social groups (No. of associations households belong to)	Membership of groups provides social safety nets and access to information. Membership of a higher number of groups enriches social networks and information sources.	1. None, 2. 1-2, 3. 3-5, 4. 5-7, 5. 8 and above
Livelihood diversification	Number of livelihood activities undertaken (subsistence and income)	Livelihood diversification provides an indication of flexibility or resilience when change impacts income sources or household resources	1-16 [item]

Appendix C: Chapter 4. Statistical tests

C1. AKWABUOSO

Preliminary test: The Shapiro-Wilk test statistic is significant, meaning the number of households is not normally distributed in the population (data is nonparametric). Therefore Kruskal-Wallis test (not ANOVA) was applied to test for any significance in differences in number of households observed among the livelihood trajectory groups.

Tests of Normality

	Livelihood trajectory group	Shapiro-Wilk		
		Statistic	df	Sig.
Number of households	Consolidating	0.351	20	0.000
	Fluctuating	0.865	59	0.000
	Marginalised	0.786	38	0.000

Test for significant difference:
Kruskal-Wallis Test

	Ranks		
	Livelihood trajectory group	N	Mean Rank
Number of households	Consolidating	20	107.50
	Fluctuating	59	68.00
	Marginalised	38	19.50
	Total	117	

Test Statistics[a,b]

	Number of households
Kruskal-Wallis H	98.138
df	2
Asymp. Sig.	0.000

a. Kruskal Wallis Test

b. Grouping Variable: Livelihood_trajectory_group

Dunn-Bonferroni nonparametric post hoc comparison test following a significant Kruskal-Wallis test.

Pairwise Comparisons of Livelihood_trajectory_group

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig[a]
Marginalised-Fluctuating	48.500	6.999	6.930	0.000	0.000
Marginalised-Consolidating	88.000	9.295	9.467	0.000	0.000
Fluctuating-Consolidating	39.500	8.706	4.537	0.000	0.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is 0.050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

C2. EKORSO

Preliminary checks for data analysis:

Tests of Normality

	Livelihood trajectory group	Shapiro-Wilk		
		Statistic	df	Sig.
Number of households	Consolidating	0.726	18	0.000
	Fluctuating	0.825	71	0.000
	Marginalised	0.777	32	0.000

Test for significant difference:

Kruskal-Wallis Test

	Ranks		
	Livelihood trajectory group	N	Mean Rank
Number of households	Consolidating	18	112.50
	Fluctuating	71	68.00
	Marginalised	32	16.50
	Total	121	

Test Statistics[a,b]

	Number of households
Kruskal-Wallis H	94.989
df	2
Asymp. Sig.	0.000

a. Kruskal Wallis Test

b. Grouping Variable: Livelihood_trajectory_group

Dunn-Bonferroni nonparametric post hoc comparison test following a significant Kruskal-Wallis test.

Pairwise Comparisons of Livelihood_trajectory_group

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig[a]
Marginalised-Fluctuating	51.500	7.395	6.964	0.000	0.000
Marginalised-Consolidating	96.000	10.233	9.381	0.000	0.000
Fluctuating-Consolidating	44.500	9.166	4.855	0.000	0.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is 0.050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

C3. PAMENG

Preliminary checks for data analysis:

Tests of Normality

	Livelihood trajectory group	Shapiro-Wilk		
		Statistic	df	Sig.
Number of households	Consolidating	0.790	13	0.005
	Fluctuating	0.889	75	0.000
	Marginalised	0.647	34	0.000

Test for significant difference:
Kruskal-Wallis Test

	Ranks		
	Livelihood trajectory group	N	Mean Rank
Number of households	Consolidating	13	116.00
	Fluctuating	75	71.85
	Marginalised	34	17.84
	Total	122	

Test Statistics[a,b]

	Number of households
Kruskal-Wallis H	94.989
df	2
Asymp. Sig.	0.000

a. Kruskal Wallis Test

b. Grouping Variable: Livelihood_trajectory_group

Dunn-Bonferroni nonparametric post hoc comparison test following a significant Kruskal-Wallis test.

Pairwise Comparisons of Livelihood_trajectory_group

Sample 1-Sample 2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig[a]
Marginalised-Fluctuating	54.008	7.220	7.480	0.000	0.000
Marginalised-Consolidating	98.162	11.388	8.620	0.000	0.000
Fluctuating-Consolidating	44.153	10.492	4.208	0.000	0.000

Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.

Asymptotic significances (2-sided tests) are displayed. The significance level is 0.050.

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Appendix D: Chapter 4 and 5. Descriptive statistics output from questionnaire surveys.

Agriculture:

1. **Percentage of farmers into cocoa farming**

Total number of farmers	Number of Cocoa farmers	Percent of cocoa farmers (174/219*100)
219	174	80%

2. **How long have you been engaged in farming?**

Category	Frequency	Percent	Valid Percent	Cumulative Percent
<2 years	2	0.6	0.9	0.9
2-5 years	14	3.9	6.4	7.3
6-10 years	24	6.7	11.0	18.3
11-20 years	53	14.7	24.2	42.5
>20 years	126	35.0	57.5	100.0
Total	219	60.8	100.0	

3. **What is the size of the farmland your household regularly cultivate (average cultivated land for the past 3 years in acres)? - Both (cash and food)**

Crop	N	Minimum	Maximum	Mean (acres)	Std. Deviation
For both cash and food crops	139	1	40	7.07	6.132
Cocoa	174	0	49	5.72	5.250

4. Mean size of total farmland held by each household:

Case Processing Summary

	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
Total farmland size per each farmer	219	60.8%	141	39.2%	360	100.0%

Descriptives

			Statistic	Std. Error
Total farmland size per each farmer	Mean		6.76	0.437
	95% Confidence Interval for Mean	Lower Bound	5.90	
		Upper Bound	7.62	
	5% Trimmed Mean		5.99	
	Median		5.00	
	Variance		41.770	
	Std. Deviation		6.463	
	Minimum		0	
	Maximum		49	
	Range		49	
	Interquartile Range		6	
	Skewness		2.762	0.164
	Kurtosis		11.709	0.327

5. How many of the following items did your household own or harvested in the previous agricultural season?

Descriptive Statistics

Crop (bag size is 100kg, except cocoa = 64kg)	N	Minimum number of bags	Maximum number of bags	Mean number of bags	Std. Deviation
Cocoa	172	0	70	9.41	9.283
Oil palm	12	1	120	31.25	40.118
Maize	128	0	30	5.21	4.494
Plantain	127	1	200	14.24	21.790
Cassava	144	0	54	8.56	9.728
Yam	6	2	15	5.67	4.803
Cocoyam	29	1	40	4.97	7.528

6. Do you have access to credit or loans for your agricultural activities?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	191	53.1	87.2	87.2
	Yes	28	7.8	12.8	100.0
	Total	219	60.8	100.0	
Missing	System	141	39.2		
Total	360	100.0			

ASGM:

7. Approaches to ASGM operations

Operational type	Frequency	Percent frequency
ASGM only on permanent basis	37	31.36
ASGM mainly with some farming elsewhere	12	10.17
Shifts between farming and ASGM seasonally in the community	43	36.44
Just as investor (do not physically take part)	2	1.69
Other (does non-farm job with mining as a support)	24	20.34
Total	118	100

From table above, number of farmer-miners = 12+43 = 55

Proportion of farmers combining farming and mining = 55/219 * 100 = 30.59 = 30.6%.

8. If applicable, how many members of your household undertake ASGM activities, what are their ages?

Age group (yrs)	Frequency
18	8
>18-30	53
31-40	41
41-50	11
>51	5

9. How miners acquired farmland

Ways miners acquire farmland	frequency	Percentage frequency (%)
Purchase from farmer	21	23.59
Purchase from landowner	44	49.44
Resource exchange/barter trade	0	0.0
Invasion	24	26.97
Total	89	100.00

10. If applicable, which ways do you get access to credit/loans for your mining activities?

Means of access	Frequency
Family/friends	21
Bank/other financial institutions	1
private persons in ASGM/'middlemen'	4
private business	0
NGOs	0
Community based organization	0
Other	2

11. Has your farmland ever been degraded or lost through ASGM activity?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	137	38.1	62.3	62.3
	Yes	83	23.1	37.7	100.0
	Total	220	61.1	100.0	
Missing	System	140	38.9		
Total		360	100.0		

12. Size of degraded farmland per household

Case Processing Summary

	Valid		Cases Missing		Total	
	N	Percent	N	Percent	N	Percent
Total size of farmland degraded	80	22.2%	280	77.8%	360	100.0%

Descriptives

			Statistic	**Std. Error**
Total size of farmland degraded	Mean		2.17	0.222
	95% Confidence Interval for Mean	Lower Bound	1.72	

		Upper Bound	2.61	
	5% Trimmed Mean		1.94	
	Median		1.75	
	Variance		3.929	
	Std. Deviation		1.982	
	Minimum		0	
	Maximum		9	
	Range		9	
	Interquartile Range		1	
	Skewness		1.886	0.269
	Kurtosis		3.069	0.532

13. Percentage of farmland degraded by ASGM per household

Total farmland size per household – mean (std dev)	Total farmland size degraded by ASGM per household – mean (std dev)	Percent size of farmland degraded.
6.76 (6.463)	2.17 (1.982)	32.1%

14. In your estimation, to what extent has ASGM impacted your access to farm labour?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Increased by	18	5.0	8.4	8.4
	decreased by	151	41.9	70.2	78.6
	No change	27	7.5	12.6	91.2
	Not sure	19	5.3	8.8	100.0
	Total	215	59.7	100.0	
Missing	system	145	40.3		
Total		360	100.0		

15. To what extent has the cost of hiring farm labourers changed due to the rise of ASGM?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Increased by	170	47.2	78.7	78.7
	decreased by	5	1.4	2.3	81.0
	No change	20	5.6	9.3	90.3
	Not sure	21	5.8	9.7	100.0
	Total	216	60.0	100.0	
Missing	System	144	40.0		
Total		360	100.0		

16. How has the price of food been impacted since the rise of ASGM began?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Increased by	284	78.9	80.5	80.5
	decreased by	9	2.5	2.5	83.0
	No change	47	13.1	13.3	96.3
	Not sure	13	3.6	3.7	100.0
	Total	353	98.1	100.0	
Missing	System	7	1.9		
Total		360	100.0		

17. What changes will you like to see regarding the ASGM activities in your community?

		Frequency	Percennt	Valid Percent	Cumulative Percent
Valid	No change/do nothing	3	0.8	0.8	0.8
	Stopped outright	38	10.6	10.6	11.5
	progressively replaced with alternative livelihoods	18	5.0	5.0	16.5
	Kept but modified to co-exist with other livelihood options	292	81.1	81.8	98.3
	other	6	1.7	1.7	100.0
	Total	357	99.2	100.0	
Missing	System	3	0.8		
Total		360	100.0		

Appendix E: Chapters 5 and 6. Sources of public datasets used

Sources of public datasets used in the study.

Mining Acts:

Minerals and Mining Law, 2006 (Act 703)

Minerals Commission Act, 1993 (Act 450)

Minerals and Mining (Amendment) Act, 2015 (Act 900)

Minerals and Mining (Amendment) Act, 2019 (Act 995)

Source: https://www.mincom.gov.gh/acts/

Regulations:

Ghana Government. MINERALS AND MINING (COMPENSATION AND RESETTLEMENT) 2012 (LI 2175).

Ghana Government. MINERALS AND MINING (HEALTH, SAFETY) 2012 (LI 2182).

Source: https://www.mincom.gov.gh/regulations/

Ghana Government. ENVIRONMENTAL ASSESSMENT REGULATIONS, 1999 (LI 1652).

Source: http://www.epa.gov.gh/epa/regulations

https://www.fao.org/faolex/results/details/en/c/LEX-FAOC078169/

Policy:

Ghana Government (Minerals Commission). MINERALS AND MINING POLICY OF GHANA, 2014.

Source: https://www.mincom.gov.gh/wp-content/uploads/2021/06/Mineral-and-Mining-Policy-Ghana.pdf

Ghana Government (Minerals Commission). Small scale and Community Mining - Operational Manual, 2021. 2021.

https://www.mincom.gov.gh/wp-content/uploads/2021/11/Small-Scale-and-Community-Mining-Operational-Manual-Sep.-2021-1.pdf

Ghana Government: Min of Water Resources W and H. Riparian Buffer Zone Policy for Managing Freshwater Bodies in Ghana. 2013.

Source: https://www.wrc-gh.org/dmsdocument/93

National Agriculture investment Plan (IFJ) – Ghana (2018-2021)

https://mofa.gov.gh/site/publications/policies-plans

Public sector reports:

Ghana Audit Service. Performance audit report of the Auditor-General on regulating reclamation activities at small-scale mining sites. 2021;

Source: https://audit.gov.gh/files/audit_reports/Performance_Audit_Report_of_the_Auditor-General_on_Regulating_Reclamation_Activities_at_Small-Scale_Mining_Sites.pdf

Atiwa West District. Composite Budget for 2021-2024: Programme Based Budget estimates for 2021. 2021.

Source: https://mofep.gov.gh/sites/default/files/composite-budget/2021/ER/Atiwa_West.pdf

Geological Survey of Denmark and Greenland. Artisanal and Small scale Mining Handbook for Ghana with a regional perspective [Internet]. 2017. 160 p.

Available from: http://www.oagsafrica.org/images/training/WP3SUCCESSSTORY/FINAL-Artisanal-Handbook-for-Ghana.pdf

Appendix F1: Chapter 6. Laws and regulations for artisanal and small-scale mining governance in Ghana.

Period of establishment	Laws and regulations
Established in the 1980s	• Mercury Act (PNDCL 217) – replaced with Act 703, 2006 • Small-scale Mining Act (PNDCL 218) – replaced with Act 703 • Precious Minerals Marketing Company Act, 1989 (PNDCL 219)
Established in the 1990s	• The Constitution, 1992 • *Minerals Commission Act, 1993 (Act 450)* • Environmental Protection Agency Act, 1994 (Act 490) • Water Resources Commission Act, 1996 (Act 522) • Local Government Act, 1993 (Act 462) • Office of the Administrator of Stool Lands Act, 1994 (Act 481) • *Environmental Assessment Regulations, 1999 (LI 1652) ('Environmental Regulations')*
Established in the 2000s	• *Minerals and Mining Act, 2006 (Act 703) as amended by the Minerals and Mining (Amendment) Act, 2015 (Act 900) and the Minerals and Mining (Amendment) Act, 2019 (Act 995),* • Internal Revenue Act, 2000 (Act 592) as amended and associated regulations • Lands Commission Act, 2008 (Act 767) • Ghana Revenue Authority Act, 2009 (Act 791)
Established in the 2010s	• *Minerals (Royalties) Amendment Act, 2010 (Act 794)* • Minerals and Mining (General) Regulations, 2012 (LI 2173) Minerals and Mining (Support Services) Regulations, 2012 (LI 2174) • *Minerals and Mining (Compensation and Resettlement) Regulations, 2012 (LI 2175)* • *Minerals and Mining (Licensing) Regulations, 2012 (LI 2176)* • *Minerals and Mining (Health, Safety, and Technical) Regulations, 2012 (LI 2182)* • *(Minerals and Mining Regulations, Explosives, 2012 (LI 2177)* • Minerals Development Fund Act 2016 (Act 912) • Minerals and Mining (Ground Rent) Regulations, 2018 (L.I 2357) • Minerals Income Investment Fund Act, 2018 (Act 978) as amended by the Minerals Income Investment Fund (Amendment) Act, 2020 (Act 1024).
Established in the 2020s	• Minerals and Mining (Mineral Operations – Tracking of Earth Moving and Mining Equipment) Regulations, 2020 (L.I 2404)

Appendix F2: Chapter 6. Legislative instruments covering ASGM activities in Ghana

Offences	Penalty	Legislation
Undertaking small-scale mining operation without a licence	Summary conviction to a fine of not less than ten thousand penalty units and not more than fifteen thousand penalty units, and to a term of imprisonment of not less than fifteen years and not more than twenty-five years.	Section 99 of Act 703 as amended by Section 2a of Act 995. New Section 99 (2)(a)
Use of explosives without the written permission of the Minister.	Summary Conviction to a fine of not more than the cedi equivalent of US$5,000.00 (at first instance). The cedi equivalent of US$500.00 for each day the offence is continued (after first conviction).	Section 95 of Act 703
Use/purchase of mercury from an unauthorised dealer.	Summary Conviction to a fine of not more than the cedi equivalent of US$5,000.00 (at first instance). The cedi equivalent of US$500.00 for each day the offence is continued (after first conviction).	Section 96 of Act 703
Buying or selling minerals without a licence or valid authority by the Minister.	Summary Conviction to a fine of not less than ten thousand penalty units and not more than fifteen thousand penalty units, and to a term of imprisonment of not less than fifteen years and not more than twenty-five years.	Section 99 of Act 703 as amended by Section 3 (1) of Act 995. New Section 99 (1).
Manufacture/use any mining equipment to obtain minerals in or along the banks of natural water bodies.	Summary conviction to a fine of not less than fifty thousand penalty units or to a term of imprisonment of not less than fifteen years and not more than twenty-five years or to both	Section 99 of Act 703 as amended by Section 6 of Act 995. New Section 99 (6).
Provides or involved in provision of excavator or any other equipment for mining operations contrary to a provision of the Act 703.	Summary conviction to a fine of not less than fifty thousand penalty units and not more than one hundred thousand penalty units or to a term of imprisonment of not less than fifteen years and not more than twenty-five years or to both	Section 99 of Act 703 as amended by Section 7 of Act 995. New Section 99 (7).
Undertaking or facilitating small-scale mining as a foreigner.	Liable on a conviction to a fine of not less than one hundred thousand penalty units and not more than three hundred and fifty thousand penalty units or a term of imprisonment of not less than twenty years and not more than twenty-five years; or to both.	Section 99 of Act 703 as amended by Section 3 of Act 995. New Section 99 (3).
A Ghanaian employing or engaging a foreigner to undertake or participate in small-scale mining	Summary conviction to a fine of not less than thirty thousand penalty units and not more than one hundred thousand penalty units and to a term of imprisonment of not less than fifteen years and not more than twenty-five years.	Section 99 of Act 703 as amended by Section 5 of Act 995. New Section 99 (5)
Contracting a non-Ghanaian to provide mining support services in small-scale mining	Summary conviction to a fine of not less than ten thousand penalty units and not more than fifteen thousand penalty units and to a term of imprisonment of not less than fifteen years and not more than twenty-five years.	Section 99 of Act 703 as amended by Section 1c of Act 995. New Section 99 (1)(c)

Appendix F3: Themes with content generated from thematic analysis of data for the three objectives.

Themes:

Objective one:

Changes in rural livelihoods and cocoa farming (1990s–2000s)

This highlights the shift in rural livelihoods, particularly in cocoa farming, from the 1990s to 2000s, amidst shifting socio-economic and environmental conditions. In the 1990s, fertile land, reliable rainfall, and minimal human pressure supported farming, despite poor infrastructure. By the 2000s, government interventions and improved infrastructure led to expanded cocoa farming, attracting migrants and diversifying livelihoods. These changes marked a broader rural transformation.

Livelihood diversification, economic gains and environmental impact of ASGM

This outlines the economic impact of ASGM in Atiwa West District since 2010, which contributed significantly to household incomes and boosted local businesses through increased trade and migration. However, the growth of ASGM came with environmental costs, including water pollution, deforestation, and the degradation of natural resources, which negatively affected other livelihood activities like fishing and forest-based livelihood activities. Infrastructure improvements, such as electricity and roads, facilitated livelihood diversification alongside ASGM's rise.

Household characteristics shaping livelihood shifts with the rise of ASGM

Highlights how household factors—such as age, education, health, and family structure—have influenced livelihood changes since the rise of ASGM in 2010. Younger, energetic household heads were more likely to shift into ASGM, while education and good health provided greater flexibility for livelihood changes. Larger families with more dependents faced constraints in converting resources into productive opportunities, while ASGM’s steady income helped households manage health challenges more effectively.

Resource access and financial assets shaping livelihood transitions with ASGM

Highlights how access to land and financial resources influenced households' ability to shift livelihoods, particularly with the rise of ASGM. Households with secure land tenure could lease land or engage in ASGM, while those without land rights were sometimes forced into mining when their farmlands were repossessed. Prior to ASGM, limited access to formal loans restricted livelihood changes, and high-risk farming discouraged lenders. ASGM was seen by locals as a new financial opportunity to overcome these barriers.

Infrastructure and external factors driving livelihood shifts toward ASGM

Emphasises how improved infrastructure, such as roads, electricity, and communication networks, enabled residents to diversify their livelihoods, particularly into ASGM support services. Poor farm produce prices, rising farming costs, erratic rainfall, and competition for land also pushed farmers into mining. Informal mining thrived as registration processes were seen as costly and complex, further encouraging livelihood diversification.

Opportunities and livelihood diversification through artisanal mining

Outlines the diverse opportunities arising from the emergence of ASGM, including livelihood diversification, access to business networks, and the sale or lease of natural assets like land. ASGM has facilitated the rental of mining equipment, the acquisition of new skills, and a boost to the local economy through increased market access and purchasing power, driven by a high influx of mine workers.

Barriers to sustainable development amidst artisanal mining emergence

Presents significant barriers resulting from the rise of ASGM, including land and water degradation, inadequate support from local authorities, and limited access to financial resources, particularly for the marginalised. Issues such as insecure land tenure, social-cultural barriers, and insufficient state support further complicate the situation. Additionally, the emergence of ASGM has led to increased food prices, reduced farming labour, and decreased school attendance, all of which threaten the long-term sustainability of local communities.

Objective two:

Diverse methods employed in ASGM practices

Describes various methods used in ASGM, including manual techniques with pickaxes and shovels, as well as mechanised approaches using excavators and dredgers. These methods are applied in diverse locations, such as farmlands, near waterways and areas with alluvial gold deposits. The use of metal detectors and washing techniques illustrates the range of practices employed to extract gold from both active and abandoned mining sites, highlighting the adaptability and resourcefulness of miners.

Impact of ASGM on agricultural land

Emphasises the detrimental effects of informal ASGM on agricultural land, crucial for local livelihoods, with farmers losing their holdings. Mined areas were either unreclaimed or poorly reclaimed, rendering the land unsuitable for farming and threatening food security. It highlights the effects both at household and community levels.

Impacts of ASGM on water resources

Highlights the critical role of water resources for both miners and farmers, noting significant pollution due to ASGM activities. Despite regulations requiring a 300 m buffer zone around water bodies, miners have contaminated rivers and low-lying areas, using polluted water for washing gold-containing soil while relying on purchased water for drinking. Farmers have ceased using these water sources for irrigation, leading to crop wilting from excessive mud and chemical contamination, which threatens agricultural productivity and livelihoods. The pollution of waterways poses wider implications both at the household level and the community level.

ASGM impacts on financial and Infrastructure

Illustrates how informal ASGM has provided financial and physical assets to customary landowners and households engaged in mining, enhancing their livelihoods. ASGM has contributed to improved economic conditions both within households and communities, underscoring the financial opportunities presented by ASGM.

Institutional linkages between agriculture and ASGM

Highlights a significant absence of formal connections between the mining and agriculture sectors at various levels and no direct collaboration. Additionally, no formal linkages and collaboration exist

between traditional institutions and state entities like the District Assembly, and Minerals Commission regarding ASGM governance, indicating a need for improved collaboration and governance among all stakeholders.

Financial challenges and hardships faced by farmers

Describes significant financial hardships faced by farmers, citing inadequate subsidies and incentives. farmers also faced unpredictable profits resulting from challenges such as climate change, reduced crop productivity due to pests and diseases, limited market access for their produce and fluctuating input prices. These factors collectively hinder their ability to maintain sustainable livelihoods.

Complexities of customary land tenure and informal land markets in ASGM

Highlights the role of complex informal land markets in enabling miners' access to minerals, illustrating the predominant customary land tenure systems in the Atiwa West area and their implications for ASGM governance. Traditional authorities and landowners are often blamed for the rise of ASGM. While licensed miners typically negotiate access with local chiefs, landowning farmers claim that concessions are often granted without their consent, leading to tensions. This situation prompts landowners to assert control over mineral rights, facilitating direct deals with illegal miners. Despite regulations requiring fair compensation for land use, informal negotiations frequently undermine transparency, particularly affecting women and tenant farmers.

Challenges in community leadership amidst mining influx

Addresses the challenges faced by community leaders in new frontier areas in managing the influx of miners. Community members are dissatisfied regarding their chiefs' leadership, with expectations for leaders to negotiate with miners for community development initiatives, such as borehole provision and restrictions on degradation caused by ASGM operations. Despite receiving mining funds, traditional authorities have not implemented developmental projects. Informal land dealings between miners and community leaders often prioritise convenience over ensuring direct benefits for the community, hindering sustainable development.

Attitudes of ASGM miners and gold traders

Highlights the attitudes of ASGM miners, characterised by a short-term mindset of "dig, strike, and move on." Miners prioritise quick returns on investments due to high gold demand, often at the expense of environmental and social responsibilities. Mining gangs exhibit little interest in site reclamation, opting instead to seek new deposits, underscoring the competitive nature of the industry and the influence and demands of powerful backers in the mining process. This environment of non-enforcement of reclamation laws leads to a culture where both regulated and unregulated miners neglect their environmental obligations, worsening the challenges of sustainable mining practices.

Power imbalance and ineffective institutional support in ASGM

Emphasises the ineffective monitoring and support from relevant institutions in regulating ASGM, leading to significant land degradation. Farmers expressed frustration about the lack of assistance from state agencies, including the Minerals Commission, Environmental Protection Agency, District Assembly, and police, when dealing with miners. They noted that miners often escape accountability due to their financial resources and potential political connections, creating a challenging environment for legal disputes, exacerbating the power imbalance between wealthy ASGM entrepreneurs and vulnerable smallholder farmers.

Objective three:

The themes generated from expert interviews are summarised below:

Connections and coherence between mining and land policies
Reflects the partial coherence between land and mining policies, highlighting the government's struggle to implement designated ASGM areas and the lack of coordination between relevant agencies. Additionally, challenges in landowner-miner compensation negotiations are noted, partly due to limited district-level presence of the state lands agency, the Lands Commission.

Mining and agriculture linkages and policy coherence
Highlights the absence of formal collaboration between the mining and agricultural sectors, despite the acknowledged impacts of ASGM on agriculture. Weak coordination, lack of defined roles for the agricultural sector, and minimal engagement during policy formulation reflect the disjointedness between these two sectors, emphasising the need for a stronger policy drive to foster coherence.

Mining and water management links and policy coherence
Reflects the gaps in coordination between mining and water management policies, as indicated by the pollution of water bodies and the weak collaboration among key agencies like the Environmental Protection Agency (EPA), Minerals Commission (MC), Water Resources Commission (WRC). While monitoring efforts and stakeholder meetings aim to address these issues, inconsistencies in implementation and communication hinder effective governance of mining activities impacting water resources.

Mining and development connections and policy integration
Underscores the absence of a national policy framework directing district assemblies to integrate sustainable ASGM practices into local development plans. Limited district-level presence of key agencies, such as MC and EPA, forces miners into informal operations, while weak coordination between mining governance and regional development structures further impedes effective policy coherence, hindering the potential for mining to contribute to district development.

Mining and environment coordination and policy coherence
Highlights the partial coherence between mining and environmental policies, characterised by ad hoc inter-agency coordination and collaboration, and weak enforcement mechanisms. Inconsistent monitoring, resource constraints, and the lack of entrenched policies for joint operations contribute to the fragmented approach to addressing environmental issues in the ASGM sector. Efforts to promote responsible mining practices exist, but challenges in logistics, monitoring, and policy enforcement undermine their effectiveness.

Political influence in ASGM formalisation and policy implementation
Reflects the influence of politics on ASGM formalisation and the implementation of related policies. While direct political interference in the day-to-day operations of licensing and compliance enforcement is not prevalent, individuals often claim political connections to fast-track processes or avoid penalties. Additionally, political influence impacts regulatory enforcement, with some miners exploiting perceived political protection. Despite regulations and strict employment terms for public workers, political affiliations sometimes challenge the integrity of ASGM governance, highlighting the need for stronger institutional oversight and supervision.

Institutional challenges in ASGM formalisation and policy coherence
Stresses the institutional barriers in formalizing ASGM due to centralised processes and lack of intersectoral coordination. The tradition of processing licenses and permits at national head offices

leads to delays, pushing miners toward illegal operations. Decentralization of these processes and breaking away from sectoral silos, exacerbated by limited budgets and unclear policies, are critical for improving policy coherence and addressing illegal mining challenges effectively.

Financial challenges hindering ASGM formalisation and policy implementation

Emphasises how inadequate budget allocation and logistical support severely impact the monitoring, enforcement, and governance of ASGM. Financial deficits limit the capacity of key institutions like the EPA and MC to effectively monitor legal mining activities, address illegal operations, and provide necessary district-level infrastructure. Insufficient funds prevent recruitment, training, and the establishment of additional offices, which hampers efforts to ensure policy coherence and proper mining practices across regions.

Regulatory challenges in ASGM formalisation and policy coherence

Highlights the overarching issue of insufficient and irregular coordination among stakeholders and institutions in ASGM governance. ASGM formalisation faces significant challenges due to fragmented coordination, inconsistent stakeholder engagement, and inefficient institutional processes. Although key institutions like the EPA, MC, WRC, and others occasionally meet to discuss mining issues, these interactions are typically ad hoc and not mandated by any regulation or policy. The absence of structured, regular interagency collaboration leads to inconsistencies in governance. Additionally, policy gaps including the lack of explicit regulations to support the establishment of local offices and clear directives for district assemblies, contribute to inadequate management of ASGM impacts and benefits at the local level.

Socio-cultural settings in ASGM formalisation and policy coherence

The socio-cultural landscape surrounding ASGM formalisation in Ghana reveals a complex interplay of institutional autonomy and the potential for collaborative governance. Officials value institutional autonomy but are open to collaboration when supported by clear national policies and strong political will. There is lack of ideological barriers to collaboration, suggesting that enhanced communication and coordination could improve ASGM governance. Additionally, addressing inadequate salaries and lax supervision would reduce corruption and promote accountability. When adequately incentivised, officials prioritise sustainable practices and compliance, ultimately supporting responsible development within the ASGM sector.