

Transitioning from Vulnerability to Viability: Fisher community responses to illegal gold mining
impacts on small-scale fisheries along the Ankobra river, Ghana

by

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

Abstract

Small-scale fisheries in Ghana's Ankobra River basin are increasingly threatened by the expansion of illegal and small-scale gold mining (ASGM), resulting in environmental degradation, declining fish stocks, and reduced livelihood resilience. This thesis investigates the socio-ecological impacts of ASGM on fishing communities in Ajomoro Eshiem, Eziome, and Sanwoma, using a convergent mixed-methods approach grounded in the Social-Ecological Systems (SES) frameworks. The research aims to (a) Explore the nature of ASGM activities and the key characteristics of the small-scale fishery industry in the Ankobra basin, (b) Assess the socio-economic and ecological well-being of small-scale fisheries due to the impact of ASGM on livelihoods, (c) Investigate the adaptive strategies adopted by fishing communities in response to ASGM-related disruptions. Quantitative survey data, along with qualitative interviews and focus groups, were integrated to provide a comprehensive understanding of household expenditures, changes in fish catch, access to support services, compensation mechanisms, and the inclusion of women and marginalized groups in decision-making. Findings reveal that ASGM has led to substantial declines in fish catch, increased household expenditures to mitigate health and environmental impacts, and widespread dissatisfaction with compensation and support services. Women and marginalized groups remain largely excluded from local governance processes, further weakening community resilience. While some fishers employ livelihood diversification and collective action to cope, these strategies are constrained by limited institutional support and infrastructural deficits. This research highlights the urgent need for inclusive governance, targeted capacity building, and sustainable alternative livelihood programs to enhance resilience and ensure the long-term viability of fisheries-dependent communities. It contributes to the understanding of how mixed-methods and SES-based analysis

can inform policy and practice in mining-impacted regions. Further studies can support viable transition pathways for affected communities.

Keywords: Small-scale fisheries, Illegal gold mining, Livelihood resilience, Social-ecological systems, Adaptive capacity

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List of Abbreviations

Abbreviation	Full Term
ASGM	Artisanal and Small-Scale Gold Mining
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
NGO	Non-Governmental Organization
SSF	Small-Scale Fisheries
UN	United Nations

Chapter 1

Introduction

1.0 Background to the study

Mining constitutes a cornerstone of global resource extraction, supplying indispensable non-renewable resources essential for economic development. Among the continents endowed with vast mineral reserves, Africa stands out as a hub of mineral wealth, boasting coveted resources like platinum, diamonds, and notably, gold (Attiogbe, 2017). In this context, Ghana emerges as a significant player, renowned for its rich gold deposits and historical mining heritage (Kpabitey et al., 2020). However, alongside the economic benefits of gold mining, there exists a nuanced interplay between mining activities and the sustainability of critical natural resources, particularly freshwater bodies crucial for small-scale fisheries. Gold mining holds a prominent position in Ghana's economic landscape, dating back to the middle-ages and entrenched as a key driver of economic growth and prosperity (Hilson, 2002). The nation's gold mining industry ranks seventh globally and represents the largest in Africa, contributing significantly to national tax revenue and gross domestic product (Atta & Tholana, 2022). Nonetheless, the extensive mining operations, encompassing both large-scale and small-scale (legal and illegal) endeavors, have left enduring impacts on vital water bodies, posing challenges for sustainable resource management.

Alongside the gold mining industry, Ghana's fishing sector emerges as another vital contributor to the nation's economy and livelihoods, particularly for coastal communities. The fishing industry, inclusive of both inland and marine fisheries, plays a crucial role in poverty alleviation and sustenance, making substantial contributions to Ghana's overall gross domestic product (Koomson, 2021). Small-scale fisheries (SSFs) represent a cornerstone of Ghana's fishing activities,

supporting millions of livelihoods and contributing significantly to the nation's fish catches (Aheto et al., 2019). The Ankobra River basin, situated in Ghana's Western Region, epitomizes the intricate relationship between mining and fisheries. Recognized by the Ministry of Fisheries and Aquaculture Department (MoFAD) as a crucial source of fish resources essential for local communities, the Ankobra River basin sustains diverse fishing activities crucial for both freshwater and marine species (Effah et al., 2021). However, amidst the reliance on these resources for sustenance and livelihoods, challenges arise concerning their effective management and sustainability.

The concept of the Tragedy of the Commons elucidates the inherent risks associated with unregulated access to shared resources, highlighting the need for responsible resource management practices to avert overconsumption and depletion (Hardin, 1968). In the context of gold mining, particularly surface mining methods like open-pit mining and dredging, concerns regarding environmental degradation and water resource depletion have garnered attention, underscoring the imperative for sustainable mining practices (Timsina et al., 2022). Moreover, Small-Scale fisheries face a myriad of challenges, including disruptions caused by mining activities, climate change, and unfavorable economic policies, which threaten their effectiveness and sustainability (Kolding et al., 2014). The extensive use of water in gold mining processes poses a significant threat to nearby surface water and groundwater quality, with lasting repercussions on aquatic ecosystems and local communities (Gardner et al., 2017). Considering these complexities, a comprehensive examination of the intersection between gold mining and small-scale fisheries in Ghana is warranted. While this study initially set out to examine the general impacts of gold mining on small-scale fishery communities, the data and community insights overwhelmingly identified illegal and small-scale gold mining (ASGM) as the most critical and immediate threat.

Consequently, the thesis shifts its focus to explore the socio-ecological impacts and adaptive responses specifically associated with ASGM. The study further investigates the multifaceted effects of ASGM on small-scale fisheries in the Ankobra River Basin, offering insights into both the challenges and opportunities for sustainable resource management in the region. In doing so, it evaluates the resilience and coping strategies of affected fishing communities, aiming to inform more inclusive and community-based approaches to sustainable development and environmental governance.

1.1 Problem statement and rationale

Communities along the Ankobra river in Ghana have historically relied on the river's fish stocks for their livelihoods, nutrition, and cultural identity. In recent decades, however, small-scale gold mining especially illegal operations have intensified in the region, resulting in severe environmental degradation and a dramatic decline in fishing activities (Effah et al., 2021). The number of active fishermen and canoes has plummeted from approximately 210 fishermen and 170 canoes to about 50 fishermen and 60 canoes. In some areas, such as Sanwoma, canoes are now used more for harvesting and transporting mangroves than for fishing, while many residents have shifted to alternative livelihoods like rubber and oil palm cultivation (**Figure 1**). This trend is mirrored upstream, where environmental degradation and pollution from mining have contributed to rural-urban migration and dwindling livelihood opportunities (Effah et al., 2021). Illegal gold mining in Ghana is closely linked to environmental degradation, particularly mercury pollution, ecosystem disruption, and overall environmental impact (Addai-Arhin et al., 2023). Mercury, recognized as one of the world's most severe pollutants by the UN's International Chemical Safety Programme, is widely used especially in illegal and small-scale gold mining operations, especially during ore washing. This practice contributes to widespread contamination and poses significant risks to both human health and ecosystem integrity (Kuffour et al., 2018). The extensive use of

water in mining processes near water bodies further exacerbates pollution, leading to elevated turbidity levels that harm river organisms and increase water treatment costs. Studies have documented widespread contamination of water, sediment, soil, and food crops in gold mining-affected areas, including the Ankobra river basin, primarily due to mercury pollution (Asare-Donkor, 2022).

Beyond mercury, illegal and unregulated gold mining operations contribute to the loss of agricultural lands, alteration of landscapes, and further degradation of water quality through the release of chemicals and heavy metals (Bansah et al., 2018; Attiogbe & Nkansah, 2017). These environmental challenges have made fishing less viable, increased health risks, and contributed to the loss of biodiversity. The destruction of mangroves and overexploitation of natural resources have further undermined the resilience of local livelihoods and the ecological balance of the river system. Despite these visible impacts, there is limited understanding of how small-scale fisheries communities are coping with these challenges, what adaptive strategies they employ, and how social, institutional, and environmental factors shape their ability to respond. Women and marginalized groups, in particular, often face additional barriers to participation in decision-making and access to support, further deepening community vulnerability. A comprehensive understanding of these issues is essential for designing effective interventions and policies that can help restore livelihoods, promote sustainable resource use, and strengthen the resilience of communities dependent on the Ankobra River (Effah et al., 2021; Göthberg & Greger, 2006; Kuffour et al., 2018; Adimado & Baah, 2002; Babut et al., 2003; Bansah et al., 2018; Attiogbe & Nkansah, 2017).

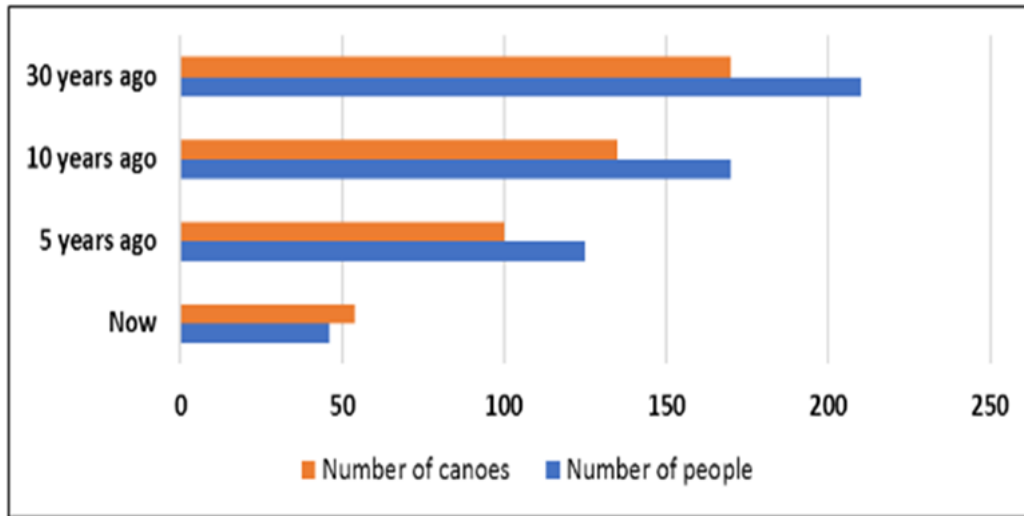


Figure 1 Number of canoes and number of people engaged in fishing in Ankobra region:

Source: https://www.crc.uri.edu/download/GH2014_ACT051_HM_FIN508.pdf

1.2 Statement of purpose

This study aims to examine the process of transitioning small-scale fisheries in Ankobra from vulnerability to viability amidst the impacts of ASGM activities. While existing literature highlights ecological and economic impacts, such as aquatic system destruction and economic constraints, there's a notable gap in understanding the coping and adaptive responses of these communities (Adimado & Baah, 2002; Nasirudeen and Allan, 2014; Mudyazhezha and Kanhukamwe, 2014; Ruelas-Inzunza et al., 2015; Owusu & Andriesse, 2020; Azumah et al., 2021; Bansah et al., 2018; Eduful et al., 2020; Franco-Hernández et al., 2010). The study critically examines both short-term coping mechanisms and longer-term adaptive responses. It aims to identify which strategies are proving effective, which are unsustainable or harmful, and where community efforts need strengthening or external support. By doing so, the research moves beyond surface-level responses to investigate the underlying capacities and constraints that shape how communities respond to environmental and socio-economic stressors. Ultimately, this study seeks

to fill an important gap by exploring the ecological, socio-economic, and cultural dimensions of these responses, offering grounded insights that can inform more targeted, inclusive, and resilient approaches to sustainable resource management in ASGM-impacted riverine fishing communities.

Through a convergent mixed method approach, the research will qualitatively and quantitatively investigate coping and adaptive strategies, design mitigation measures, and assess their effectiveness.

1.3 Study Objectives and Research Questions

This research aims to evaluate the resilience and adaptive responses of Small-Scale fisheries communities in the Ankobra River basin to the environmental and livelihood challenges posed by gold mining to inform sustainable development strategies and community-based management in the region by addressing key questions.

a) Exploring the nature of gold mining activities (legal and illegal) and the key characteristics of small -scale fisheries industry in Ankobra.

- i. What are the main operational practices and techniques used in gold mining and small-scale fisheries within the Ankobra River basin?

b) Assessing the socio-economic and ecological well-being of small-scale fisheries in the Ankobra region due to the impact of illegal ASGM impacts on livelihoods.

- i. What are the primary economic challenges experienced by small-scale fisheries as a result of gold mining activities in the Ankobra River basin?

c) Exploring coping and adaptive strategies of Ankobra small-scale fisheries to gold mining impacts.

- i. What coping and adaptive mechanisms are employed by small-scale fisheries to address the impacts of illegal ASGM on their livelihoods?

These questions are designed to evaluate the adaptive responses employed by small-scale fisheries in addressing the specific vulnerabilities arising from gold mining, and to examine how effectively these strategies contribute to enhancing resilience and promoting the transition from vulnerability to long-term viability within the Ankobra River basin communities.

1.4 Significance of study

This research holds both academic and practical relevance as it addresses the critical challenges faced by small-scale fishery communities in Ghana's Ankobra river basin amid the expansion of gold mining, particularly illegal artisanal and small-scale gold mining (ASGM). By examining the vulnerabilities and adaptive capacities of these communities, the study fills a key gap in understanding the complex interactions between mining activities and small-scale fisheries. Specifically, it identifies the drivers of vulnerability and resilience, providing a strong foundation for evidence-based decision-making and targeted interventions. The findings will not only inform support strategies for the Ankobra communities but also offer transferable insights for other small-scale fisheries facing similar mining-related pressures.

By documenting coping and adaptive responses, the research offers valuable guidance for policymakers, community leaders, and development partners in designing responsive and inclusive programs. Furthermore, it proposes actionable measures to strengthen the resilience and sustainability of small-scale fisheries, enhancing their ability to manage both ecological and socio-economic stressors. Ultimately, this study contributes to the promotion of sustainable livelihoods, improved governance, and long-term socio-ecological well-being in mining-impacted regions.

1.5 Theses organization

This thesis is organized to provide a comprehensive understanding of the adaptive responses of small-scale fisheries to the vulnerabilities resulting from gold mining activities in the Ankobra

river basin. Following the introductory chapter, the thesis is structured around the three specific research objectives, with each objective addressed in a dedicated chapter. Each of these chapters includes an introduction to the objective, a review of relevant literature, a description of the methods employed, and a presentation and discussion of the results. Chapter One introduces the study, outlines the background and context of Small-Scale fisheries and gold mining in the Ankobra river basin, and presents the research objectives and significance of the study. Chapters Two, Three, and Four are each devoted to one of the three specific research objectives. Each chapter begins with an introduction to the objective, followed by discussion of the findings related to that objective. Chapter Five synthesizes the key findings across all objectives, draws overall conclusions, highlights the implications for policy and practice, and suggests areas for further research. This structure allows for an in-depth and systematic exploration of each research objective, ensuring clarity and coherence throughout the thesis.

Chapter 2

Literature review

2.1 Introduction

Natural resources play a crucial role in shaping the economic landscapes of nations, serving as pivotal elements for development and sustainability. This global phenomenon is particularly evident in Africa, where countries leverage abundant natural resources to drive economic development and prosperity. Fedele et al. (2021) emphasize that 30% of the 1.2 billion people in the tropics rely significantly on nature for their basic needs. In Ghana, a nation blessed with diverse natural resources, over 70% of the population depends on land, forestry, fishery, and mining for their livelihood (Armah et al., 2014). Especially in rural areas, these natural resources form the bedrock for meeting daily sustenance (Bonye et al., 2023). The mining industry in Ghana attracts a significant 50% of foreign direct investment (FDI) into the country (Ampaw et al., 2023), highlighting its pivotal role in shaping both national and international economic dynamics. Gold, undoubtedly Ghana's crown jewel, has been a formidable force in the nation's economic landscape. Long before the discovery of the Jubilee Field in 2007 and the initiation of offshore oil development in 2010, gold held a prominent position, constituting 90–95% of Ghana's total mineral exports (Skaten, 2018). As of 2021, gold was projected to contribute USD 10 billion to Ghana's export revenue, surpassing the USD 4.65 billion value of crude petroleum (Ros–Tonen, 2021), underscoring its sustained economic importance. Ghana, recognized as Africa's leading gold producer and ranked sixth globally in 2022, further solidifies its economic prowess.

Certain regions in Ghana, particularly the western part, are endowed with abundant and diverse natural resources, including forests, minerals, fisheries, and oil. Due to its expansive water cover, many communities in this region heavily depend on fisheries as a primary source of livelihood. In

2018, the Ministry of Fisheries and Aquaculture Department (MoFAD) officially recognized the Ankobra river basin, situated in Ghana's western region, as a vital reservoir of fish resources crucial for sustenance and the livelihoods of local communities (Effah et al., 2021). The river estuary fishery, involving the extraction of shellfish and finfish from freshwater, brackish water, and marine sources, plays a crucial role. A fish inventory identified a total of 27 fish species belonging to 21 families in the area.

However, in regions like the western part of Ghana, where both gold mining and fisheries coexist, a notable challenge arises as the impact of one activity significantly affects the other, thereby influencing livelihoods. Regrettably, these challenges emerge when individual interests in exploiting shared resources for personal gain overshadow the well-being of the entire population. Upstream communities of Sanwoma (one of the communities) have witnessed a substantial reduction in both fishermen and canoes over the past 30 years, mainly attributed to rural-urban migration. However, the decline in catch or fish harvested is presently associated with the use of undersized mesh in fishing and illegal mining activities upstream, contributing to pollution and degradation of fish spawning grounds (Effah et al., 2021).

Furthermore, Ankobra river, which is the main point of the estuary, Adimado & Baah (2002) investigated mercury (Hg) concentrations in human blood, urine, hair, nails, and fish in the Ankobra and Tano river basins. This concentration of Hg (mercury) was researched and gathered that the Ankobra river, fed by water from streams covering extensive agricultural lands with both small- and large-scale mining operations, traverses mining-affected areas (Akabzaa et al., 2009). In effect, the river flow which carried these harmful chemicals which comes from gold mining activities in the region, runs through all the various tributaries, affecting lives, destroying aquatic life, and affecting livelihoods within these communities.

2.2 Purpose of Literature review

The aim of the literature review is to provide an overview of relevant research on the topic of transitioning small-scale fisheries (SSFs) in the Ankobra fishery community from vulnerability to viability, particularly in the context of the adverse effects of illegal gold mining activities. The review seeks to demonstrate the significance of the research gap identified and highlight the specific focus of the proposed study. The literature review explores the current state of vulnerability experienced by SSFs in Ankobra due to the impacts of gold mining activities. It examines various dimensions of vulnerability, including economic, social, and environmental factors, and highlights the challenges faced by the community in sustaining their livelihoods amidst these pressures. By synthesizing existing research, the review aims to elucidate the complexities of vulnerability in the Ankobra fishery community and underscore the urgency of addressing this issue.

Furthermore, the literature review sets the stage for the proposed research by framing the investigation as a process of understanding and addressing vulnerability in SSFs. While the review acknowledges the existence of adaptive measures within the community, it emphasizes the need to evaluate these measures and explore additional strategies for transitioning SSFs towards viability. This evaluation forms a crucial component of the proposed research, which aims to not only understand the factors contributing to vulnerability but also to identify effective pathways for enhancing resilience and sustainability in the Ankobra fishery community.

2.3 Structure of literature review

The literature review of the proposed study comprises of a study of the gold mining sector (both large and small scale), understanding fishers' vulnerability and contributing factors and lastly the viability of Small-Scale fisheries. Literature will first probe some activities in the gold mining sector, its economic contributions and resulting impacts, then a thorough study on the activities of

gold mining that has led to the vulnerability of the small-scale fisheries community in Ankobra and finally, tackle some adaptive measures to assist them move from vulnerability to viability.

2.4 Theoretical Framework

2.4.1 Understanding Socio-Ecological systems

Understanding the complex interplay between human and environmental systems—encompassing economic, social, political, and ecological dimensions—is central to addressing sustainability challenges. The Social-Ecological Systems (SES) framework offers a robust lens for examining these dynamics (Nayak, 2014). Rooted in resilience thinking, SES theory emphasizes the interdependence of social and environmental changes and has become increasingly influential over the past two decades (Pacheco-Romero et al., 2020). Core concepts in this framework—vulnerability, adaptive capacity, resilience, and viability—are particularly relevant to the context of small-scale fisheries impacted by gold mining.

In the Ankobra region, vulnerability reflects the susceptibility of fisheries-dependent communities to ecological degradation and socio-economic disruptions caused by illegal and small-scale gold mining (ASGM) (Adger, 2006; Cutter et al., 2012). Viability, in contrast, speaks to the community's ability to persist and thrive by sustaining their livelihoods and ecological systems over time (Miller et al., 2010). Drawing from resilience theory, this study explores how communities adapt—both reactively and proactively—to the stresses induced by ASGM, assessing the effectiveness and sustainability of these responses (Holling, 2001; Gunderson et al., 2003). The works of Elinor Ostrom and Fikret Berkes have been instrumental in advancing the SES framework, particularly in understanding how local resource users navigate environmental change and institutional constraints. Following Partelow (2018), this study adopts the SES framework as a conceptual tool to analyze the interactions between key variables—such as governance, resource access, social inclusion, and environmental stressors—shaping adaptive and coping responses. By

integrating concepts of vulnerability and viability, the framework helps situate community responses within a broader sustainability discourse, offering insights into pathways toward resilient and inclusive resource management.

2.5 Gold mining in Ghana

Mineral resources, especially gold, play a crucial role in shaping Ghana's economic landscape, contributing significantly to export revenue and economic stability (Skaten, 2018). Ghana strategically utilizes its diverse natural resources, including oil, gas, manganese, bauxite, and diamonds, for developmental projects and economic prosperity. The exploration landscape extends to various resources like aluminium, cement, lead, natural gas, salt, and silver (Hilson, 2016). Gold remains Ghana's crown jewel, constituting 90–95% of mineral exports, with a projected contribution of USD 10 billion to export revenue in 2021, surpassing crude petroleum earnings (Ros-Tonen et al., 2021).

2.5.1 Legal and regulatory frameworks of gold mining in Ghana

The Minerals and Mining Act 703 of 2006 governs the mining sector in Ghana. According to this law, obtaining an official mining license is a prerequisite for anyone looking to engage in reconnaissance, prospecting, exploration, or mining activities within the nation (Ofosu-Mensah, 2010; Benmudez-Lugo, 2016). Informal artisanal small-scale gold mining, known locally as 'Galamsey' in Ghana, is a major contributor to the country's economy. It directly employs roughly one million individuals and sustains the livelihoods of about 4.5 million more, which accounts for nearly 35% of Ghana's total gold production. (CERGIS, 2019). The prevalence of artisanal small-scale gold mining, often informal and illegal, poses significant environmental threats, ranging from mechanized extraction methods to irresponsible practices observed in some large-scale mining operations (Basu et al., 2015). Amidst these environmental concerns, there is a growing recognition of the imperative for integrated mechanisms and inclusive stakeholder engagement to harmonize

economic development with sustainable practices (Adomako & Nguyen, 2023). Moreover, Adomako and Nguyen (2023) advocate for the adoption of green management practices, emphasising the critical role of a robust legal framework and effective oversight mechanisms in ensuring environmentally responsible practices within the gold mining industry.

2.6 Understanding small-scale fisheries' vulnerability

Small-scale fisheries communities play a crucial role in the livelihoods of over 200 million people globally, demonstrating diverse structures and cultural dynamics (Chuenpagdee & Jentoft, 2018). Central to understanding the challenges these communities face is the concept of vulnerability and viability within socio-ecological systems, particularly concerning aquatic resources. Vulnerability refers to the susceptibility of these systems to various stressors, including environmental changes, economic pressures, and limited access to capital (Berkes & Nayak, 2018). In contrast, viability signifies the capacity of these communities to adapt and thrive in the face of challenges, thereby ensuring the sustainable use of aquatic resources. Challenges confronting Small-Scale fisheries communities are multifaceted, encompassing weak institutional support, political instability, inadequate economic resources, market pressures, illegal fishing practices, and deficient infrastructure (Bennett et al., 2022). These challenges exacerbate their vulnerability, further underscoring the need for a transdisciplinary approach to address the drivers affecting the ecological, economic, and social dimensions of these communities (Berkes & Nayak, 2018).

2.6.1 Ecological vulnerability

Fisherfolk in the developing nations face challenges such as environmental issues, economic disparities, and conflicts over depleting natural resources (Sowman, 2015). Even though the extractive sectors like gold mining contribute to economies, they pose environmental and health risks, with water utilization and the release of pollutants such as mercury leading to degradation

(Fischer et al., 2015). Further studies by Páez-Osuna et al. (2017) concluded that these pollutants from gold mining enter the food chain, threatens human health and aquatic ecosystems. In addition, both Franco-Hernández et al. (2010) and Sowman (2015) shared similar view that gold mining, while economically beneficial, negatively impacts fisherfolk and their livelihoods, necessitating robust governance structures to balance economic interests and community well-being. Addressing these challenges is crucial for the resilience and long-term viability of Small-Scale fisheries communities (Sowman, 2015).

2.6.2 Economic vulnerability

Gold mining's economic uncertainties and environmental risks create challenges for small-scale fisheries (SSF), impacting the social and economic aspects of these communities (Girard et al., 2022). Following the research by Owusu and Andriesse (2020) they pointed to women in SSF as major groups who face heightened vulnerability due to declining fish catches, leading to livelihood loss. Consequently, these economic hardships drive some, to engage in illegal gold mining (IGM), influenced by factors like social injustice and unemployment as reported by Eduful et al., (2020). Agreeing to this course is (Bene, 2009) who mentioned that poverty exacerbates challenges, impacting local farmers and fishermen, resulting in hunger and poverty. The enduring effects of gold mining on marginalized populations emphasize the need for comprehensive strategies addressing root causes and broader impacts on SSF livelihoods.

2.6.3 Social vulnerability

The decline in fishing activities in the Ankobra river fishery community and neighboring areas over the past 30 years, as highlighted by Effah et al. (2021), has been a matter of significant concern. This decline has been attributed to various factors, with gold mining emerging as a dominant causal agent, according to Bansah et al. (2018). Their study identified adverse impacts

on water bodies, soil, vegetation, and fisheries, resulting in the destruction of livelihoods. The severity of this decline, although not explicitly quantified in the literature, underscores the urgent need for intervention.

Furthermore, Azumah et al. (2021) shed light on the social consequences of this decline in fishing activities. They revealed that the destruction of livelihoods has forced many community members to resort to illegal gold mining as an alternative means of survival, thereby endangering their lives. Additionally, the shift in livelihoods has led to detrimental effects on the community's social fabric, contributing to increased absenteeism and school dropout rates among the youth. This phenomenon, driven by the allure of quick income from gold mining activities, has resulted in a breakdown of societal systems, leading to a rise in social vices such as sexually transmitted diseases, drug addiction, prostitution, teenage pregnancy, and accidental deaths within the community. The multifaceted nature of these issues necessitates holistic approaches that consider historical practices, cultural influences, and the broader consequences on community well-being. Such approaches should not only address the immediate environmental and economic challenges posed by gold mining but also focus on restoring the social cohesion and resilience of the affected communities.

2.7 Moving from Vulnerability to Viability

2.7.1 Resilience

Resilience, as defined by Folke et al. (2010) and Ommer et al. (2014), refers to a system's ability to endure shocks and adapt, albeit with nuanced perspectives when applied to small-scale fisheries communities such as Ankobra. Folke et al. (2010) emphasizes the importance of adaptive processes in protecting the system's core, asserting that resilience-building strategies should focus on

enhancing adaptive capacity to effectively respond to disturbances. They suggest that proactive measures, such as diversifying livelihoods and promoting community-based management, can help mitigate stressors like gold mining and foster adaptive coexistence within the community.

In contrast, Ommer et al. (2014) advocate for a more proactive approach to resilience-building by prioritizing the mitigation of stressors like gold mining before they escalate into significant disruptions. They argue that while adaptive capacity is essential, efforts should be directed towards addressing the root causes of stressors to prevent their adverse impacts on small-scale fisheries communities. Ommer et al. (2014) emphasize the need for integrated governance frameworks and participatory decision-making processes to effectively manage and mitigate the impacts of gold mining on community resilience. The debate between Folke et al. (2010) and Ommer et al. (2014) underscores the complexity of resilience-building in small-scale fisheries communities and highlights the differing perspectives on the role of adaptive processes and proactive interventions in addressing gold mining impacts. While Folke et al. (2010) prioritizes enhancing adaptive capacity, Ommer et al. (2014) emphasize the importance of proactive measures to mitigate stressors and prevent disruptions to community resilience.

2.7.2 Adaptation

Savo et al. (2017) assert that the adaptation of coastal communities, particularly those in Ankobra, relies on a complex interplay of interconnected social and ecological factors. These encompass social norms, worldviews, lifestyles, age, gender, socioeconomic status, as well as cultural standards, and the pervasive impacts of marginalization and inequality processes. The research by Savo et al. (2017) serves as a valuable resource for comprehending the intricate dynamics of adaptability in coastal communities, offering practical insights to enhance resilience in the face of

challenges. Their findings provide a clear roadmap for mitigating setbacks and fortifying overall community resilience, emphasizing the necessity of proactive measures in Ankobra.

2.7.3 Feedback loop between Adaptation and Resilience

There is a feedback loop between adaptation and resilience, wherein adaptation actions contribute to building resilience, and increased resilience, in turn, enables more effective adaptation (Adger, 2000). For instance, adaptive measures implemented by coastal communities to address the impacts of gold mining activities may strengthen social cohesion, improve resource management practices, and enhance local governance structures, thereby increasing the community's overall resilience to future disturbances. In summary, adaptation and resilience are interconnected concepts, with adaptation actions contributing to building resilience and increasing resilience facilitating more effective adaptation. In the context of coastal communities like those in Ankobra, understanding the relationship between adaptation and resilience is crucial for developing strategies to address the challenges they face and enhance their capacity to thrive in the face of environmental and socio-economic uncertainties.

2.7.4 Capital

Capital can be broadly defined as the stock of resources that individuals, communities, or societies possess, utilize to generate wealth, maintain livelihoods, and sustain well-being (Bourdieu, 2018). This definition encompasses various dimensions of capital, each contributing to the overall resource portfolio available to individuals or communities. Gutierrez-Montes et al. (2009) offer a framework that delineates these dimensions into distinct categories (human, financial, physical, social, and natural forms), recognizing the complexity and interconnectedness of resources across multiple domains. These categories of capital are not mutually exclusive but are interconnected and interdependent, influencing each other's dynamics and contributing to overall livelihood outcomes. For instance, investments in education and health (human capital) can lead to increased

productivity and earning potential, thus enhancing financial capital. Similarly, social networks and community cohesion (social capital) can facilitate access to financial resources and opportunities, while also promoting cooperation in natural resource management (natural capital).

Popovici (2018) highlights the consequences of damage to these various forms of capital, including property loss, decreased productivity, social disintegration, economic insecurity, and environmental degradation. Recognizing the interplay between different forms of capital underscores the importance of holistic approaches to sustainable development, which acknowledge the multifaceted nature of resources and the need for integrated strategies to enhance livelihoods and promote prosperity.

2.7.4.1 Natural capital

Lemos et al. (2013) highlight the pivotal role of well-protected natural resources in contributing to community resilience, especially in the context of natural disasters. The shared understanding among scholars is that the preservation of these resources is vital for communities to withstand and recover from environmental shocks. The essential role of natural capital, encompassing crucial elements like water, air, and all living things, is paramount in fostering community adaptability and resilience. However, in addressing impacts from human activities like gold mining in Ankobra, the approach may differ from that pertaining to natural disasters. A comprehensive effort is needed to ensure sustainable environmental practices fortify community resilience against both human-induced and natural catastrophes. This underscores the importance of further research through in-depth exploration and empirical studies to identify specific practices that effectively enhance community resilience, offering practical insights for targeted strategies to mitigate the impact of various environmental challenges.

2.7.4.2 Social capital

Wagner et al. (2008) contribute by emphasizing the measurement of social capital, involving an assessment of the influence of various entities such as networks, corporations, religious institutions, social groups, and organizations on public policy. This perspective underscores the multifaceted nature of social capital, extending beyond interpersonal relationships to encompass broader societal structures. Chow and Chan (2008) bring attention to the critical role of social structure, norms, and trust in fostering a cooperative and collaborative society. Their focus on social cohesion aligns with the broader theme of social capital, emphasizing the interconnectedness and mutual support within communities.

2.7.5 Well-being

Reducing vulnerability requires a holistic strategy, as Nayak and Berkes (2018) explain in their analysis. This involves enhancing the material, relational, and subjective well-being of a system. By prioritizing these dimensions, resilience efforts should recognize the importance of social connections and individual perspectives alongside resource management. In essence, emphasizing the interconnectedness of relational, material, and subjective well-being is crucial for understanding the intricate nature of vulnerability reduction. Recognizing that vulnerability encompasses not only tangible material factors but also the quality of social relationships and individual perceptions underscores the comprehensive approach needed to enhance resilience. This holistic perspective encourages a more nuanced understanding of the multifaceted dimensions that contribute to vulnerability, paving the way for targeted strategies and interventions that address relational, material, and subjective well-being in an integrated manner.

2.7.5.1 Material well-being

The living standards of individuals constitute a key component of human development and survival. Individuals rely on ecological systems that provide resources enabling them to establish

and sustain themselves over an extended period. The proper utilization of these resources not only ensures the accumulation of income but also contributes to wealth creation, thereby enhancing an individual's material well-being (Armitage et al., 2012). Such positive outcomes are predominantly feasible when the environment or ecological system offers an abundance of accessible resources and provides a safe working environment, supporting resilience and fostering an elevated standard of living.

2.7.5.2 Relational well-being

The well-being of individuals is intricately tied to local interactions, and building a stronger society relies on well-coordinated individuals fostering positive relationships. Societal institutions, such as family, educational establishments, religious bodies, and corporate organizations, play crucial roles in establishing structures that promote resilience and viability through shared common goals. With the family serving as the primary institution connecting individuals, children often act as intermediaries in more isolated communities, creating connections with mainstream social worlds through school and friendship networks. Researchers (Castillo & Fenzi-Crossman 2010) examined the impact of family structure and interactions on outcomes for children. However, when a community confronts stressors leading to vulnerability and migration, the breakdown of these structures may ultimately result in the disintegration and destruction of the community.

2.8 Conclusions

In conclusion, the literature review unveils the intricate relationship between gold mining activities and the Ankobra fishery community in Ghana, highlighting the adverse impacts on both economic activities and livelihoods. The study emphasizes the importance of transitioning Small-Scale fisheries from vulnerability to viability in the face of environmental stressors. The review investigates the legal and regulatory frameworks of gold mining, underscoring the persistent

challenges of illegal mining despite governmental efforts. It explores the vulnerabilities of Small-Scale fisheries communities, including ecological, economic, and social aspects, emphasizing the multifaceted nature of challenges faced by these communities.

Furthermore, the review delves into the concept of resilience, acknowledging its dynamic nature and the interconnectedness of different forms of capital (human, financial, physical, social, and natural) in sustaining livelihoods. Theoretical frameworks like the social-ecological systems approach provide a comprehensive lens to understand the complex dynamics of human-environment interactions. The study concludes by asserting the need for holistic strategies to enhance the well-being, adaptive capacity, and resilience of the Ankobra fishery community, considering the interconnected dimensions of material, relational, and subjective well-being.

Chapter 3

Research Design

3.1 General Research Methodology

The transformative worldview adopted for this research emphasizes intertwining research inquiry with political agendas to address social oppression (Mertens, 2010). This approach gives voice to marginalized participants and fosters social change (Creswell & Creswell, 2021). To effectively capture the multifaceted nature of the research topic and ensure comprehensive understanding, a mixed methods research design is employed. Mixed methods research integrates both qualitative and quantitative data (Creswell & Creswell, 2021). Béné's (2009) argument that vulnerability assessments must consider both perceived and unperceived losses-particularly in cases of livelihood erasure-is directly reflected in the design of this study's methodology. By employing a convergent mixed methods approach, this research intentionally combines quantitative surveys, which capture the losses and impacts that community members can readily identify and report, with qualitative interviews and observations that probe deeper into less visible or unarticulated forms of loss. This dual strategy ensures that both the explicit, measurable effects of gold mining on small-scale fisheries communities (perceived losses) and the more subtle, long-term, or culturally embedded impacts (unperceived losses) are systematically documented. Such a comprehensive approach is especially critical in contexts where entire livelihoods are at risk of disappearing, as affected individuals may not always be able to fully recognize or express the extent of their vulnerability. Thus, aligning with Béné's (2009) perspective, the methodology adopted in this study provides a more holistic and accurate assessment of community vulnerability and resilience.

3.2 Study demography

3.2.1 Description of study area

The study was conducted in communities along the Ankobra Basin within the Ellembele district. Three communities; Sanwoma, Eziome and Ajomoro Eshiem were selected for the study (**Figure 2**). The selection of these three communities was based on the need to comprehensively assess the level of impacts. To achieve this, it was essential to prioritize communities located upstream, in the middle belt, and downstream, as their geographical positioning influences their exposure to mining-related effects. Sanwoma, located downstream where the Ankobra River meets the sea, experiences direct ecological and livelihood impacts due to changes in water quality and fishing conditions. Eziome, positioned in the middle belt, serves as a transitional zone where both upstream and downstream influences converge, offering insights into the cumulative effects of gold mining activities. Ajomoro Eshiem, situated upstream near significant gold mining operations, represents the source of environmental stressors affecting the river system (**Figures 3 and 4**)



Figure 2 Map of Lower Ankobra river with five communities

Source: https://www.crc.uri.edu/download/GH2014_ACT081_HM_FIN508.pdf



Figure 3 River Ankobra as it joins the sea at Sanwoma: Photo: Prince Agyapong



Figure 4 River Ankobra as it flows along Eziome and Ajomoro Eshiem; Photo: Prince Agyapong

3.2.2 Interpretation of the convergent mixed methods design model

This study employed a convergent mixed methods design, in which both qualitative and quantitative data were collected and analyzed concurrently to provide a comprehensive understanding of the adaptive responses of small-scale fisheries communities in Ankobra to the impacts of gold mining activities (Creswell & Creswell, 2021). In this approach, qualitative and quantitative data are gathered during the same phase of the research process, analyzed separately, and then merged to identify areas of convergence, divergence, or complementarity (Creswell & Plano Clark, 2018). The qualitative component focused on exploring the ecological, socio-economic, and cultural dimensions of community adaptation through in-depth interviews, participant observations, and focus group discussions. Simultaneously, the quantitative component involved administering structured surveys to capture measurable data on the prevalence and patterns of adaptive strategies, as well as the extent of mining impacts on livelihoods.

After collecting both types of data, the results were analyzed independently. The findings were then integrated to determine how the qualitative insights and quantitative results confirm, complement, or contradict each other (Creswell & Creswell, 2021). This integrated analysis enabled a more robust and nuanced interpretation of the adaptive strategies employed by the

communities, as well as the effectiveness of mitigation measures, by considering ecological, economic, social, and cultural dimensions in parallel. By employing a convergent mixed methods design, the study leveraged the strengths of both qualitative and quantitative approaches, resulting in a richer and more validated understanding of the challenges faced by small-scale fisheries communities and identifying pathways for enhancing their resilience and sustainability (Creswell & Plano Clark, 2018; Creswell & Creswell, 2021).

3.2.3 Data Collection Procedures

3.2.3.1 Qualitative Phase – Interviews

To understand the adaptive measures of Small-Scale fisheries in Ankobra, semi-structured interviews were conducted. These interviews facilitated flexible dialogue between the researcher and participants, allowing exploration of thoughts, feelings, and beliefs on the topic (DeJonckheere & Vaughn, 2019). Additionally, participant observation within the Ankobra small-scale fisheries community provided insights into daily practices and challenges. Thematic analysis was employed to identify key themes and patterns from qualitative data. Open-ended interviews and FGDs provided deeper insights into lived experiences, perceptions, and adaptive strategies. All interviews were audio recorded (with consent) and later transcribed manually for analysis. Field notes were maintained throughout, capturing observations and reflections during the five months of immersion in the communities. Snowball sampling began with chief fishers, who referred the researcher to other key participants. In each community, 10 fisherfolk were interviewed, including women in fish processing/trading, male fishers, and youth (both genders, aged 18–30). Five additional key informants were interviewed from the mining sector, health, government, and NGOs. FGDs explored perceptions of place, resource management, and social impacts of mining.

Approximately 30 small-scale fishers within the three communities in Ankobra were interviewed through household visits using a planned interview protocol (Creswell & Creswell 2021).

3.2.3 Quantitative Methods

3.2.3.2 Survey Questionnaires

Surveys were strategically employed to systematically quantify knowledge, behaviors, and perceptions across the study communities, providing a statistically representative foundation to contextualize and triangulate qualitative findings (Yaddanapudi & Yaddanapudi, 2019). The three communities: Sanwoma, Eziome and Ajomoro Eshiem with populations 3500, 120 and 500 respectively (Effah, 2021). Sample sizes for each community were determined using Yamane's (1967) formula for finite populations, which is suitable for social research involving known population sizes. The formula is:

$$n = \frac{N}{1 + N(e)^2} \quad n = \frac{1}{\frac{1}{N} + (e)^2}$$

where n is the sample size, N is the population size, and e is the margin of error (set at 0.05 for a 95% confidence level). **Table 1** summarizes the population and sample sizes for each study community. This rigorous approach ensured the survey captured population-level trends critical for generalizability, as summarized in Table 1. The actual sample sizes obtained during fieldwork were lower than the calculated targets for each community. These reductions were primarily due to field constraints such as limited availability of respondents and logistical challenges.

Table 1 Sample size determination

Community	Population	Sample Size (Actual)	Typical Formula Outcome ($\alpha=0.05$)	Percentage cut-off (%)
Sanwoma	3,500	259	~359	27.9
Eziome	120	30	~92	67.4
Ajomoro Eshiem	500	89	~222	59.9

3.2.3.3 Perception-Based and categorical questions

To systematically capture respondents' subjective experiences and perceptions, the questionnaire included several perception-based and categorical questions. These questions addressed key issues such as environmental degradation, fish catch decline, income loss, and livelihood disruption. Respondents were asked to select from predefined response categories designed to standardize answers and facilitate comparative analysis. For quantitative estimation, percentage ranges were provided (e.g., 0–25%, 26–50%, 51–75%, 76–100%) to assess the extent of perceived changes or impacts. For qualitative perceptions, categories such as “high,” “moderate,” and “low,” or “increased,” “decreased,” and “stayed the same” were used. This approach enabled the systematic quantification and analysis of subjective data, allowing for clear identification of trends and patterns across the study communities (Bradburn (2004). The use of categorical options ensured consistency in responses, minimized ambiguity, and supported robust statistical analysis of community perceptions regarding the impacts of gold mining on fisheries and livelihoods.

3.3 Data Management, Cleaning, and Analysis

3.3.1 Data Cleaning and Processing

Upon completion of data collection, all quantitative data exported from KoboToolbox to Excel underwent thorough data cleaning. This included checking for missing values, outliers, and inconsistencies, as well as validating data entries against field notes and enumerator logs. Any

discrepancies were resolved through cross-verification with original records. Cleaned data were analyzed in Microsoft Excel. Descriptive statistics summarized trends in socio-economic and ecological impacts. Charts were generated using Excel's PivotChart feature for visual representation of key findings. Where associations or differences among communities needed to be tested, chi-square analysis was conducted to determine statistical significance.

3.3.2 Qualitative Analysis

All interview audio recordings underwent a thorough quality assurance process. Recordings were replayed multiple times to ensure clarity and completeness. Fisher interviews were conducted in the local language, Twi, and were subsequently transcribed in detail to preserve the nuances of participants' responses. Key informant interviews, which were conducted in English, were also transcribed thoroughly. Manual transcription was employed for all interviews to maximize accuracy. The resulting transcripts, together with field notes and summaries from focus group discussions (FGDs), were imported into NVivo qualitative analysis software. NVivo was used to facilitate systematic coding, theme development, and the identification of patterns across the dataset. A hybrid approach was adopted, combining deductive coding based on initial research questions with inductive coding to allow new themes to emerge from the data. This approach supported a rigorous thematic analysis, enabling the extraction of rich insights and ensuring the credibility and reliability of the qualitative findings.

3.3.3. Researcher Reflexivity

3.3.3.1 Reflexivity

Reflexivity was integral to this study. The researcher resided in the study communities for five months, enabling immersion in the daily routines and cultural practices of fisherfolk. Field notes were maintained throughout, capturing personal observations, reflections on the data collection process, emerging insights, and participants' reactions. These memos and notes were used to

support the development of themes and codes, and to critically reflect on the research process and the researcher's positionality (Creswell & Creswell, 2021).

3.3.3.2 Validity and Reliability

To ensure the accuracy and trustworthiness of the study's findings, several strategies were employed. Prolonged engagement in the field allowed for a deeper understanding of the research context and enhanced the credibility of the data. Triangulation was achieved by utilizing multiple data sources and methods, while member checking enabled participants to review and validate the interpretations of their responses. Further, peer review and expert consultation contributed to the rigor of the analysis by providing external perspectives and critical feedback. All transcripts and coding processes were meticulously reviewed to maintain consistency and clarity (Gibbs, 2007). Reflexive memos were used throughout the research process to document how the researcher's interpretations were influenced by cultural, historical, and socio-economic contexts, thereby clarifying potential biases. Criterion validity was addressed by comparing survey results with established measures or objective criteria where possible. Internal consistency reliability was assessed to ensure that survey items consistently measured the intended constructs. These combined approaches strengthened the overall validity and reliability of the research.

3.4 Limitations

Several limitations were recorded in this study:

- **Geographic scope:** The focus on Ankobra river small-scale fisheries communities means that findings may not be generalizable to other regions or countries with different ecological, social, or economic contexts.

- Resource constraints: Limited time and funding restricted the breadth of data collection. In Eziome, the sample size was reduced because many community members were unavailable during the field visit.
- Sample size and participation: The sensitive nature of the research topic-illegal gold mining and its impacts-significantly affected participant recruitment and response rates. In some communities, notably Eziome, there was a low turnout, and in others, several potential participants declined to take part due to concerns about confidentiality or fear of repercussions. Additionally, ongoing migration driven by the impacts of mining further reduced the number of available respondents, resulting in actual sample sizes that were lower than initially targeted.
- Sensitive topic: The surge in illegal gold mining in Ghana during the study period heightened sensitivity around the topic, which may have influenced participants' willingness to engage fully. According to the Ghana Chamber of Mines and media reports, illegal mining (galamsey) activities surged significantly between 2022 and 2024, leading to increased environmental and social tensions in mining-affected communities.

These limitations, particularly those related to sample size and participation, may affect the representativeness and generalizability of the findings. Nevertheless, the study provides valuable insights into the experiences and challenges of Small-Scale fisheries communities along the Ankobra River.

Chapter 4

Exploring the nature of gold mining activities and the key characteristics of Small -Scale fishing industry in Ankobra

4.0 Introduction

Gold and other mineral resources are integral to Ghana's economy, serving as key drivers of export revenue and overall economic stability (Skaten, 2018). The mining sector accounts for 50% of the country's foreign direct investment (FDI) inflows, highlighting its critical role in both national and global economic frameworks (Ampaw et al., 2023). Gold mining in Ghana operates at two distinct levels: large-scale and small-scale. While large-scale mining employs advanced scientific techniques and modern machinery, small-scale mining relies primarily on basic tools for gold extraction (Alhassan et al., 2022). As of 2020, Ghana had sixteen large-scale mineral production enterprises, including fourteen gold mines, one manganese mine, and one bauxite mine (*Minerals Commission, 2021*). Between 2018 and 2020, large-scale gold mining contributed 8,632,418 ounces of gold, accounting for 63.19% of the country's total gold production. Despite the dominance of large-scale mining, small-scale mining remains a significant part of Ghana's mining sector, positioning the country as Africa's leading gold producer and the sixth largest globally. With over a million individuals employed in ASM, the sector holds the potential to generate substantial revenue for the government if effectively regulated to address persistent challenges such as environmental degradation, health risks, informality, inadequate licensing systems, and the disconnect between regulations and local realities. Over time, ASM has undergone various management reforms and is now formalized under the revised Minerals and Mining Act (Act 703, 2006), specifically in sections 81-99, as enforced by the (Minerals Commission, 2021).

Parallel to gold mining, fisheries communities are crucial to the livelihoods of over 200 million people worldwide, with diverse structures and cultural dynamics (Chuenpagdee & Jentoft, 2018).

Ghana's fishery industry plays a vital role in the nation's economy and food security. The sector is composed of both inland and marine fisheries, providing livelihoods for many communities across the country. Despite its significance, the fishery industry contributes about 1.1% to Ghana's GDP, amounting to approximately GHS 1.6 billion (Fisheries Commission, 2021). Small-scale fisheries are often integrated into household livelihood portfolios, which encompass various economic activities, assets, and access to resources (Ellis, 2000). While industrial fishing primarily serves international markets and provides limited direct benefits to local communities (Gillett, 2016), Small-scale fisheries contribute significantly to local food security and economic stability. Fish from small-scale operations are commonly consumed within households or traded in local markets, reinforcing their vital role in sustaining coastal populations (Teh & Sumaila, 2013; Gillett & Tauati, 2018). Located in the western part of Ghana is the Ellembelle district, among the most agriculturally and mineral significant areas of the region (Ministry of Food and Agriculture, n.d.). Bounded to the south by the Gulf of Guinea, the district shares its northern border with the Wassa Amenfi West District and the northeastern Axim Municipality, while the Jomoro District lies to the west. The eastern boundary is defined by the Ankobra river, a major water body separating Ellembelle from the Axim Municipality. Covering approximately 1,468 square kilometers, the district accounts for about 6.8% of the Western Region's total land area. Agriculture remains the primary economic driver, with farming, fishing, and cocoa cultivation serving as the main sources of livelihood. The district's coastal communities depend primarily on fishing, whereas the inland population relies on crop farming. The area is also rich in mineral resources, characterized by an undulating landscape that reaches a maximum elevation of 450 feet above sea level. Its geological formations, including Cambrian-age rocks of the Birimian Formation and Tarkwaian Sandstone-

Association Quartzite, contain valuable mineral deposits such as gold, silica, and kaolin (Ministry of Food and Agriculture, n.d.).

The Ankobra basin, covering an estimated 8,403 km², spans eleven districts, including Wassa Amenfi, Wassa West, and Nzema East. Flowing approximately 190 kilometers southward into the Gulf of Guinea, it is geographically positioned between the Pra Basin to the east and the Tano Basin to the north and west (Hen Mpoano, 2016; Osman et al., 2016). The fishing industry, inclusive of both inland and marine fisheries, plays a crucial role in poverty alleviation and sustenance, making substantial contributions to Ghana's overall gross domestic product (Koomson, 2021). Small-scale fisheries (SSFs) represent a cornerstone of Ghana's fishing activities, supporting millions of livelihoods and contributing significantly to the nation's fish catches (Aheto et al., 2019). The Ankobra River basin, epitomizes the intricate relationship between mining and fisheries. The basin falls within the South-Western Equatorial and Wet Semi-Equatorial climatic zones, characterized by high annual rainfall. The Ankobra River has long supported Small-Scale fisheries, serving as a vital source of food security and income for local communities (Effah et al., 2021). Recognizing its importance, the Ministry of Fisheries and Aquaculture Development (MoFAD) officially designated the Ankobra River Basin as a crucial fish resource reservoir in 2018, emphasizing its role in sustaining local communities (Effah et al., 2021). The estuarine fishery, which includes harvesting shellfish and finfish from freshwater, brackish, and marine environments, is vital to the region's economic and nutritional stability.

Gold mining and small-scale fisheries are two of Ghana's most significant economic activities, especially in riverine communities along the Ankobra river. However, the coexistence of these industries has led to escalating environmental, socioeconomic and political tensions, primarily due to the activities of illegal artisanal small-scale miners, commonly known as "galamsey"—a term

derived from the phrase "gather them and sell" (Bansah et al., 2018). The proliferation of galamsey operations has resulted in severe environmental degradation, including heavy metal contamination, land degradation, and deteriorating water quality. These adverse effects pose significant threats to fish populations and disrupt traditional fishing practices (Obodai et al., 2023), raising concerns about the long-term sustainability of small-scale fisheries and the livelihoods they support (Teh & Sumaila, 2013). Despite the critical role of gold mining in Ghana's economy—driving export revenue and foreign direct investment (Ampaw et al., 2023)—the expansion of illegal mining has placed immense pressure on vulnerable communities. Small-scale fisheries communities, which depend on the Ankobra river for food security, economic sustenance, and cultural preservation, are among the most affected (Effah et al., 2021). Research indicates that elevated levels of arsenic, cadmium, and mercury in soils near mining sites pose severe ecological risks, with gold mining identified as a primary source of heavy metal contamination (Hou et al., 2023). Communities in proximity to these operations face heightened exposure to toxic metals, leading to significant health risks, particularly for vulnerable groups such as pregnant women and children (Ernawati et al., 2024; Hou et al., 2023). A meta-analysis further highlights that individuals residing near gold mines are at substantial risk of non-carcinogenic health effects due to mercury and arsenic exposure (Hou et al., 2023).

The Ghana News Agency reported in September 2023 that five illegal miners were sentenced to a total of 125 years in prison for mining in the Ankobra river without authorization, highlighting the legal repercussions of such activities (GNA, 2023). Despite these enforcement efforts, challenges persist. In April 2024, women in Gwira-Dominasi, a community within the Nzema East Municipality, lamented the lack of potable water, attributing the pollution of the Ankobra river to ongoing illegal mining activities (GNA, 2024). These incidents emphasize the pressing need for

comprehensive strategies to address the environmental degradation and public health concerns arising from unregulated gold mining along the Ankobra river. The ecological disruptions caused by illegal gold mining not only threaten fishery resources but also pose significant health risks to those dependent on the river for their livelihoods (Ernawati et al., 2024). Given the interconnection between gold mining and small-scale fisheries in the Ankobra region, it is essential to examine the nature of mining activities and the defining characteristics of the local fishing industry. This chapter explores the scale, methods, and environmental consequences of gold mining, alongside an analysis of the structure and operations of the small-scale fisheries sector.

4.1 Materials and Methods

The methodological approach for this objective is as described in **Chapter 3 (General Methodology)**. The sampling procedures, data collection techniques, and analysis methods outlined therein were applied to address **(Objective 1)**. No additional methods were employed for this objective.

4.2 Results: Objective 1 (Exploring the nature of gold mining activities and the key characteristics of small-scale fishing industry in Ankobra)

4.2.1 Thematic analysis from interviews

Thematic analysis of interview data in NVivo identified the following key themes (**Table 3, see appendix for complete themes with subthemes**).

Table 2 Summary of themes and subthemes from NVivo analysis

Broad Theme	Description	Number of sources	Number of mentions
Small scale fisheries industry	Structure and Socioeconomic Role of Small-Scale fisheries	40	114
Gold mining activities	Nature and Dynamics of and Small-Scale Mining	42	103
Environmental Impacts	Changes in the natural environment, health	39	201

Livelihood Impacts and Adaptation	Livelihood challenges, coping, adaptation	37	219
Governance and Institutional Response	Governance, policy, compensation, leaders	33	184
Social Structure and Inequality	Social capital, inequality, gender, youth	34	141
Knowledge and Communication	Knowledge gaps, miscommunication, justice	34	63

Note. "No. of Sources" refers to the number of unique interviews or documents in which each theme was identified. "No. of Mentions" refers to the total number of times each theme was referenced across all sources.

The following sections (**Subsection 4.3.1.1 to 4.3.1.7**) present each theme in detail, illustrated with representative quotes and narratives from participants.

4.3.1.1 Theme 1: Structure and Characteristics of small-scale fisheries

The small-scale fisheries in the Ankobra region is central to community livelihoods and food security. Thematic analysis identified three core subthemes: fish species and population, infrastructure and resources, and fishing practices.

Fish Species and Population

The Ankobra estuary supports a diverse range of fish species, including bagrid catfish, cassava croaker, Nile tilapia, and various shellfish. Fishers reported that the estuary serves as a critical nursery and feeding ground, with fish populations fluctuating seasonally. During the rainy season, catches tend to increase, providing essential protein and income for local households.

“We depend on the river for fish like tilapia and catfish. Some months, we catch more, especially when the rains come.” (Fisher, Sanwoma)

Despite this diversity, some participants expressed concern about declining fish stocks, which they attributed to environmental changes and increased competition for resources.

Infrastructure and Resources

Fishing operations in the Ankobra region are largely artisanal, relying on simple gear such as canoes, gill nets, raffia pots, and bamboo traps. Access to modern equipment is limited, and most fishers operate with minimal external support. Community members noted that infrastructure such as storage, processing facilities, and access to markets remains basic.

“We use the nets and canoes handed down from our fathers. There is not much help from outside, and we do most things ourselves.” (Fish processor, Eziome)

Occasionally, government or NGO interventions provide training or equipment, but such support is not consistent across communities.

Fishing Practices

Fishing is conducted year-round, with activity peaking during the rainy season. Practices are largely traditional and adapted to the estuarine environment. Both men and women participate in the fishery, with women often involved in processing and marketing. The Ankobra Community-Based Fisheries Management Association plays a key role in coordinating activities and promoting sustainable practices.

Table 3 Summary of subthemes derived from NVivo analysis of interviews on the structure and characteristics of small-scale fisheries in the Ankobra region

Subtheme	Key Findings	Illustrative Quotes
Fish Species and Population	- The estuary supports diverse species (e.g., bagrid catfish, cassava croaker, Nile tilapia, shellfish). - Functions as a critical nursery and feeding ground. - Seasonal fluctuations, with increased catches during the rainy season. - Concerns about declining stocks due to environmental changes and competition.	<i>“We depend on the river for fish like tilapia and catfish. Some months, we catch more, especially when the rains come.” (Fisher, Sanwoma)</i>
Infrastructure and Resources	- Predominantly operations using simple gear (canoes, gill nets, raffia pots, bamboo traps). - Limited access to modern equipment and external support. - Basic infrastructure for storage, processing, and market access. - Occasional, inconsistent support from government and NGOs.	<i>“We use the nets and canoes handed down from our fathers. There is not much help from outside, and we do most things ourselves.” (Fish processor, Eziome)</i>
Fishing Practices	- Fishing occurs year-round, peaking during the rainy season. - Practices are traditional and adapted to the estuarine environment. - Both men and women participate, with women focused on processing and marketing. - The Ankobra Community-Based Fisheries Management Association coordinates activities and promotes sustainability.	<i>“Everyone in the family helps during the busy season especially from April to September. The association helps us manage the river and solve problems.” (Youth, Ajomoro Eshiem)</i>

4.3.1.2 Theme 2: Nature and Dynamics of Gold Mining Activities

Gold mining is a prominent economic activity in the Ankobra region, shaping both the landscape and the livelihoods of local communities. Thematic analysis revealed three key subthemes: nature and types of gold mining, gold mining related challenges, and gold mining locations and scale.

Nature and types of Gold Mining

Gold mining in Ghana is characterized by two main types: large-scale industrial operations and artisanal/small-scale mining (ASGM). As shown in **Table 5**, large-scale mining accounts for 66% of national gold production, utilizing advanced mechanized techniques and operating primarily in established mining belts. In contrast, ASGM contributes 34% of production, is widespread-often near rivers as illustrated in Figure 6-and relies on manual or semi-mechanized methods. Spatial analysis (see **Figure 6**) reveals that ASGM activity has expanded over recent years, increasingly encroaching on watersheds and rural landscapes. This expansion has heightened environmental concerns, particularly regarding water pollution and deforestation. Table 6 synthesizes the key differences and characteristics of each mining type, providing a comprehensive overview for further discussion.

Table 4 Types and characteristics of gold mining in Ghana based on sector representative interview and literature review

Type of Mining	Share of National Production	Scale/Technology	Spatial Distribution	Environmental Impact	Notes
Large-scale Mining	66%	Industrial, mechanized	Concentrated in established mining belts (e.g., Ashanti, Western Regions)	High, but regulated; land disturbance, water use	Dominated by multinational companies
& Small-scale Mining (ASM)	34%	Manual to semi-mechanized	Widespread, often near rivers and in rural areas (as shown in maps)	High, often unregulated; mercury use, water pollution, deforestation	Provides livelihoods for many rural communities

Note. This summary incorporates spatial insights from the map presented in **Figure 5**.

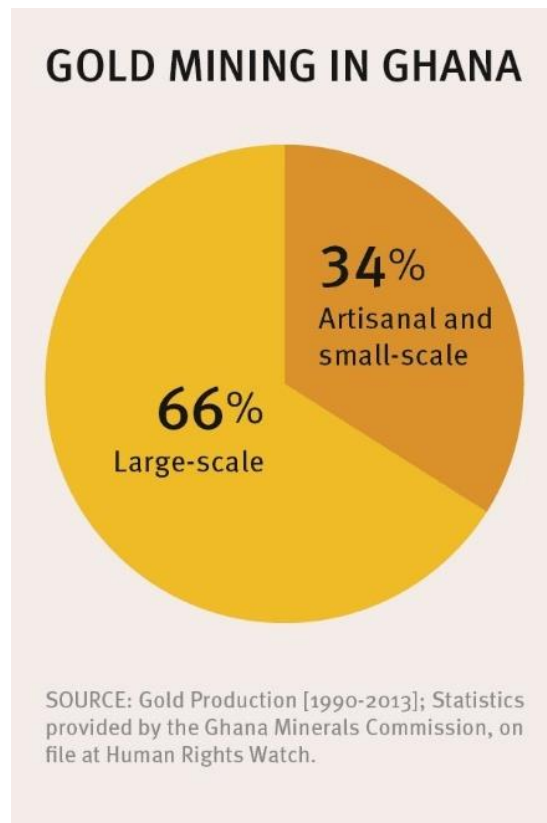


Figure 5 Proportion of gold mining production in Ghana (1990 to 2013)

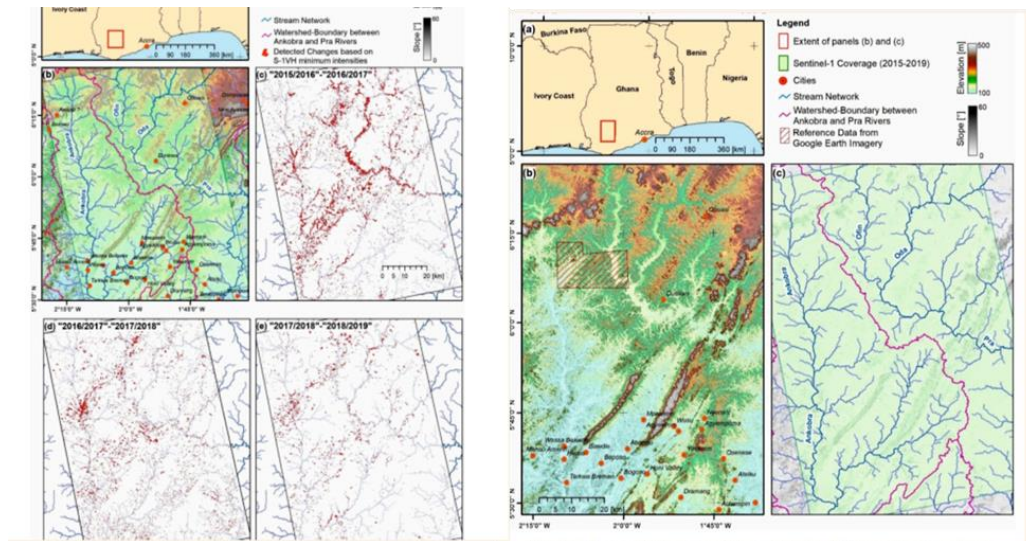


Figure 6 Spatial distribution of and small-scale gold mining sites in the Ankobra watershed, 2018–2022. Data derived from satellite imagery analysis (Source: <https://storymaps.arcgis.com/stories/a703a139298f4b759103947f9fbb7d2d>)

The earlier tables (**Tables 5**) provided an overview of the types and spatial scale of gold mining activities in Ghana, distinguishing between large-scale, small-scale, and operations. These data highlighted the predominance of artisanal and small-scale mining (ASGM), especially in areas close to riverbanks and upstream locations, as further illustrated by the spatial distribution in Figure 6. The prevalence of artisanal and small-scale mechanized mining, much of it unlicensed, aligns with both the spatial data and community testimonies:

“There are many people mining in the river but not here. It is mostly done upstream, and some do it with machines and others with just shovels. Not everyone has a license.” (Community chief fisher, Eziome).

These statements were further expanded by a representative from large scale mining sector, who outlined the activities of a licensed large scale mining company (Newmont Ghana) and its operations. He said:

“Newmont operates large-scale, regulated mining operations. It does not operate gold ore washing activities in the Ankobra region. The company’s mining process involves crushing, grinding, flotation, and carbon-in-leach (CIL) processing at well-established sites. He further added that: “Large-scale mining at Newmont is fully regulated, with strict environmental and safety standards. ASM operations, however, are often informal and unregulated. Newmont’s mining by-products include tailings, waste rock, and process water, all of which are managed through tailings storage facilities, water treatment plants, and environmental monitoring. The Ankobra River region is more associated with artisanal and small-scale mining (ASM), which uses mercury and rudimentary washing techniques”. (Representative, mining sector).

As shown in Table 6, (manual) mining is largely unregulated, relies on basic tools, and is labor-intensive, while small-scale mechanized operations-though sometimes licensed-raise significant environmental concerns due to their use of dredges and pumps. The phenomenon of galamsey is particularly problematic, involving both local and migrant participants, and is associated with high environmental and health risks due to practices such as mercury use and in-river dredging. This detailed typology complements the earlier quantitative findings, illustrating how the diversity of mining practices contributes to the complex socio-environmental landscape of gold mining in Ankobra.

Table 5 Classification of gold mining types in Ankobra by legal status, methods, participants and environmental impacts from interviews and literature.

Type of Mining	Legal Status	Methods Used	Main Participants	Typical Locations	Notable Features/Issues
(manual)	Mostly illegal	Shovels, pans, sluices	Local men, some migrants	Riverbanks, upstream	Low cost, high labor, often unregulated
Small-scale mechanized	Some licensed	Small dredges, pumps	Locals, migrant workers	River, river basin	More productive, environmental concerns
Galamsey (illegal)	Illegal	Dredging, mercury use	Migrants, youth, locals	Within river, hidden sites	High environmental impact, health risk

Note. In this study, “galamsey” is presented as a distinct category based on local interviews and field observations, where it refers specifically to clandestine, illegal mining operations, often involving higher environmental risks. However, in much of the academic literature, “galamsey” is broadly synonymous with informal or illegal artisanal and small-scale mining (ASM) in Ghana.

Gold Mining Related Challenges

Illegal artisanal gold mining activities have led to significant environmental and social challenges, including water pollution, land degradation, and conflicts with other resource users. Participants

described how mining has contributed to the decline of fish populations, reduced water quality, and increased competition for land and resources.

“The galamsey makes the water dirty and kills the fish. We have lost everything. The river is just dead, we don’t use it anymore. We only rely on the ocean.” (Fisher, Sanwoma)

Enforcement of mining regulations is often weak, and efforts to address these challenges have had limited success.

Gold Mining Locations and Scale

Gold mining is widespread especially the unregulated ones along the Ankobra River and its tributaries, with certain communities more heavily impacted than others (see **Figure 2**). The scale of operations varies from individual miners to organized groups, and mining hotspots are often located near accessible riverbanks and forested areas.

“Mining, mainly galamsey is everywhere along the river. Some places have big machines, while others are just small groups working together.” (Representative, Environmental Protection Agency).

These findings show the central role of both small-scale fisheries and gold mining in the Ankobra region. While the fishery provides critical food and income, it faces challenges from environmental degradation and resource competition driven by expanding mining activities. Understanding the structure and dynamics of these sectors is essential for developing effective management and policy interventions.

4.3.1.3 Theme 3: Environmental Impacts

Illegal ASGM mining in the Ankobra region has led to a wide range of environmental impacts, as consistently described by community members and local stakeholders. The most immediate concern is pollution: participants reported severe water contamination, increased turbidity, and the

presence of toxic substances such as mercury and arsenic in the Ankobra River. As one fisher from Sanwoma explained, *“The river is no longer clear. Sometimes we see oil and chemicals floating on the surface, and the water smells so bad.”* (Fisher, Sanwoma).

Beyond pollution, many respondents connected environmental degradation to broader climate change impacts, noting changes in weather patterns and increased unpredictability of rainfall. These shifts were often attributed to deforestation and land degradation caused by mining activities. A community elder from Eziome observed,

“The rains don’t come as they used to, and the sun is much hotter. We believe it’s because the trees are gone, and the land is bare. The illegal miners have cut down most of our trees in the forest.” (Chief fisher, Eziome).

Some participants acknowledged ongoing or past efforts to restore degraded land and water bodies, such as community tree planting and riverbank stabilization projects. However, these efforts were widely viewed as inadequate given the scale of destruction. As a youth fisher from Ajomoro Eshiem stated,

“We have planted trees along the river, but the mining continues, and it’s hard to see real change.” (Fisher, Ajomoro Eshiem). The loss of habitat and biodiversity was another recurring concern. Many noted the decline in fish populations and the disappearance of certain plant and animal species.

“We used to see many birds and animals around the river, but now they are gone. Even the fish are fewer,” (Fisher Eziome).

Resource scarcity, especially regarding clean water and fertile land, was also frequently mentioned. Participants described difficulties accessing safe drinking water and reduced agricultural

productivity due to polluted soils and water sources. One farmer from Sanwoma shared, *“We now have to walk long distances to fetch clean water, and our farms don’t yield as much as before because anytime we try to irrigate or spray our cocoa farms with the river, it burns the crops completely due to the chemicals.”* (Farmer, Sanwoma)

These findings collectively demonstrate the breadth and depth of environmental impacts experienced by communities along the Ankobra River. While some restoration efforts exist, the scale of mining-related damage continues to threaten local livelihoods and natural resources.

Table 6 Summary of environmental impacts of Illegal ASGM in Ankobra region on fisheries

Subtheme	Key Impact/Observation	Example Quote
Pollution	Water contamination, mercury/arsenic, turbidity	<i>“The river is no longer clear... chemicals floating...”</i>
Climate Change Impacts	Unpredictable rainfall, hotter temperatures	<i>“The rains don’t come as they used to, and the sun is much hotter.”</i>
Ecosystem Restoration	Tree planting, riverbank stabilization (seen as inadequate)	<i>“We have planted trees... but the mining continues...”</i>
Habitat & Biodiversity	Loss of fish, birds, wildlife	<i>“We used to see many birds and animals... now they are gone.”</i>
Resource Scarcity	Scarcity of clean water, poor crop yields	<i>“We now have to walk long distances to fetch clean water...”</i>

4.3.1.4 Theme 4- Livelihood impacts and adaptation

Illegal ASGM rise in the Ankobra region has profoundly affected the livelihoods of fishing communities. Interview analysis revealed that resource scarcity, economic vulnerability, and health impacts are deeply interconnected, creating a cycle of hardship for local residents.

A central concern is resource scarcity, particularly the shortage of clean water and declining fish stocks. Pollution from mining has degraded water quality, making it unsafe for consumption and reducing fish populations vital to local livelihoods. As one fisher from Sanwoma explained,

“We now struggle to find clean water for drinking and for our homes. The river is polluted, and the fish are disappearing.”

Economic vulnerability has also increased as a result of these changes. With declining fish stocks, reduced agricultural productivity, and the loss of alternative livelihood options, many fishers report lower daily incomes and greater difficulty sustaining their families. Some have been forced to diversify into other activities or migrate in search of work. A fish processor from Eziome shared,

“Before the mining, we could rely on fishing and farming. Now, both are difficult, and we have to look for other ways to survive.”

Health impacts further compound these livelihood challenges. Community members report increased illness due to contaminated water, as well as accidents and the spread of diseases linked to mining activities and social disruption. A community health worker from Axim Government Hospital noted,

“Many people are getting sick from the water; and there are more accidents now with the mining around (District health worker)”

Research highlights that health impacts in mining regions are complex, involving both direct (chemical exposure, waterborne disease) and indirect (food insecurity, social stress) pathways. Despite some interventions, negative health outcomes remain prevalent in affected communities.

These findings illustrate how gold mining has created a cycle of resource scarcity, economic vulnerability, and health risks for small-scale fishing communities along the Ankobra River. While some community members attempt to adapt through diversification or migration, the cumulative pressures threaten the viability of traditional livelihoods and overall well-being.

Table 7 Summary of livelihood impacts of Illegal ASGM in Ankobra region

Subtheme	Key Impact/Observation	Example Quote
Resource Scarcity	Shortage of clean water, declining fish stocks, degraded natural resources	<i>“We now struggle to find clean water... the fish are disappearing.”</i>
Economic Vulnerability	Lower incomes, loss of livelihood options, need for diversification/migration	<i>“Before the mining, we could rely on fishing and farming. Now... ”</i>
Health Impacts	Increased illness, waterborne disease, accidents, food insecurity, stress	<i>“Many people are getting sick from the water... more accidents...”</i>

4.3.1.5 Theme 5- Governance and Institutional Response

The governance of gold mining activities in the Ankobra region is shaped by complex institutional arrangements and persistent challenges. Interview analysis revealed that enforcement challenges, fragmented regulatory frameworks, limited government effectiveness, and persistent policy gaps all contribute to ongoing difficulties in managing mining activities. A central issue raised by community members is the challenge of enforcement. Despite the existence of mining laws and periodic interventions by police or military, many illegal artisanal and small-scale miners continue to operate without licenses due to bureaucratic and costly processes. As a community leader from Eziome observed,

“We see the police and soldiers come to stop the mining, but after some time, the miners come back. It is like a cycle (Chief fisher, Eziome)

Corruption and political interference further undermine enforcement efforts, with some officials reportedly benefiting from illegal mining activities.

Participants also described the regulatory environment as fragmented and confusing, with overlapping responsibilities among agencies and little effective coordination.

“There are many rules, but it is not clear who is really in charge. Sometimes, the agencies do not even talk to each other,” (Fisher, Sanwoma).

The high cost and complexity of obtaining legal status discourage many small-scale miners from formalizing their operations. Government interventions have included the creation of special committees, temporary bans, and community mining programs. While these initiatives are intended to promote responsible mining, participants expressed skepticism about their effectiveness, citing a lack of sustained impact and limited community involvement. As a fish processor from Ajomoro Eshiem stated,

“The government says they are helping, but we do not see much change. The mining still goes on, and we are not really involved in the decisions (Fishmonger, Ajomoro Eshiem).

Local authorities often lack the resources and authority to enforce regulations effectively, further limiting the reach of government responses. Despite numerous policy initiatives, significant gaps remain. Participants highlighted insufficient community engagement, weak monitoring, and a lack of political will to prosecute offenders as ongoing issues.

“Policies are made in Accra, but those of us affected by mining are not consulted. Sometimes, it feels like our voices do not matter (Fisher, Eziome).

There is a widespread perception that policies prioritize top-down enforcement over participatory governance, limiting the effectiveness of interventions. These findings reveal that governance and institutional responses to gold mining in the Ankobra region are characterized by enforcement challenges, fragmented regulatory frameworks, limited government effectiveness, and persistent policy gaps. While efforts have been made to address illegal mining, the lack of coordination, transparency, and community participation continues to undermine progress.

Table 8 Summary of governance and institutional response issues in Ankobra region

Subtheme	Key Issue/Observation	Example Quote
Enforcement Challenges	Laws not consistently enforced; miners return after interventions; corruption	<i>“We see the police and soldiers... but the miners come back. It is like a cycle.”</i>
Regulatory Frameworks	Overlapping agency roles; lack of coordination; costly/legal complexity	<i>“There are many rules, but it is not clear who is really in charge.”</i>
Government Response	Temporary bans, committees, community mining programs; limited impact	<i>“The government says they are helping, but we do not see much change.”</i>
Policy Gaps/Inadequacies	Weak monitoring, little community input, lack of political will	<i>“Policies are made in Accra... Sometimes, it feels like our voices do not matter.”</i>

4.3.1.6 Theme 6: Social Structure and Inequality

The social fabric of Ankobra’s small-scale fishing and mining communities is shaped by persistent inequalities and evolving relationships. Economic disparities are evident both within and between communities. The expansion and rise in artisanal and small-scale gold mining has created new opportunities for some but has also widened the gap between those with access to mining profits and those who remain dependent on increasingly precarious fishing livelihoods. As a fisher from Ajomoro Eshiem noted,

“We see some people getting rich from mining, but for most of us, life is getting harder. The prices go up, but our income does not.”

These inequalities are further exacerbated by limited access to basic services, infrastructure, and alternative sources of income, especially for those outside the mining sector. Gender roles remain pronounced in resource use and management. Men dominate fishing and mining, while women are more involved in processing, trading, and, in some cases, mangrove management and restoration. Women and girls also bear a disproportionate burden in household tasks, such as water collection, which limits their time for education and economic activities.

“Young men go to the mines or fish, but girls have to help at home or sell fish. It’s not easy for them to get ahead. They don’t even listen to us when we speak (Fish processor, Sanwoma)

Youth engagement is mixed; while some young people migrate to mining areas seeking quick income, others participate in community-based resource management or alternative livelihoods like aquaculture. However, limited opportunities and social expectations often constrain the full participation of both women and youth. Social ties, including kinship, community associations, and traditional authority, remain central to resource management and daily life. Community groups often self-organize around resource use, with rules and sanctions applied to all members. However, the influx of migrants for mining and the changing economic landscape have strained some traditional relationships and social cohesion.

“People used to work together more, but now there is more competition and sometimes conflict, especially with newcomers. The blame game has started between fishers and people in the community accused of being involved in illegal gold mining. We have been living at peace in the community before these issues started (Chief fisher, Eziome)

Despite these challenges, strong social networks continue to provide support and facilitate collective action, particularly in times of hardship. These findings highlight how economic and gender inequalities, alongside evolving social ties, shape the experiences and opportunities of individuals and groups in the Ankobra region. Addressing these disparities and strengthening social cohesion are essential for promoting inclusive and sustainable development.

Table 9 Summary of social and inequality in Ankobra region

Subtheme	Key Impact/Observation	Example Quote
Economic Inequality	Wealth gap between miners and fishers; limited access to services and opportunities	<i>“We see some people getting rich from mining, but for most of us, life is getting harder.”</i>
Gender Inequality & Youth	Men dominate mining/fishing; women/youth face barriers in participation and decision-making	<i>“Young men go to the mines or fish, but girls have to help at home or sell fish.”</i>
Social Ties & Relationships	Kinship and community groups central, but strained by migration and competition	<i>“People used to work together more, but now there is more competition and sometimes conflict.”</i>

4.3.1.7 Knowledge and Communication

Knowledge gaps and miscommunication present significant barriers to effective resource management and community development in the Ankobra region. Many community members lack adequate information about the environmental and health risks associated with gold mining and unsustainable fishing practices. Limited access to formal education and public awareness campaigns has contributed to misconceptions about pollution, resource depletion, and the long-term impacts of current activities.

“Some people don’t know how the mining affects the river or our health. They just see it as a way to make money (Fisher, Sanwoma)”

This lack of awareness undermines efforts to promote sustainable practices and hinders community participation in conservation initiatives. Participants also reported that engagement with government agencies, NGOs, and mining companies is often superficial or inconsistent. Consultations and meetings are sometimes held without genuine dialogue or follow-up, leaving community members feeling excluded from decision-making processes.

“They come and talk to us, but we don’t see any real changes or get a chance to share our ideas
(Chief fisher, Eziome).

This ineffective engagement leads to mistrust, reduces the uptake of new policies or interventions, and perpetuates a sense of powerlessness among residents. A further challenge is the notable shortage of technical skills related to both sustainable resource management and alternative livelihoods. Many fishers and miners lack training in improved methods, safety practices, and value addition, limiting their ability to adapt to changing conditions or benefit from new opportunities.

“We want to learn new ways to fish or farm, but there are not enough trainings or support (Fish processor, Ajomoro Eshiem).

Bridging these technical knowledge gaps is essential for enhancing resilience and supporting long-term community development. These findings demonstrate that knowledge gaps and miscommunication hinder effective management of natural resources and limit the capacity of communities to respond to environmental and economic challenges. Addressing these issues through targeted education, inclusive engagement, and technical training will be crucial for fostering sustainable and resilient livelihoods in the Ankobra region.

Table 10 Summary of knowledge and communication issues in Ankobra region

Subtheme	Key Impact/Observation	Example Quote
Awareness and Education	Limited understanding of environmental/health risks; misconceptions persist	<i>“Some people don’t know how the mining affects the river or our health.”</i>
Ineffective Community Engagement	Superficial consultations; lack of genuine dialogue; exclusion from decisions	<i>“They come and talk to us, but we don’t see any real changes or get a chance to share our ideas.”</i>
Knowledge Gaps in Technical Skills	Shortage of training in sustainable practices and alternative livelihoods	<i>“We want to learn new ways to fish or farm, but there are not enough trainings or support.”</i>

4.4 Demographic profile of respondents: A mixed-methods perspective

The demographic profile of respondents from Sanwoma, Eziome, and Ajomoro Eshiem provides essential context for understanding the diverse experiences and perspectives within these communities. Factors such as age, gender, education level, and socio-economic activities influence how individuals engage with and are affected by illegal ASGM and fishing livelihoods. For instance, gender roles shape participation in fishing versus mining-related activities, while education levels may affect awareness of environmental and health risks associated with mining. Age and fishing experience can also impact vulnerability and adaptive capacity to changing resource availability. By presenting these socio-demographic characteristics, this study ensures that subsequent thematic analyses and discussions are grounded in the lived realities of the participants, allowing for a more nuanced interpretation of the social, economic, and environmental impacts of gold mining in the Ankobra region

Table 11 Socio-demographic characteristics of respondents

Characteristics	Sanwoma	Eziome	Ajomoro Eshiem	Total
Sex of respondent				
Male	183	13	53	249
Female	76	17	36	129
Age Distribution				
18-30	51	3	7	61
31-40	52	5	18	75
41-50	100	7	33	140
51-60	43	13	20	76
61 and above	13	2	11	26
Marital status				
Cohabiting	9	0	0	9
Divorced	28	5	6	39
Married	126	22	74	222
Single	86	3	5	94
Widowed	10	0	4	14
Size of household				
01-05	99	18	54	171
06-10	141	7	33	181
11-15	19	5	2	26
16-20	0	0	0	0
20 and above	0	0	0	0
Education background				
No former education	102	15	51	168
Primary	54	8	18	80
Junior high	11	4	6	21
Secondary	64	1	12	77
Vocational/Technical	14	0	1	15
Higher education	14	2	1	17
Years of fishing experience				
Less than 1 year	15	4	1	20
1-5 years	54	6	13	73
6-10 years	75	5	25	105
More than 10 years	115	15	50	180
Socio-economic characteristics				
Farming	36	16	68	120
Fish processing and trading	9	0	0	9
Fishing	171	8	18	197
Fish mongering	20	0	0	20
Not currently engaged in fishing	23	6	3	32

4.4.1 Interpretation of Results- Socio-Demographic characteristics

Across all three communities, males constitute the majority of respondents, with Sanwoma having the highest proportion (183 out of 259). However, Eziome (17 out of 30) and Ajomoro Eshiem (36 out of 89) show a more balanced or even female-skewed distribution, suggesting community-specific gender dynamics (**Table 14**). Interviews and focus groups confirm traditional gender roles: men primarily engage in fishing, while women dominate post-harvest activities such as processing and trade. As a fishmonger in Sanwoma explained,

"We get it from the fishermen. Without their catch, we have nothing to sell." (Fishmoner, Sanwoma)

A young fish processor from Eziome described the marketing role of women:

"When the men bring in their catch from the river, we used to take it to Dominase to sell and earn some money." (Fish processor, Eziome). In Ajomoro Eshiem, male fisher mentioned outmigration of the youth for work in the community:

"Most of us tend to move out of the community to other places to work. I have had some of my friends leave this community to Dominase and Esiama due to the current situation." (Fisher, Ajomoro Eshiem).

The quantitative gender distribution is supported by qualitative accounts of traditional labor divisions, but the higher female presence in some communities is explained by male migration-a nuance captured only through qualitative data. The largest age group is 41–50 years (140 out of 378, 37%), especially in Sanwoma. The youth (18–30 years) are underrepresented (61 out of 378, 16%). The dominance of middle-aged fishers suggests extensive experience in the sector. The low number of young fishers may point to a generational shift away from fishing, possibly toward alternative livelihoods or outmigration.

“The youth no longer want to be fishing because they don’t see any future in it. They make up the majority in this town but most of them have also migrated” (Chief fisher, Sanwoma)

Most respondents are married (222 out of 378, 59%), with Sanwoma having the highest number. Single respondents are also notable (94 individuals), especially in Sanwoma. Cohabitation is minimal and observed only in Sanwoma. Again, most households have 6–10 members (181 out of 378, 48%), with nearly as many having 1–5 members (171 out of 378, 45%). No households reported more than 15 members. Interviewees described extended family living arrangements, balancing economic dependency with available resources.

“We used to live together as a large family and took care of each others needs. The issue is not like that anymore as our main livelihood is destroyed.” (Chief fisher, Ajomoro Eshiem). The moderate household sizes seen in the survey are explained in interviews as a practical adaptation to economic realities and social norms. Education levels are low: 44% (168 out of 378) have no formal education, especially in Ajomoro Eshiem. Only 17 respondents have higher education. The predominance of informal education is seen as a barrier to economic diversification and resilience. Limited access to advanced learning restricts alternative livelihood options. In an interview a fishmonger expressed worry over lack of educational facilities in the community leading to high illiteracy rate in the community.

“We don’t have any school in this community. My son is 9 years old and hasn’t been to school yet because we don’t have any”. (Fishmonger, Eziome)

A majority (180 out of 378) have more than 10 years of fishing experience, with Sanwoma leading. Few (20) have less than one year’s experience. Fishing has been a long-time practise and has been passed on from generation to generation. Majority of the fishers having more than 10 years experience showed the magnitude of benefits they have in this occupation.

“Oh yes, this is all I know and love to do. My dad did it and passed it on to me. I am also trying to pass it on to my son. Unfortunately, he is not showing much interest because he sees no future in it for him. Its primarily because of the current situation we are faced with”. (Fisher, Eziome).

Together, these quantitative and qualitative insights highlight both the depth of experience among current fishers and the emerging challenges to sustaining this tradition in the face of changing socio-economic and environmental conditions. Fishing is the dominant occupation (197 out of 378, 52%), especially in Sanwoma. Ajomoro Eshiem shows a shift toward farming (68 respondents). Some (32) are not engaged in fishing-related activities. A respondent from Eziome highlighted a shift to farming:

"I am a farmer; I grow cocoa and that has sustained me." (Fisher, Eziome).

Fish processing and mongering are exclusive to Sanwoma, likely due to proximity to the ocean. Some respondents reported abandoning fishing due to mining impacts:

“Many fishers have abandoned their equipment.” Livelihood diversification is evident, as one fish processor shared:

“I do other business, like porridge selling and selling of mangrove fibrewoods.” (Fish processor, Sanwoma).

Quantitative data show fishing’s dominance but also diversification, while qualitative data explain these shifts as adaptive responses to environmental and economic pressures, especially mining.

Table 12 Summary of demographic triangulation

Demographic Domain	Quantitative Result	Qualitative Insight/Quote
Sex	Mostly male, but more balanced in some areas	<i>Male outmigration; women in post-harvest roles; “We get it from the fishermen...”</i>
Age	Majority 41–50 years; few youth	<i>Youth less interested in fishing; possible shift to other livelihoods</i>
Marital Status	59% married; some single, little cohabitation	<i>Reflects social stability and possible economic/cultural variation</i>
Household Size	Most 6–10 members	<i>Extended family structures common; balance of dependency and resources</i>
Education	44% no formal education	<i>Low education limits adaptation and diversification</i>
Fishing Experience	Majority >10 years; few new entrants	<i>Long-term reliance on fishing; new entrants deterred by sector decline</i>
Socio-Economic	Fishing dominant, some farming/diversification	<i>“I am a farmer...”, “Many fishers have abandoned equipment”, “I do other business...”</i>

Integrative Narrative

This mixed-methods demographic profile reveals communities deeply rooted in fishing, with traditional gender roles and extended family structures. However, qualitative insights highlight dynamic responses to changing conditions: male outmigration, livelihood diversification, and adaptation to environmental and economic pressures, particularly those linked to gold mining. Low educational attainment and an aging workforce may pose challenges for future resilience and adaptation.

4.5 Extent illegal ASGM and socio-economic characteristics of small-scale fisheries in the Ankobra River

Illegal ASGM activities have become a challenging issue facing fishing communities along the Ankobra River, affecting the daily lives and livelihoods of small-scale fisheries. This section

explores how frequently fishers encounter mining operations, their access to fishing equipment and community support. It also examines their household income levels and the number of dependents they support, providing a clearer picture of their socioeconomic conditions. The following charts illustrate these key socioeconomic factors, offering insights into the challenges and realities faced by fishers in the region (**Figures 7–11**) provide a visual representation of these findings.

4.5.1.1 survey analysis on size of fishers' fishing operations

The results show that Sanwoma had the highest number of small-scale fisheries, with 151 respondents reporting fishing activities involving 1-5 crew members. This highlights the prominence of Small-Scale fisheries in the community, where local fishers typically rely on family-based or small-team operations rather than large commercial endeavors. Additionally, 48 individuals engage in subsistence fishing, while 32 participate in medium-scale fishing (6-10 crew members). Notably, 28 respondents fall under the "Not Applicable" category, indicating that a portion of the community does not participate in fishing. Ajomoro Eshiem also had a significant number of Small-Scale fisheries (68 respondents), but this number is far lower than in Sanwoma. The number of subsistence fishers (18 respondents) is slightly higher than in Eziome but still lower than in Sanwoma. The medium-scale fishing category is almost non-existent, with just one respondent. The presence of a relatively high number (2 respondents) in the "Not Applicable" category suggests that some members of the community are not directly involved in fishing, possibly engaging in alternative livelihoods. Eziome showed the lowest fishing activity among the three communities. Only 22 respondents are engaged in Small-Scale fisheries, while 7 are involved in subsistence fishing. The medium-scale fishing category has no participants (0 respondents), suggesting that fishing operations are more constrained in this community (**Figure 7**). A fisher from Eshiem shared,

“The industry was booming, and we had lots of fish. We used canoes and simple nets for fishing, especially during the rainy season. We drank from the river and used it for our daily activities.”
(Fisher, Ajomoro Eshiem).

This statement highlights the reliance on low-tech, sustainable methods and intimate knowledge of local ecosystems—hallmarks of Small-Scale fisheries industries. In line with this, during a focus group discussion, several fishermen in Sanwoma emphasized the community's engagement in beach seining and paddling, both of which are characteristic techniques of Small-Scale fisheries. These methods are labor-intensive, localized, and often carried out with basic equipment, which contrasts sharply with industrial fishing practices that rely on mechanized vessels and larger crews. The chief fisherman in Eziome further described their operations, saying,

“We used nets and canoes and woven baskets.” (Chief fisher, Eziome).

His testimony reinforces the notion of Small-Scale fisheries as a flexible, hands-on industry that prioritizes traditional, low-capital methods over the industrialized approaches seen in larger-scale fisheries. This reliance on simple tools and smaller crews speaks to the sustainability and community-centered nature of Small-Scale fisheries, as opposed to the resource-heavy demands of large commercial operations.

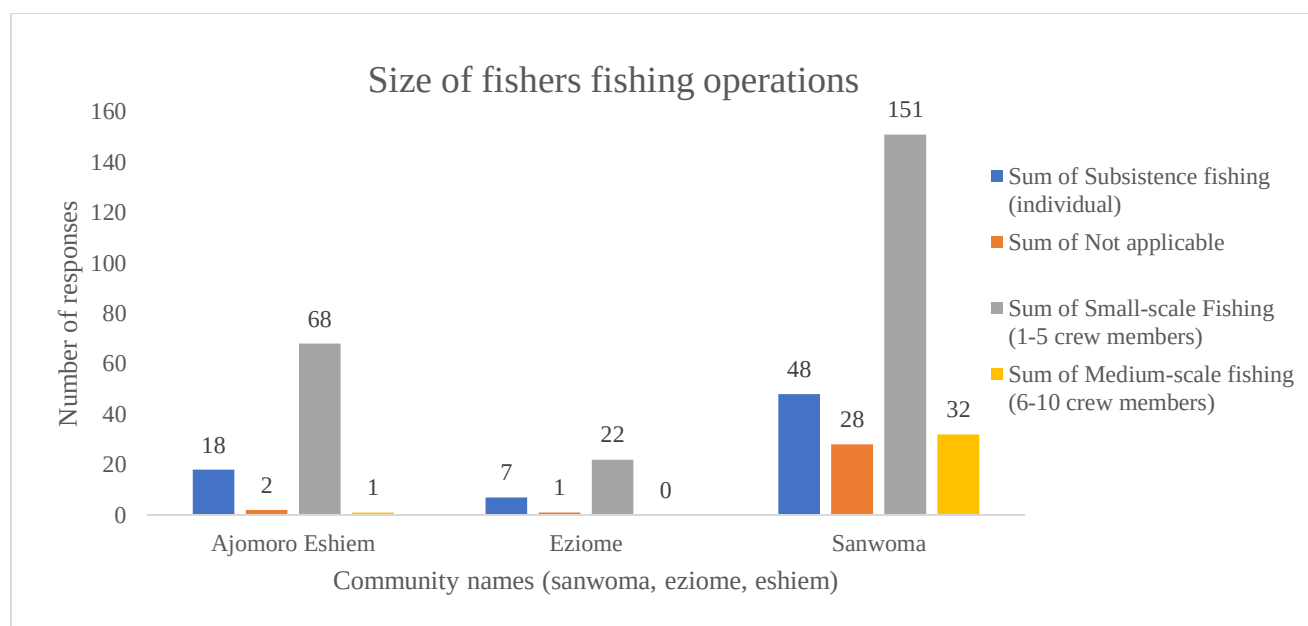


Figure 7 Size of fishers fishing operations within the Ankobra region

4.5.1.2 survey analysis on fishers' ownership of fishing equipment after illegal ASGM impacts

In Sanwoma, the largest proportion of respondents (41.3%) own some fishing equipment but also rent or borrow, showing a mix of ownership and dependency on external resources. Additionally, 25.1% of respondents rely entirely on renting or borrowing, reinforcing the idea that many fishers face financial constraints that prevent them from fully owning their fishing tools. Meanwhile, 20.5% do not use any fishing equipment, suggesting engagement in alternative livelihoods. Only 13.1% of respondents own all their fishing equipment, demonstrating that full independence in fishing operations is relatively uncommon in this community.

In Eziome, a significant percentage (43.3%) indicated that they do not use any fishing equipment due to the gold mining issues, suggesting that a large portion of respondents may not be directly engaged in fishing. Among those involved, 40% own some equipment but also rent or borrow, showing a shared reliance on available resources. However, only 13.3% of fishers own all their equipment, indicating that full ownership is limited, while 3.3% depend entirely on renting or borrowing. The low percentage of respondents relying solely on rented equipment suggests that

financial barriers or limited access to shared fishing resources could be shaping ownership dynamics in this community.

In Ajomoro Eshiem, nearly half of the respondents (48.3%) own some equipment but also rent or borrow, suggesting a similar trend of mixed ownership and dependency. Meanwhile, 24.7% reported not using any fishing equipment, which could indicate the presence of alternative livelihood strategies. A relatively higher proportion of fishers (19.1%) in Eshiem reported full ownership of their fishing equipment compared to the other communities, suggesting a slightly stronger fishing asset base. However, 7.9% depend entirely on renting or borrowing, demonstrating that a segment of the community still lacks access to independent fishing operations. Overall, these findings highlight that across the three communities, full ownership of fishing equipment is relatively low, with most fishers either renting, borrowing, or partially owning their gear (**Figure 8**). A testimony by the chief fisher in Sanwoma, stated,

12 canoes, some are even spoilt, so what we do is, we collaborate and share fishing equipment so we can share the money, especially for those with spoilt canoes.” (Chief fisher, Sanwoma).

This explains how fishers in the community rely on collective strategies to sustain their livelihoods despite equipment shortages. A fisher from Eshiem emphasized the difficulty of acquiring fishing tools, stating,

“The fishing equipment is not very available in this community.” (Fisher, Ajomoro Eshiem).

This reinforces the idea that fishers often have to share, rent, or borrow tools to sustain their livelihoods.

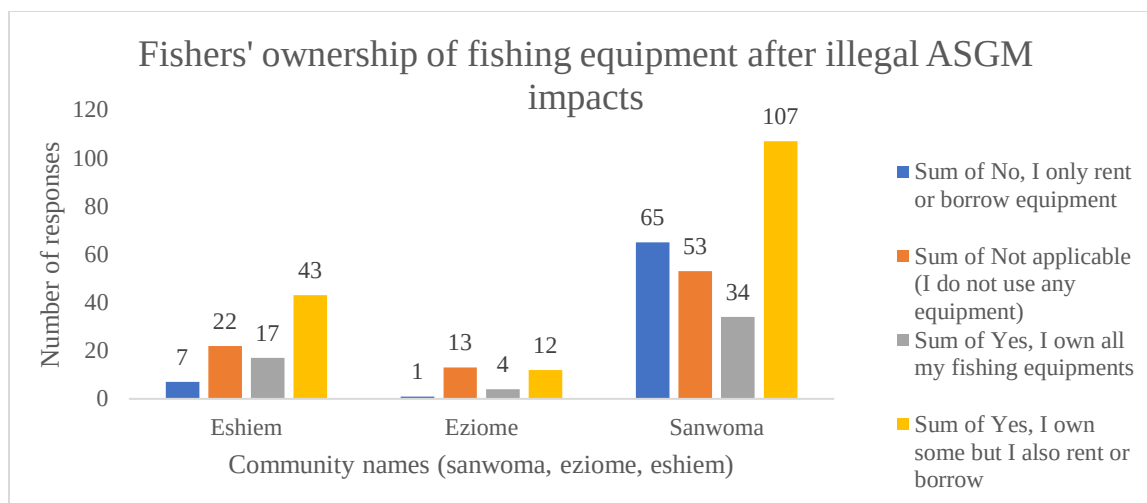


Figure 8 Number of fishers who own fishing equipment after illegal ASGM impacts

4.5.1.4 survey analysis on fishers' monthly household income range after illegal ASGM impacts

In terms of the monthly household income range, Sanwoma had 134 out of 259 falls within the 500-1,000 (Ghana cedis) income range, accounting for about 51.7% of the sample. A significant portion of households 64 out of 259 earn less than 500 (Ghana cedis) per month, representing 24.7% of the community. Fewer households in Sanwoma have higher income ranges, with just 1 household earning above 3,000 (Ghana cedis) per month, highlighting the relatively low-income nature of this community. This income distribution suggests that a large portion of Sanwoma's population faces economic constraints, with a significant share of households living just above or below the poverty threshold.

In Eziome, the income distribution is notably more balanced compared to Sanwoma, but still heavily skewed towards the lower income brackets. The largest proportion of households (13 out of 30) representing 43.3% falls within the 500-1,000 (Ghana cedis) range, while 4 (13.3%) households earn less than 500 (Ghana cedis) per month, representing the most impoverished households. There are minimal numbers of households in the higher income categories, with only

1 household earning above 3,000 (Ghana cedis) per month. This data suggests that the economic situation in Eziome is also constrained, though less extreme than in Sanwoma.

In Ajomoro Eshiem, the income range is more concentrated in the 500-1,000 category, with 65 out of 89 households (73.0%) earning within this bracket. A smaller number of households earn below 500 (10 households), and there are only a few in the higher income categories. Similar to the other communities, there is a very small percentage of the population (1 household) earning above 3,000 (Ghana cedis), suggesting a relatively low-income economy overall in Ajomoro Eshiem as well.

Overall, the findings indicate that all three communities Sanwoma, Eziome, and Ajomoro Eshiem are predominantly characterized by low household incomes, with the majority of households earning between 500 and 1,000 (Ghana cedis) per month. These figures highlight the financial challenges faced by the populations, particularly in terms of economic vulnerability and the potential impacts on livelihoods and coping mechanisms in the face of external stressors such as gold mining activities (**Figure 9**). In an interview with a fishmonger in Ajomoro Eshiem, she stated that

“I used smoke lots of fishes years back and made lots of money. The fish quantity is not as it used to be and that has greatly affected my income” (Fishmonger, Ajomoro Eshiem).

A fisher in Sanwoma pointed out that *“I used to manage the money I get from the fish to take care of my household. We ate what we liked but now, I can’t even take care of them. Income has reduced drastically” (Fisher, Sanwoma).*

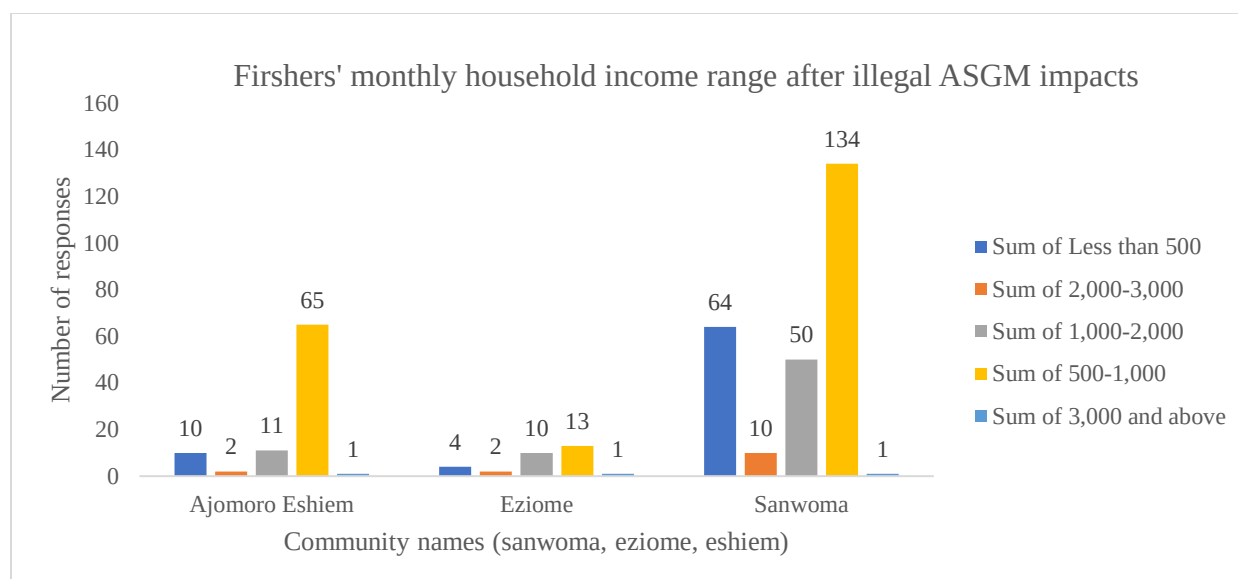


Figure 9 fishers' monthly household income range after illegal ASGM impacts

4.5.1.5 survey on number of people who depend on fishers' monthly household income after illegal ASGM impacts

The distribution of household income dependence varies across the three communities, highlighting different levels of economic dependency within households. In Sanwoma, 59.1% responded that 3-4 people depend on their monthly household income, indicating a moderate level of dependency within households. Additionally, 17.8% reported 1-2 dependents, while 15.1% have 5-6 dependents, showing a mix of household sizes with different financial burdens. A smaller proportion (5.8%) reported more than 6 dependents, suggesting that large households exist but are less common. Meanwhile, 2.3% of respondents stated that no one depends on their income, implying possible financial independence or alternative household income sources.

In Eziome, 46.7% of respondents indicated that 3-4 people depend on their income, almost similar to the trend observed in Sanwoma. A significant 33.3% reported having only 1-2 dependents, suggesting that smaller household sizes or independent earners are more common here. Meanwhile, 13.3% indicated having 5-6 dependents, and 3.3% reported more than 6 dependents,

showing that high dependency is less frequent in this community. Only 3.3% of respondents reported no dependents, suggesting a small proportion of financially independent individuals.

In Ajomoro Eshiem, more than half of the respondents (62.9%) reported that 3-4 people depend on their monthly household income, making it the dominant category in this community as well. About 23.6% have 1-2 dependents, while 5.6% have 5-6 dependents, showing a lower proportion of larger households compared to the other two communities. 2.2% reported more than 6 dependents, which is the lowest among the three communities, while 5.6% reported no dependents, indicating a small group of financially self-sufficient individuals.

Overall, the data suggests that in all three communities, most households support 3-4 dependents, indicating that a typical household structure involves multiple dependents relying on a single or combined income. However, there are variations in the proportion of individuals with smaller or larger household sizes. The presence of households with more than 6 dependents, though relatively small, suggests financial strain, which may require targeted support programs such as income diversification initiatives, financial aid, or skills development programs to reduce economic vulnerability in these fishing communities (**Figure 10**). The chief fisher in Eziome responded that *“We lived together as a family, and we connected with our extended families as well. Years back, a typical household can total 10 or more people because there was job (fish) and we could take care of everyone now it’s not the same, we are mostly around 3 to maximum 6 people because of the hardship”* (Chief fisher, Eziome)

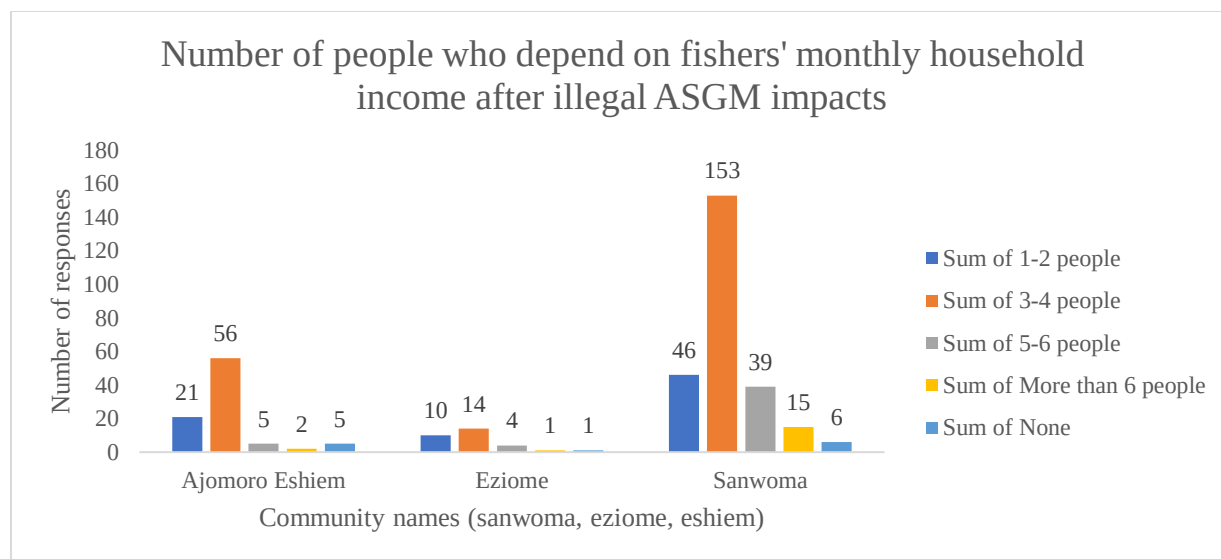


Figure 10 Number of people who depend on fishers' monthly household income after illegal ASGM impacts

4.5.1.6 Survey analysis on fishers' encounter of illegal ASGM activities near fishing sites

Knowledge with regards to encounter of illegal ASGM activities was carried out among community members within the three communities. Interestingly, Sanwoma had a majority (50.6%) of respondents who reported that they sometimes encounter gold mining activities near their fishing sites. Additionally, 23.2% rarely encounter gold mining activities, suggesting that while gold mining exists, it is not a daily occurrence for many fishers. Only 5.0% reported often encountering gold mining activities, while one respondent (0.4%) stated they always experience mining activity at their fishing site. Interestingly, a significant 50.6% (131 respondents) claimed they never encounter gold mining near their fishing locations, highlighting a potential spatial separation between gold mining operations and fishing zones for some residents. In Eziome, a majority (70.0%) of respondents never encounter gold mining near their fishing sites, suggesting that mining activities are either absent or occur at a distance from their fishing zones. Meanwhile, 10.0% reported sometimes encountering gold mining, and 6.7% rarely experience such activities. A small proportion (6.7% reported often encountering mining near their fishing sites), while no

respondents indicated that they "always" encounter mining. This suggests that Eziome is the least affected community in terms of gold mining presence near fishing activities.

Again, in Ajomoro Eshiem, among respondents from this community, 39.3% stated they sometimes encounter gold mining activities, making this the most frequently reported category. Additionally, 30.3% of respondents reported never experiencing gold mining near their fishing sites, a significantly lower proportion compared to Sanwoma and Eziome. 30.3% rarely encounter mining activities, while 2.2% reported often encountering mining. No respondents reported always experiencing mining. **(Figure 11)**. In a focus group discussion of women in Ajomoro Eshiem a fisher pointed out that

“Yes, I have seen them move from upstream- dominase and other areas to come mine here. Some of our youth here are also engaged in illegal mining”. (Women FGDs, Ajomoro Eshiem)

Another one too added that *“They have friends in this town, and they do the galamsey with them here in this town”. (Women FGDs, Ajomoro Eshiem)*

In Sanwoma, a young male fisher also stated that *“Oh yes, I do some of the galamsey but not here (Fisher, Sanwoma)*

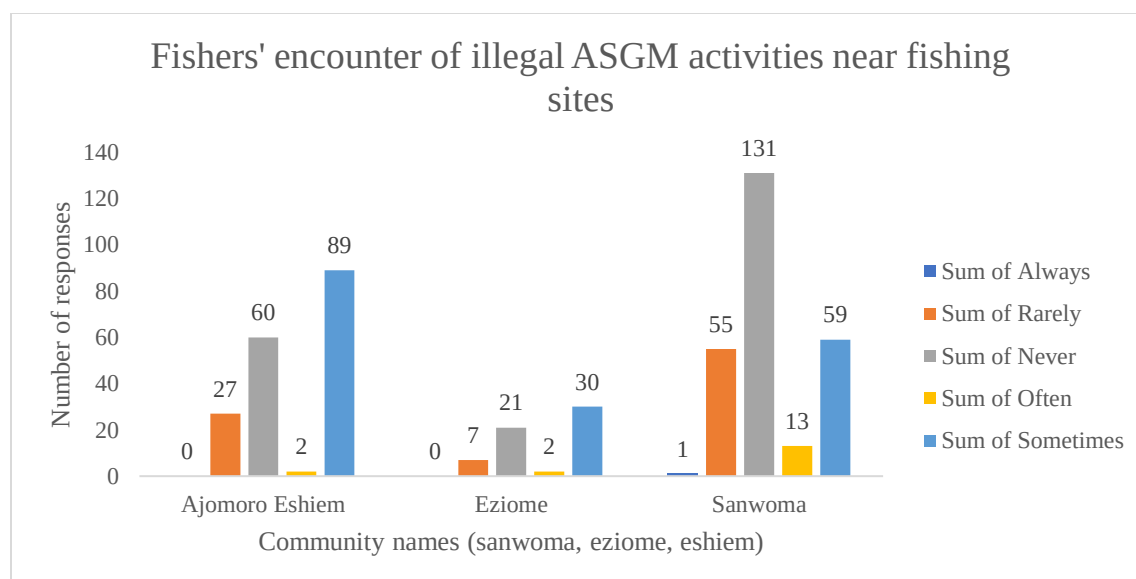


Figure 11 Fishers' encounter of illegal ASGM activities near fishing sites

4.5.1.6 Availability of support mechanisms from government to fishers impacted by illegal ASGM activities.

The availability of support from government for fishers varies across the three communities, indicating disparities in access to assistance programs, financial aid, or technical support. In Sanwoma, a slight majority (52.1%) reported having access to government support, suggesting that some levels of governmental assistance are available for fishers in the community. However, 47.9% indicated they do not receive any support from government, reflecting a nearly even split in access. This indicates that while support systems exist, they may not be sufficient or equally distributed among fishers. Contrary to this, in Eziome all respondents (100%) stated that they do not have access to any governmental support, highlighting a significant gap in assistance.

This indicated that either support mechanisms are absent in this community or that existing programs fail to reach fishers in need. The complete lack of support in Eziome may have contribute to increased vulnerability among fishers in this area. In Ajomoro Eshiem a majority (84.3%) reported not having access to government support, indicating that most fishers in this community

operate without external aid. Only 15.7% of respondents stated that they receive government support, suggesting that assistance programs exist but are limited in reach or accessibility (**Figure 12**).

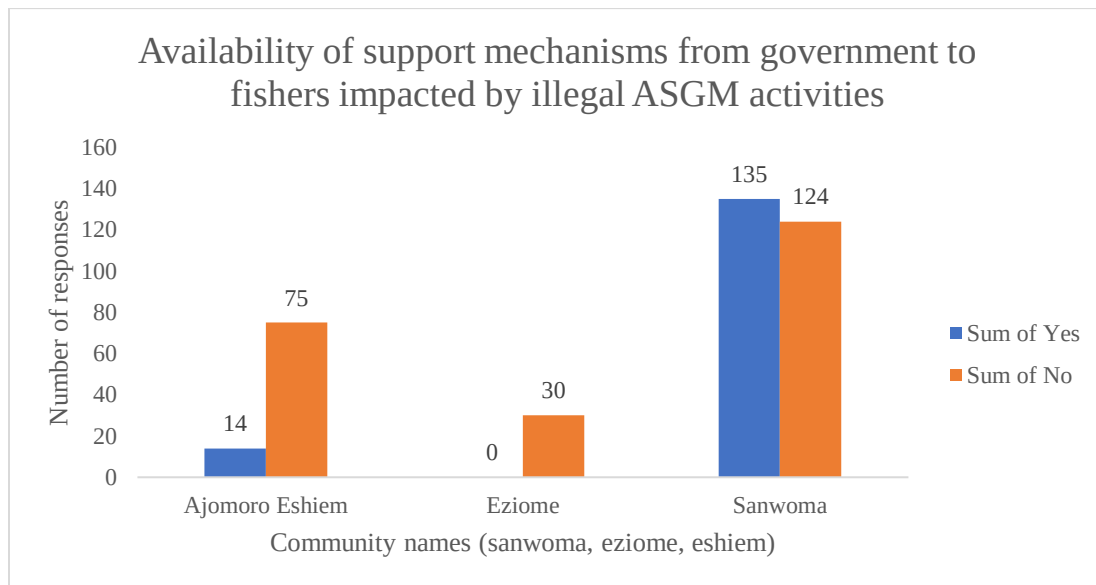


Figure 12 Availability of support mechanisms from government to fishers impacted by illegal ASGM activities

4.5.1.7 Interactions Between illegal ASGM and Small-Scale fisheries Livelihoods in the Ankobra River Basin.

Table 14 shows the relationship between gold mining activities and changes in fish catches. A large majority of respondents (82.5%) reported a significant decrease in fish catches since gold mining activities increased. Both surface mining and river dredging were associated with these declines. The association between mining method and fish catch change was statistically significant (Pearson $\chi^2 = 97.56$, $p = 0.0018$, Cramér's $V = 0.26$).

Table 13 Changes in fishers' fish catch since rise in illegal ASGM activities within the Ankobra region

Primary method used in gold mining operations in your area	Change in fish catches			
	Decreased significantly	Increased slightly	Stayed the same	Total
Dredging (River mining)	144	2	24	170
Not sure	14	0	0	14
Surface mining (open-pit)	152	4	36	192
Underground mining	2	0	0	2
Total	312	6	60	378

Pearson Chi2 = 97.5614 Prob = 0.0018 Cramér's V = 0.2618

A fishmonger from Eziome expressed concern about the reduced availability of fish for processing, stating:

"The gold mining has affected the fish stocks; we don't get a lot of fish to smoke anymore."
(Fishmonger, Eziome).

Similarly, a fisher from Ajomoro Eshiem directly linked mining activities to fish stock depletion, saying:

"The fish population has declined as a result of the gold mining." (Fisher, Ajomoro Eshiem).

A fisher from Sanwoma provided further insight into the broader impact on the local fishing economy:

"The fishing industry has experienced a significant decline. We used to catch abundant fish, but now our catches have dwindled. Gold mining has adversely affected the fishing sector." (Fisher, Sanwoma).

These findings significantly show how fish population in the Ankobra river has greatly been affected by gold mining within the region.

4.5.1.8 Interactions between gold mining and small-scale fishers' livelihoods in the Ankobra region.

Table 14 Gold mining activities and the impacts on water quality within the Ankobra region

Primary method used in gold mining operations in your area	Change in quality of water in the Ankobra River due to gold mining			
	Extremely affected	Not affected at all	Significantly affected	Total
Dredging (River mining)	116	1	53	170
Not sure	12	0	2	14
Surface mining (open-pit)	138	0	54	192
Underground mining	2	0	0	2
Total	268	1	109	378

Pearson Chi2 = 37.0538 Prob = 0.0276 Cramér's V = 0.1995

Survey data reveal a pronounced deterioration in the quality of water in the Ankobra River associated with gold mining activities. Of the 378 respondents, 70.9% (268) reported that the river was *extremely affected*, while 28.8% (109) indicated it was *significantly affected*. Only a single respondent (0.3%) believed the river was *not affected at all*. Both surface mining (open-pit) and river dredging were strongly linked to these negative perceptions, with 138 out of 192 (71.9%) and 116 out of 170 (68.2%) respondents, respectively, reporting the river as extremely affected in their areas.

The association between the primary mining method and perceived water quality change is statistically significant (Pearson Chi² = 37.05, p = 0.0276), with a moderate strength of association

(Cramér's $V = 0.20$). This underscores widespread community concern about the environmental impacts of gold mining on the Ankobra River.

Interviews and focus groups across Sanwoma, Eziome, and Ajomoro Eshiem consistently attributed the decline in water quality to illegal mining (galamsey). A fishmonger from Sanwoma recalled,

“Mining has been happening long time ago. Our river was very clear and clean, but galamsey (illegal artisanal gold mining) has destroyed it now.” (Fishmonger, Sanwoma)

A youth from Sanwoma noted the visible and practical effects:

“Yes, the color of the water has changed, and we experience flooding a lot.” (Fisher, Sanwoma).

An Environmental Protection Agency official confirmed that noticeable changes in the river's condition began around 2019, coinciding with the expansion of alluvial mining:

“It started from 2019, and the river's color has changed because of the alluvial mining activities that happen there.” (Representative, Environmental Protection Agency).

He further emphasized that mining regulations prohibit operations near water bodies, but these rules are often ignored:

“Law (LI 2) does not permit people to mine close to water bodies. Even if it is the case, it is to be 100 meters away. Most of the people who engage in the mining are illegal (galamsey) miners.”

Interviews with youth involved in small-scale illegal gold mining revealed that economic hardship drives participation in illegal mining, despite its environmental consequences:

“There is no job here, and most of us tend to move out of the community to other places to work. Some also engage in the illegal mining (galamsey)” (Illegal miner, Sanwoma).

4.6 Summary discussion of emerging findings from chapter results

The data presented above revealed several important patterns regarding the relationship between gold mining and small-scale fisheries in the Ankobra river region. First, the predominance of small-scale, family-based fishing operations-characterized by traditional methods and low capital investment shows the vulnerability of these communities to external pressures such as gold mining. The limited ownership of fishing equipment, with most fishers relying on shared or borrowed tools, highlights ongoing financial constraints and a lack of investment capacity, which may be exacerbated by declining fish stocks and environmental degradation linked to mining activities. Low and declining household incomes across all three communities further illustrate the economic vulnerability of fishing-dependent households. Qualitative accounts reinforce this, with fishers and fish processors reporting reduced catches and incomes compared to previous years, often attributing these changes to the impacts of gold mining-such as water pollution, habitat destruction, and increased competition for resources.

These findings suggest a strong association between the expansion of gold mining activities especially unregulated types and the declining viability of small-scale fishing livelihoods. The shift away from fishing among youth, as indicated by both survey data and interview excerpts, may reflect both the diminished prospects in fisheries and the allure or necessity of alternative livelihoods, including mining itself or migration to urban areas. The persistence of low incomes and equipment shortages further limits the ability of fishers to adapt or invest in more sustainable practices, potentially creating a cycle of poverty and resource depletion. In summary, the data indicate that small-scale fishing communities along the Ankobra River are experiencing significant socio-economic challenges, many of which are linked to the growth of gold mining activities. Addressing these challenges will require targeted interventions to support alternative livelihoods, improve access to fishing equipment, and mitigate the environmental impacts of mining.

Chapter 5

Assessing the socio-economic and ecological well-being of Small-Scale fisheries in the Ankobra region: The impacts of illegal ASGM on livelihoods

5.0 Introduction

Small-scale fisheries play a crucial role in sustaining livelihoods and food security in many developing countries, particularly in Ghana, where fishing communities depend on rivers, estuaries, and coastal waters for their sustenance. However, the rapid expansion of and small-scale gold mining (ASGM) has posed severe threats to these fisheries, disrupting local economies and ecological balance (Bansah et al., 2018). In the Ankobra region, gold mining activities have exacerbated environmental degradation, with direct consequences on water quality, fish populations, and the overall well-being of fishers (Attiogbe & Nkansah, 2017). Mercury and cyanide, commonly used in gold extraction, contaminate water bodies, leading to bioaccumulation in aquatic species and endangering both fish stocks and human health (Babut et al., 2003; Göthberg & Greger, 2006). Additionally, the destruction of riverine habitats and changes in water flow patterns contribute to a decline in biodiversity, further diminishing fishery resources (Ofosu et al., 2020). The economic ramifications of these environmental challenges are significant, as dwindling fish stocks translate into declining incomes, food insecurity, and increased vulnerability among fishing communities (Effah et al., 2021).

The "Tragedy of the Commons" framework, as proposed by Hardin (1968), offers a lens through which the unsustainable exploitation of natural resources can be understood. In the context of gold mining, particularly surface mining methods like open-pit mining and dredging, concerns regarding environmental degradation and water resource depletion have garnered attention,

underscoring the imperative for sustainable mining practices (Timsina et al., 2022). The unregulated expansion of artisanal and small-scale gold mining (ASGM) in the Ankobra region exemplifies this principle, where the absence of stringent environmental policies has led to resource depletion and community displacement (Timsina et al., 2022). While gold mining is a vital contributor to Ghana's economy—accounting for approximately 90–95% of total mineral exports and attracting significant foreign direct investment (Skaten, 2018)—its benefits often come at a great cost to marginalized communities. As Ros-Tonen (2021) highlights, despite gold contributing an estimated USD 10 billion to Ghana's export revenue in 2021, the socio-environmental costs for small-scale fisheries are frequently overlooked. The Ankobra River, once a thriving ecosystem supporting hundreds of fishers, has seen a drastic reduction in fish populations and fishing activities due to mining-induced pollution (Akabzaa et al., 2009) (see **chapter 1, figure 2**).

Beyond ecological concerns, the socio-economic repercussions of gold mining are profound. The contamination of water bodies affects not only fisheries but also agricultural productivity, as pollutants infiltrate irrigation systems and reduce soil fertility (Adimado & Baah, 2002). Many displaced fishers and farmers have been forced to seek alternative livelihood options, such as cultivating cash crops like rubber and oil palm, yet these transitions are not always economically viable (Bonye et al., 2023). Additionally, rural-urban migration has intensified, with many young people leaving the Ankobra region in search of better opportunities elsewhere, exacerbating socio-economic disparities (Ampaw et al., 2023). This shift has led to increased dependency on mining itself as a source of employment, perpetuating a cycle of environmental exploitation and social vulnerability (Fedele et al., 2021). Furthermore, studies have demonstrated that mercury concentrations in human blood, urine, hair, nails, and fish in the Ankobra and Tano river basins

have reached hazardous levels due to mining activities (Adimado & Baah, 2002). The Ankobra river, which flows through extensive agricultural lands and mining zones, carries pollutants downstream, affecting not only immediate fishing communities but also those in adjacent regions (Akabzaa et al., 2009). Mercury exposure has been linked to severe health conditions, including neurological disorders, kidney damage, and developmental issues in children (Kuffour et al., 2018). These findings underscore the urgency of implementing regulatory measures to mitigate the adverse effects of gold mining on small-scale fisheries and community well-being.

The relationship between gold mining and small-scale fisheries in the Ankobra region is emblematic of the broader challenges facing resource-dependent communities in Ghana. While gold mining remains a significant driver of national economic growth, its socio-environmental consequences demand greater attention from policymakers, researchers, and local stakeholders. Addressing these issues requires a multidimensional approach that integrates sustainable mining practices, environmental remediation efforts, and livelihood diversification programs. Given the precarious state of small-scale fisheries in the Ankobra region, it is imperative to develop adaptive strategies that not only mitigate the impacts of gold mining but also enhance the resilience of fishing communities in the face of ongoing environmental and economic transformations (Kolding et al., 2014). By fostering a more equitable balance between resource extraction and ecological sustainability, the livelihoods of small-scale fisheries can be safeguarded, ensuring a more viable future for generations to come. This chapter aims to assess the socio-economic and socio-ecological well-being of small-scale fisheries in the Ankobra region, focusing on the impact of gold mining on their livelihoods. Understanding these challenges is crucial for developing policies that ensure sustainable fisheries and equitable resource management while mitigating the negative impacts of mining activities.

5.1 Materials and Methods

The methodological approach for this objective is as described in **Chapter 3 (General Methodology)**. The sampling procedures, data collection techniques, and analysis methods outlined therein were applied to address **(Objective 2)**. No additional methods were employed for this objective.

5.2 Results

5.2.1 Socio-ecological impacts of illegal ASGM of fishers within the Ankobra region

5.2.1.1 *Ecological and livelihood impacts of illegal ASGM in the Ankobra region*

This section presents qualitative findings on the socio-ecological impacts of illegal ASGM, and that a summary table is provided to synthesize the main reported concerns and their meanings as defined by respondents.

Table 15 Key socio-ecological impacts of illegal ASGM reported by respondents within Sanwoma, Ezime and Ajomoro Eshiem within the Ankobra region

Reported Concern / Impact	Definition / Meaning (How Defined by Respondents)
Deterioration of water quality	Water is now turbid, has an unpleasant smell, and is visibly polluted due to mining activities, especially galamsey
Decline in fish populations and quality	Fewer fish available; fish taste has changed; fish stocks are declining due to polluted breeding grounds and heavy metal contamination
Ecosystem and agricultural impacts	Plants near the river are dying; irrigation with river water damages cocoa farms; mangrove and riverbank vegetation degraded
Health and livelihood threats	Loss of fishing jobs, reduced access to clean water, and increased food insecurity due to ecosystem degradation

5.2.1.1.1 Deterioration of water quality

Respondents across all three communities described the Ankobra river as increasingly turbid and foul-smelling, attributing these changes to illegal mining activities.

“The quality of water is turbid, and the smell have changed over time (Fisher, Eziome)

An official from a large-scale mining company confirmed,

“ASGM activities increase turbidity, heavy metal contamination, and fish depletion in water bodies like the Ankobra (Representative, mining sector).

5.2.1.1.2 Decline in fish populations and quality

Many participants noted a reduction in both the quantity and quality of fish. A woman in Sanwoma observed,

“The taste of the fish has also changed (Fishmonger, Sanwoma)

A Ministry of Fisheries official added,

“Ecologically, the colour of the water has changed. The breeding grounds has been affected and mangrove degradations as a result of the mining. The ecological conditions will affect the fish stocks because the fishes cannot survive the conditions (Representative, Ministry of fisheries)

5.2.1.1.3 Ecosystem and agricultural impacts

The impact of mining activities extends beyond water pollution and fish decline to the broader ecosystem and agriculture. A fisher in Eziome highlighted these far-reaching consequences:

“Every plant around the river dies. It has even destroyed my cocoa farm when we started using it for irrigation (Fisher, Eziome)

A youth fisher in Ajomoro Eshiem, who took over his family’s farm, described a more severe impact:

“Galamsey has damaged the land, and our farms are now gone. When we use the water on our cocoa farms, it even destroys it more (Fisher, Ajomoro Eshiem) (Figure 15).

These testimonies underscore the interconnectedness of the river ecosystem with surrounding agricultural activities and the compounding effects of environmental degradation.

5.2.1.1.4 Health and livelihood threats

The testimonies also reveal significant threats to health and livelihoods. Loss of fishing jobs, reduced access to clean water, and increased food insecurity were recurring themes. Respondents described how ecosystem degradation has forced many to abandon traditional livelihoods and seek alternative sources of income. For example, a youth from Ajomoro Eshiem explained:

“There has been a major decline in this society, and I know there are two types of gold mining in this community, and I sometimes engage in gold mining to get some money (Fisher, Ajomoro Eshiem)”

Other respondents mentioned that the inability to rely on fishing or farming has led to increased migration, petty trading, or engagement in mining itself as a last resort.



Figure 13 The declining water quality, shrinking fish populations, and impacts on agriculture as a result of gold mining activities:
Photo: Prince Agyapong



Figure 14 Open pit gold mining resulting in land and water destruction: Photo: Prince Agyapong

5.2.2 Percentage of fishers' fishing area affected by illegal ASGM activities

Figure 16 and Table 17 present the distribution of perceived impact as a result of illegal artisanal and small-scale gold mining activities on fishing areas across Sanwoma, Eziome, and Ajomoro Eshiem. The survey data reveal that the vast majority of respondents in all three communities report severe degradation of their fishing grounds due to gold mining activities. In Sanwoma, 140 respondents (54.1%) indicated that 76–100% of their fishing area has been affected, while 85 respondents (32.8%) reported a 51–75% impact. In Eshiem, the effect is even more pronounced, with 61 respondents (68.5%) stating that 76–100% of their fishing area is affected and 26 respondents (29.2%) indicating a 51–75% impact. Notably, no respondents in Eshiem reported a low impact (0–25%), underscoring the widespread nature of the problem. In Eziome, 17 respondents (56.7%) reported a 76–100% impact, and 12 respondents (40.0%) reported a 51–75% impact.

The consequences of this decline in fishing viability are deeply felt within the communities. As one participant from a men's focus group discussion in Sanwoma expressed:

“Our socio-economic activities are in danger because of the fish stock decline.” (Men FGDs, Sanwoma).

This sentiment reflects the broader reality that fishing, which has long been the economic backbone of these communities, is now under threat due to environmental degradation caused by mining. The reduction in accessible and productive fishing areas not only disrupts livelihoods but also exacerbates food insecurity, economic instability, and social tensions.

Women in focus group discussions at Eziome added:

“Our children are at home now because we can’t support their schooling financially,” (Women FGDs, Eziome) highlighting the ripple effects on education and household welfare.

A fishmonger in Ajomoro Eshiem further emphasized the broader economic impact:

“Since the catch has declined, it has also affected us fishmongers.” (Fishmonger, Ajomoro Eshiem)

In Eziome, the situation has led to changes in fish sourcing, with a fishmonger reporting:

“We go to the main towns to purchase cold store fish.” (Fishmonger, Eziome).

These testimonies illustrate how the loss of fishing grounds reverberates through the entire community, affecting not only fishers but also processors, traders, and families.

Table 16 Summary of perceived percentage of fishers’ fishing area affected by illegal ASGM activities

Number / Percentage of Respondents	Reported Level of Impact	Definition / Meaning of Level of Impact
Sanwoma: 140 (54.1%)	76–100% of fishing area affected	Severe impact: Most or all fishing grounds are unusable due to mining.
Sanwoma: 85 (32.8%)	51–75% of fishing area affected	High impact: Over half of fishing grounds are significantly degraded.
Eshiem: 61 (68.5%)	76–100% of fishing area affected	Severe impact: Nearly all fishing areas are affected by mining.

Eshiem: 26 (29.2%)	51–75% of fishing area affected	High impact: Majority of fishing grounds are significantly degraded.
Eshiem: 0 (0%)	0–25% of fishing area affected	Low impact: No respondents reported minor or negligible impact.
Eziome: 17 (56.7%)	76–100% of fishing area affected	Severe impact: Over half report most fishing grounds are unusable.
Eziome: 12 (40.0%)	51–75% of fishing area affected	High impact: Significant degradation of fishing areas.

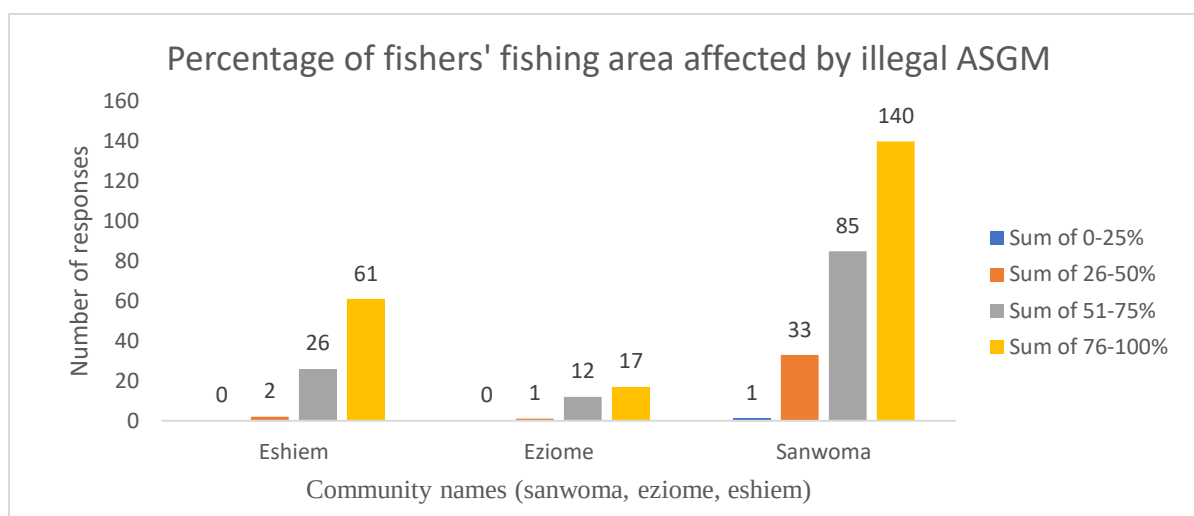


Figure 15 Percentage of fishers' fishing area affected by illegal ASGM

5.2.3 Fishers' perceived decline in fish catch and livelihood disruptions in the Ankobra region

The responses from the fishers across the three communities indicated varying perceptions on the decline of fish catch frequency, highlighting the significant ecological and livelihood challenges faced by these fishing populations. As detailed in **Chapter 2 (section 5.1)** of the literature review, gold mining activities-particularly unregulated artisanal and small-scale mining (ASGM)-have led to increased turbidity, chemical contamination, and habitat degradation in the Ankobra River. These drivers have directly contributed to the environmental changes that underpin the observed declines in fish catch frequency.

The responses from the fishers across the three communities indicated varying perception on the decline of fish catch frequency highlighting the significant ecological and livelihood challenges faced by these fishing populations. In Eshiem, 86.5% of respondents reported a significant decrease in fish catch frequency, with only 1.1% observing a slight increase and 12.4% indicating unchanged catch levels. Eziome demonstrated the most acute perception of decline, with 93.3% of respondents reporting a significant decrease in fish catch frequency, while the remaining 6.7% stated that catch levels have remained constant. Sanwoma, despite having the largest sample size, showed a slightly lower proportion of respondents perceiving significant declines (79.9%) compared to the other two communities, with 2.3% observing a slight increase and 17.8% indicating unchanged catch levels. The consistently high percentages of respondents perceiving significant decreases in fish catch frequency across all three communities, ranging from 79.9% in Sanwoma to 93.3% in Eziome, shows the widespread negative impact of gold mining activities on fishing livelihoods in the region. The variation in perceptions among the communities suggests that the ecological degradation may be particularly pronounced in Eziome relative to its size, while the slightly lower proportional perception of significant declines in Sanwoma may indicate some variability in mining impacts within this larger community **(Figure 17)**.

In an interview an official from the NGO (Hen Mpoano), which works closely with fishers in the region, provided insight into the specific impacts on certain species:

"The polluted water has affected the livelihoods of the fishers. For example, the community used to get a lot of shrimp from the Ankobra river but currently, there is a major decline in the shrimp production as a result of the pollution from galamsey". (Representative, Hen Mpoano).

This statement highlights how some fish species that were once readily accessible have now become scarce or potentially extinct in the area. The environmental degradation causing these declines was further emphasized by a participant in a women's focus group in Eziome, who stated:

"The colour of the water has changed and there is a general fish stock decline because of the turbidity and chemicals". (FDG women, Eziome)

This observation aligns with scientific understanding of how increased turbidity and chemical pollution can negatively impact aquatic ecosystems and fish populations. A representative from a large-scale mining sector attributed the loss in fish frequency specifically to unregulated small-scale mining activities, noting:

"ASM activities increase turbidity, heavy metal contamination, and fish depletion in water bodies like the Ankobra". (Representative, Mining sector)

This perspective from within the mining industry itself underscores the recognition of the detrimental effects of unregulated mining practices on local water bodies and fish populations.

A fisher from Sanwoma provided further evidence of the changing ecosystem, stating:

"Fish populations has reduced which has affected the overall fish catch and we don't get some particular fish species anymore like we used to". (Fisher, Sanwoma)

This observation was echoed by a male participant in a focus group discussion in Ajomoro Eshiem who noted:

"Some years ago, I used to catch species like cassava fish and silver fish but now, I don't get them anymore". (FDG men, Ajomoro Eshiem).

These testimonies highlight not only a general decline in fish populations but also changes in species composition, suggesting potential long-term alterations to the local aquatic ecosystem. The economic implications of these ecological changes were emphasized by a woman who processes fish in Eshiem:

"Now, our men do not get the total fishes they used to catch. The fish population and fish catch has totally reduced". (Fish processor, Ajomoro Eshiem)

This statement emphasizes the ripple effects of declining fish populations on the broader community economy, affecting not just fishers but also those involved in fish processing and related industries (Table 18).

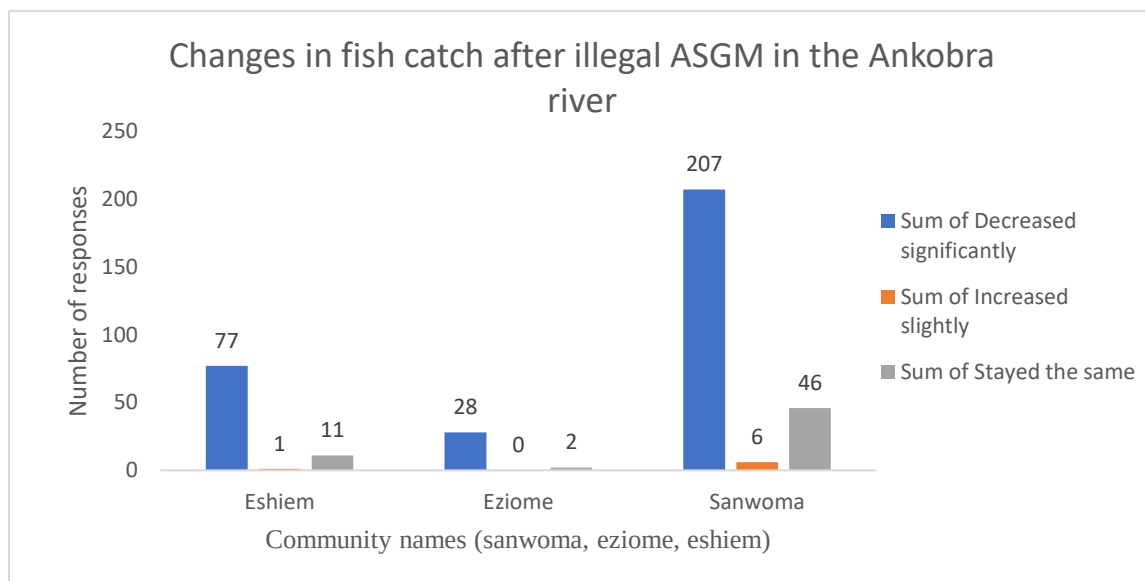


Figure 16 Changes in fishers' fish catch after illegal ASGM in the Ankobra river

Table 17 Summary of Fishers' perceived changes in their fish catch frequency due to illegal ASGM in Ankobra region

Community	Number (%) of Respondents	Reported Change & How Respondents Described It
Eshiem	77 (86.5%) significant decrease	Marked reduction in daily/weekly fish catch, fewer fish species, increased effort for less catch, economic hardship for households.
	1 (1.1%) slight increase	Minor improvement in catch, possibly due to random variation or changes in fishing location.
	11 (12.4%) no change	Fish catch frequency remained stable despite mining activities.
Eziome	28 (93.3%) significant decrease	Severe drop in fish catch, near disappearance of certain species, increased difficulty sustaining livelihoods.
	0 (0.0%) slight increase	Not reported.
	2 (6.7%) no change	No observable difference in catch frequency.
Sanwoma	207 (79.9%) significant decrease	Substantial decline in catch, loss of traditional fishing grounds, longer hours for less catch, reduced diversity of fish species.
	6 (2.3%) slight increase	Small improvement in catch, possibly due to localized conditions.
	46 (17.8%) no change	Catch frequency unchanged, possibly due to location or fishing methods.

5.3 Socio-economic impacts of illegal ASGM on fishing communities along the Ankobra river

As shown in both the table and figure (**Table 19 and Figure 18**), across all three communities, the majority of respondents reported a decline in income, highlighting the widespread economic consequences of mining activities on Small-Scale fisheries. Specifically, 244 respondents (64.6%) indicated that their income had "decreased significantly," while 101 (26.7%) reported a "slight decrease." In contrast, only 2 respondents (0.5%) noted an increase in income, and 13 (3.4%) observed no change. Additionally, 18 respondents (4.8%) fell into the "not applicable" category, likely representing individuals not directly dependent on fishing for their livelihood. A comparison across the three communities reveals spatial differences in the severity of economic decline. Sanwoma with 163 respondents (62.9%) reported a significant decrease in income and 75 (28.9%)

indicated a slight decrease. The economic impact appears even more pronounced in Eziome, where all surveyed respondents reported income losses. Specifically, 19 (63.3%) reported a significant decrease, and 11 (36.7%) indicated a slight decrease, with no respondents experiencing an increase or stability in income. Observations during the community visit corroborate these findings, as Eziome appeared largely deserted, with minimal fishing activity (**Figure 18**). In Ajomoro Eshiem, 62 out of 89 respondents (69.7%) reported a significant decrease in income, while 15 (16.9%) indicated a slight decrease.

The qualitative data from interviews further illustrated these financial hardships. A fish processor in Sanwoma remarked,

"We no longer get enough fish to sell and earn money." (Fish processor, Sanwoma).

This further expresses the economic strain faced by women in the industry. Similarly, a Fisher in Eziome stated,

"Our children are at home now because we cannot support their schooling financially." (Fisher, Eziome).

Notably, focus group discussions by fishmongers in Ajomoro Eshiem revealed that many women have been forced to adapt by purchasing fish from commercial cold storage facilities, an added financial burden they did not previously face. One participant lamented,

"The situation has now compelled most of us to buy cold store fish from Axim." (Men FGDs, Ajomoro Eshiem).

Additionally, a Fisher from Eziome participating in the discussion noted,

"I have packed all my fishing equipment. Most of the fishers have also sold theirs." (Fisher, Eziome)

further highlighting the severe disruptions to their traditional livelihoods (**Figure 20**). Interview responses further illustrate the dire situation; a young fisher in Eziome stated,

"The river is destroyed, and there is no aquatic life in the river now." (Fisher, Eziome).

The town's chief Fisher echoed similar sentiments, noting,

"My finances have declined because of the gold mining. I no longer get a greater catch, and my farms are also destroyed." (Chief fisher, Eziome).

Additionally, a fishmonger emphasized the broader economic distress, stating,

"As a fishmonger, my sales have significantly dropped. There's no money in circulation, and the economy is tough." (Fishmonger, Eziome).

Table 18 Impact of illegal ASGM on fishers' income

Name of community	Impact of illegal ASGM on fishers' income					
	Decreased significantly	Decreased slightly	Increased	No change	Not applicable	Total
Ajomoro	62	15	1	5	6	89
Eshiem						
Eziome	19	11	0	0	0	30
Sanwoma	163	75	1	8	12	259
Total	244	101	2	13	18	378

Pearson Chi2 = 10.69 Prob =0.021

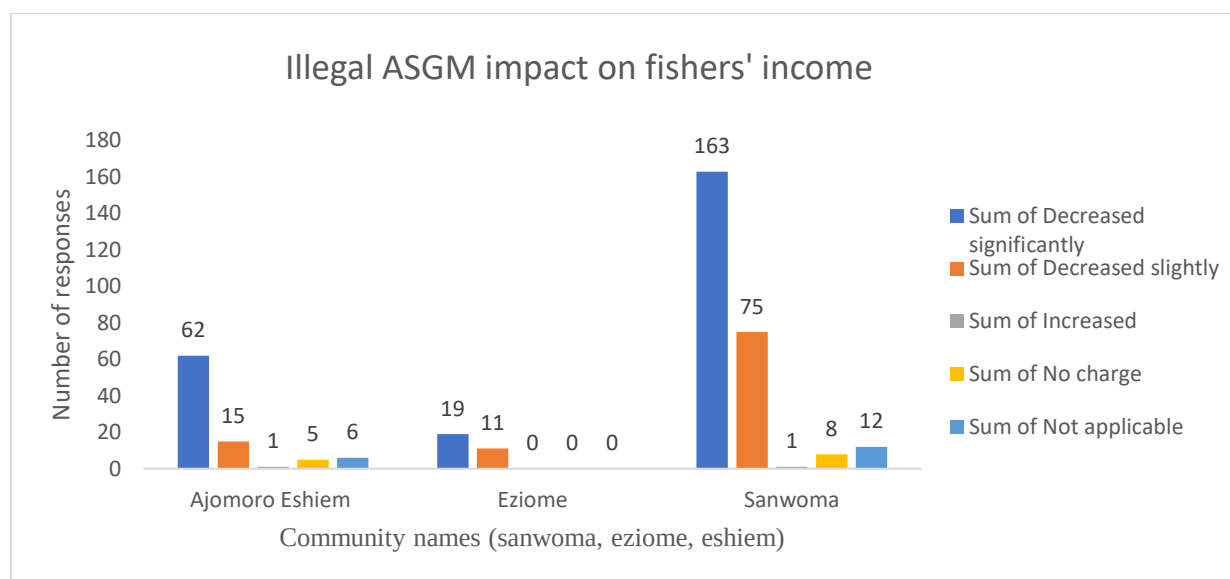


Figure 17 Impact of illegal ASGM on fishers' income

Table 19 Summary of perceived changes in fishers' income due to illegal ASGM within the Ankobra region

<i>Number (%) of Respondents</i>	<i>Reported Change in Income</i>	<i>Definition/How Respondents Described This Change</i>
244 (64.6%)	Decreased significantly	Major loss of income, inability to meet basic needs, financial hardship, selling fishing equipment, children unable to attend school.
101 (26.7%)	Slight decrease	Noticeable but less severe reduction in income, some difficulty meeting expenses, adapting by seeking alternative sources (e.g., buying cold store fish).
2 (0.5%)	Increased	Rare cases where income improved, possibly due to alternative livelihoods or other factors.
13 (3.4%)	No change	Income and economic situation remained stable despite mining activities.
18 (4.8%)	Not applicable	Respondents are not directly dependent on fishing for income or did not specify impact.



Figure 18 Eziome fishing community completely deserted due to livelihood: Photo: Prince Agyapong



Figure 19 Abandoned fishing nets and baskets at Ajomoro Eshiem: Photo: Prince Agyapong

5.3.2 Health consequences of illegal ASGM: Community perceptions and medical evidence along the Ankobra River

The findings indicate significant concerns regarding the impact of gold mining on the health of the fishing communities along the Ankobra river. Among the 378 respondents, a substantial proportion (153; 40.5%) reported that gold mining has had a severely negative effect on the overall health of

their community, while 135 (35.7%) perceived the impact as moderately negative. A smaller group (14; 3.7%) noted only a slight impact, whereas 76 respondents (20.1%) stated that mining activities had no discernible effect on community health.

At the community level, perceptions of health impacts varied based on proximity to mining activities and exposure to pollution. Sanwoma, located downstream and thus receiving the cumulative effects of mining-related contaminants, recorded the highest number of severe negative responses, with 101 out of 259 respondents (39.0%) indicating significant health consequences. Additionally, 91 respondents (35.1%) described the impact as moderately negative, while 56 (21.6%) reported no impact. Similarly, in Ajomoro Eshiem, which is geographically closer to mining operations, 39 respondents (43.8%) perceived a severely negative health impact, and 28 (31.5%) described it as moderately negative. In contrast, 19 respondents (21.3%) believed there was no impact on their health. In Eziome, which lies between the other two communities, 13 respondents (43.3%) reported severe negative health effects, while 16 (53.3%) perceived the impact as moderately negative. Only one respondent (3.3%) reported no impact, and no respondents indicated a slight impact (**Figure 21**). The chief Fisher of Ajomoro Eshiem remarked that

"Some of the fishers who dive in the polluted water always develop skin rashes due to the chemicals." (Chief fisher, Ajomoro Eshiem).

A fish processor in Sanwoma echoed similar sentiments, noting,

"I have seen an increase in skin rashes and even one case of a baby born with deformities." (Fish processor, Sanwoma).

Another fish processor from Sanwoma linked her health issues to fish consumption, stating,

"I sometimes experience diarrhea after eating fish from the river," adding that "I have been running for the past weeks, and it hasn't been easy for me." (Fish processor, Sanwoma).

A fishmonger in Ajomoro Eshiem similarly observed:

"The fish spoils much faster than before, which clearly shows how contamination is affecting not just the fish but also the health of those who consume it." (Fishmonger, Ajomoro Eshiem).

During an interview with health officer, he shared broader concerns about disease prevalence, stating,

"We have recorded cases of kidney issues, elephantiasis, and breast cancer cases within the community." (Representative, Health sector).

Some women in Eziome noted,

"We have seen people develop rashes and other skin-related diseases after using the river." (Women FGDs, Eziome).

However, a fisher from the same community mentioned,

"I have not personally heard of any major health problems here." (Fisher, Eziome).

Further testimonies highlighted the occupational hazards faced by those handling contaminated fish. A fishmonger from Eziome described her experience:

"After handling the contaminated fish with my bare hands, my palms become numb for days; the chemicals are hazardous." (Fishmonger, Eziome)

Another woman in the focus group discussion in Sanwoma added,

"We witness a lot of stomach problems and skin diseases due to the contaminated water." (Women FGDs, Sanwoma)

Interviews with key informants from the Environmental Protection Agency (EPA) and health sector provided further confirmation of these health risks. An EPA official emphasized,

"Illegal gold mining has greatly affected the community, including the health of people living in the Ankobra area." (Representative, Environmental Protection Agency)

A health officer at the district government hospital in Axim corroborated reports of child deformities, stating,

"We have recently recorded cases of children being born with deformities due to chemical exposure among their parents." (Representative, health sector)

Additionally, the health officer highlighted other socio-health consequences linked to mining activities.

"Many community members engage in gold mining because it is lucrative, but this has also led to an increase in promiscuity, resulting in a rise in HIV and other sexually transmitted diseases," he explained. He further noted,

"We have also recorded an increase in kidney-related conditions and birth defects in recent years." (Representative, Health sector).

Table 20 Perceived Impact of illegal ASGM on the overall health of fishers within the Ankobra region

Name of community	Impact of illegal ASGM fishers' health				
	Moderately negative impact	No impact	Severely negative impact	Slight impact	Total
Ajomoro Eshiem	28	19	39	3	89
Eziome	16	1	13	0	30
Sanwoma	91	56	101	11	259
Total	135	76	153	14	378

Pearson Chi2 = 8.85 Prob = 0.0650

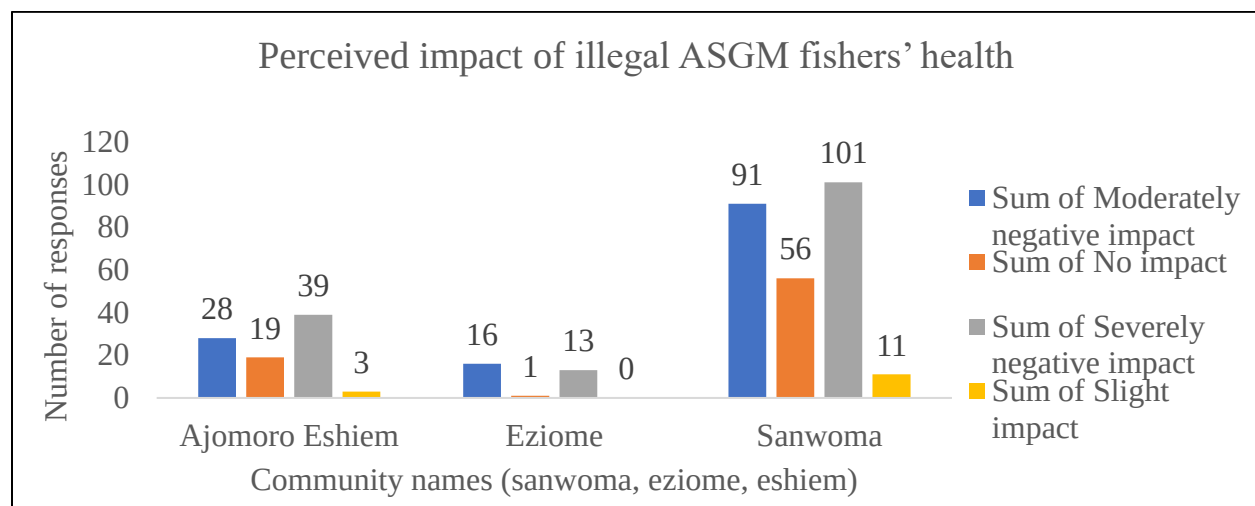


Figure 20 Perceived impacts of illegal ASGM fishers' health

Table 21 Summary of perceived health impact levels and their definitions among fishing communities

Number (%) of Respondents	Level of Impact	Definition/How Respondents Described This Level
153 (40.5%)	Severely negative	Life-threatening or chronic conditions (e.g., kidney disease, cancers, birth defects, severe skin rashes); frequent or long-term illness; inability to work or fish; major disruption to daily life.
135 (35.7%)	Moderately negative	Non-fatal but persistent health issues (e.g., skin rashes, diarrhea, malaria, respiratory problems); increased frequency of illness; noticeable but manageable disruption.
14 (3.7%)	Slight impact	Occasional or mild health issues (e.g., minor stomach upsets, mild skin irritation); little effect on daily activities.
76 (20.1%)	No impact	No reported health problems attributed to gold mining; normal health status maintained.

5.3.3 Illegal ASGM mining and employment transitions: Disruptions and adaptations in Ankobra river communities

In Table 14, The Pearson chi-square test yielded a value of $\chi^2 = 13.43$ with a p-value of 0.0094, indicating a statistically significant association between community location and reported employment transitions. This means the observed differences in employment effects across the three communities are unlikely to be due to chance. The findings indicate a significant shift in employment patterns due to gold mining activities, with varying effects across the three study communities: Ajomoro Eshiem, Eziome, and Sanwoma. Among the 378 respondents, a majority (258; 68.3%) reported that gold mining had led to a decrease in employment opportunities within their community. A smaller proportion (92 respondents; 24.3%) indicated that employment levels had remained unchanged, while 28 respondents (7.4%) reported that jobs had shifted to mining sites, suggesting a transition of labor from traditional occupations, such as fishing, to gold mining. A community-level analysis highlights variations in these employment shifts. In Sanwoma, the

most downstream community, a substantial 186 out of 259 respondents (71.8%) indicated a decrease in employment opportunities, while 61 (23.6%) reported no change. Only 12 (4.6%) stated that jobs had shifted to mining sites. Similarly, in Ajomoro Eshiem, which is closer to the mining activities, 51 respondents (57.3%) observed a decline in employment, whereas 24 (27.0%) saw no change, and 14 (15.7%) reported a shift of jobs to mining-related activities. In Eziome, a smaller but significant proportion (21 out of 30; 70.0%) noted a decrease in employment opportunities, while 7 (23.3%) reported no change, and only 2 (6.7%) observed job shifts to mining (**Figure 22**). During a focus group discussion in Eziome, a man emphasized the pressing need for employment opportunities, stating,

"We also need jobs here for our youths as the majority of our youth have migrated out of the community." (Men FGDs, Eziome).

A similar sentiment was expressed during the men's focus group discussion in Ajomoro Eshiem, where several participants affirmed,

"Yes, there are no jobs, and the majority of our youth have moved into the towns and cities." (Men FGDs, Ajomoro Eshiem).

In Ajomoro Eshiem, the chief Fisher further explained,

"Well, sometimes the young boys migrate to the towns and other places to search for jobs because we don't have any here." (Chief fisher, Ajomoro Eshiem).

A young fisher in Ajomoro Eshiem also added,

"Most of the young ones have migrated to other communities. I have even made plans to leave when I get the chance." (Fisher, Ajomoro Eshiem).

The situation was no different in Sanwoma, where signs of desperation and adaptation were evident. A fisher mentioned,

"Some of the young boys have started the galamsey (illegal mining) on the sea because its giving them some income." (Fisher, Sanwoma).

Highlighting the extent to which individuals were seeking alternative means of survival.

A fish processor in Sanwoma added,

"Especially for the youth, they don't live in the community anymore and have totally abandoned fishing. Some have resorted to galamsey (illegal mining)" (Fishmonger, Sanwoma).

Likewise, a young fishmonger in Sanwoma who previously assisted her mother in the business expressed her frustration, stating,

"I used to work side jobs like carrying goods for people from the market aside from the fish mongering business to get paid, but now there are no fishes, so I focus on carrying goods bought by people in the market carry them on my head to their houses to get paid." (Fishmonger, Sanwoma).

Table 22 Fishers' perceived impact of illegal ASGM on local employment opportunities

Name of community	Impact of illegal ASGM on local employment opportunities			
	Decreased employment	No change	Shifted jobs to mining sites	Total
Ajomoro Eshiem	51	24	14	89
Eziome	21	7	2	30
Sanwoma	186	61	12	259
Total	258	92	28	378

Pearson Chi2 = 13.43 Prob = 0.0094

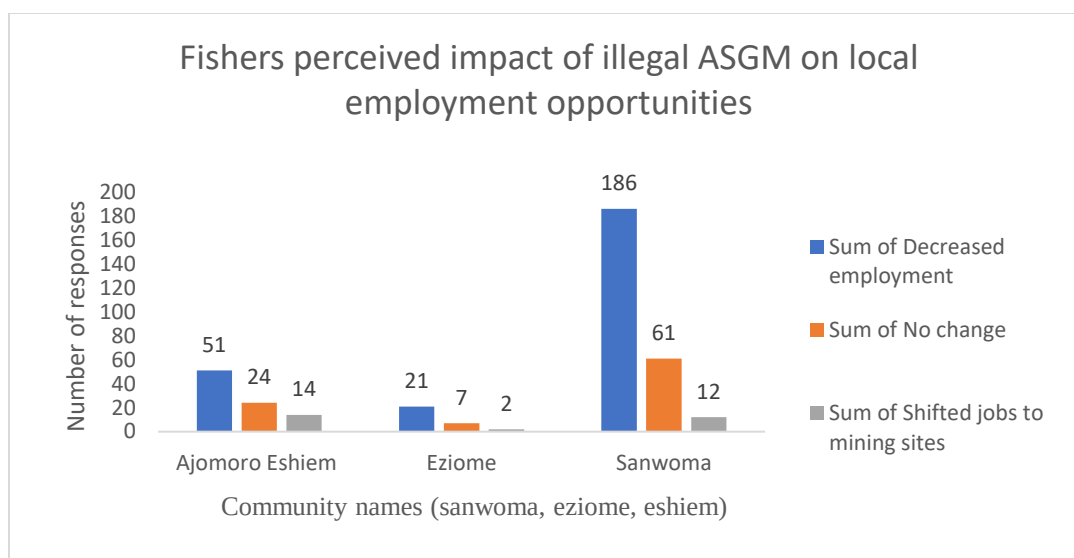


Figure 21 Fishers' perceived impact illegal ASGM on local employment opportunities

Table 23 Summary of the main response categories, the number and percentage of respondents for each, and how respondents defined these effects during interviews and focus groups.

Number (%)	Reported Effect	Definition/Description from Respondents
258 (68.3%)	Decreased employment	Fewer jobs, youth migration, loss of traditional work
92 (24.3%)	No change	No noticeable difference in job availability
28 (7.4%)	Shifted jobs to mining sites	Some moved from fishing to mining

5.3.4 Community perceptions of government's efforts to combat illegal ASGM activities: Perceived ineffectiveness and lack of intervention

Table 25 and Figure 23 presents the distribution of community perceptions regarding the government's response to the impacts of illegal ASGM on the fishing industry in Ankobra. The majority of respondents across all three communities rated the government's response as either

“ineffective” (65.6%) or “very ineffective” (19.3%), while only a small minority considered it “very effective” (3.4%) or held a neutral view (11.6%). A breakdown by community reveals some variation in perceptions. In Sanwoma, 66.0% of respondents described the response as ineffective and 18.5% as very ineffective, with 4.6% considering it very effective. In Ajomoro Eshiem, 57.3% rated the response as ineffective and 24.7% as very ineffective, while only 1.1% considered it very effective. Eziome showed the highest proportion of dissatisfaction, with 86.7% rating the response as ineffective and 10.0% as very ineffective; no respondents in Eziome considered the response very effective. The Pearson chi-square statistic ($\chi^2 = 13.25$, $p = 0.0392$) indicates a statistically significant association between community location and perceptions of government response. This means that the differences in how respondents from the three communities rated the government’s effectiveness are unlikely to be due to chance alone. In other words, community context and location appear to influence how residents perceive government interventions related to gold mining impacts (**Figure 23**). In an interview with the chief Fisher in Eziome, he plainly expressed dissatisfaction with efforts made by government in combatting the challenge. He added that

“Well, I can say yes, the government brought in some military men who came to patrol the area for some time. But when they left, we haven’t seen them here again and the mining is still going on.”. (Chief fisher, Eziome).

Surprisingly, an official from the Ministry of Fisheries revealed that

“Yes, the government has made some efforts by deploying the military and setting task force with the forestry commission to arrest the illegal miners. These interventions helped some time past but since the security personnel stopped patrolling the various mining sites, the miners have resumed their works”. (Representative NGO, Hen Mpoano)

Table 24 Government's efforts to combat activities of illegal ASGM on the fishing industry in Ankobra

Name of community	Government efforts to combat the activities of illegal ASGM within the Ankobra region				
	Ineffective	Neutral	Very effective	Very ineffective	Total
Ajomoro Eshiem	51	15	1	22	89
Eziome	26	1	0	3	30
Sanwoma	171	28	12	48	259
Total	248	44	13	73	378

Pearson Chi = 13.25 Prob = 0.0392

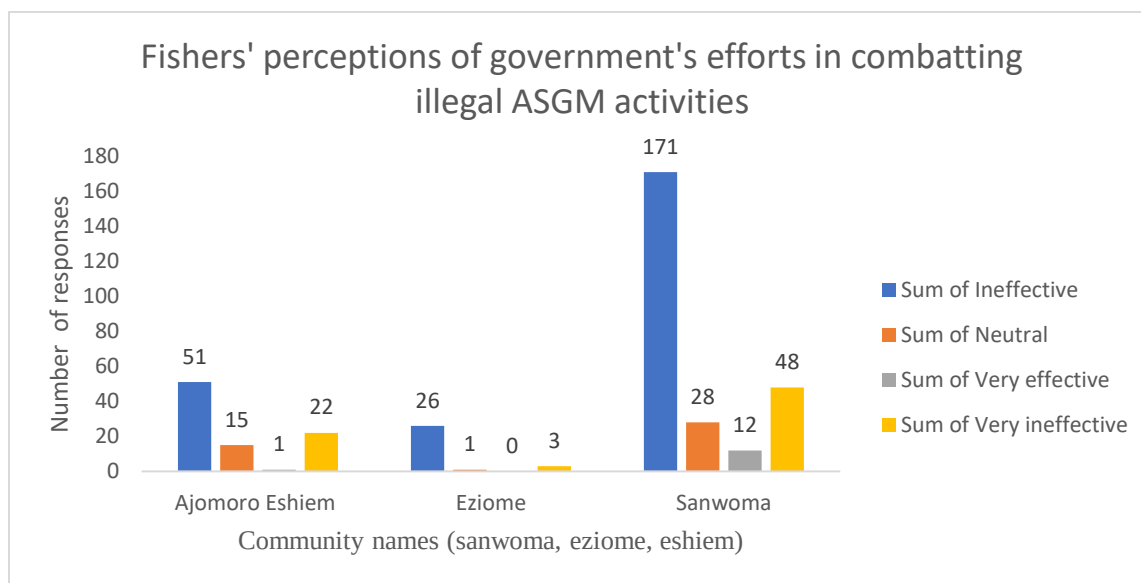


Figure 22 Fishers' perception of government's efforts in combatting illegal ASGM activities

Table 25 Summary of chapter 5 results from survey responses and interviews: Impacts, Drivers and Examples

Impact (Chapter 5)	Relevant Drivers and Changes (Chapter 1 and 2)	Notes / Examples
Decline in fish catch and livelihood disruptions	Gold mining activities (especially ASM), increased turbidity, chemical pollution, habitat loss	Mining leads to water pollution and habitat destruction, reducing fish stocks and affecting livelihoods.
Environmental Degradation	Deforestation, land clearing, riverbank destruction, sedimentation, chemical runoff from mining	Increased turbidity, siltation, and toxic chemicals degrade river ecosystems and water quality.
Percentage of fishing area affected	Expansion of mining sites into traditional fishing grounds, restricted access, physical alteration of riverbanks	Fishers lose access to significant portions of their fishing areas due to mining encroachment.
Declining incomes	Reduced fish catch, loss of fishing grounds, increased competition, market instability	Lower fish availability leads to reduced sales, affecting both fishers and fish processors.
Health consequences	Water contamination (mercury, heavy metals, chemicals), increased turbidity, poor sanitation	Exposure to polluted water causes health issues (skin diseases, gastrointestinal problems, etc.).
Gold mining and employment transitions	Loss of viable fishing livelihoods, attraction to mining jobs, economic necessity	Some fishers shift to mining for income, leading to changes in community employment patterns.
Community perceptions of government response: Ineffectiveness and absence of intervention	Weak enforcement of mining regulations, inadequate support for affected communities, lack of government presence	Communities perceive government action as insufficient or absent in addressing mining-related impacts.

5.4 Summary discussion of emerging findings from chapter 5 results

The results from this chapter reveal a profound and multifaceted transformation of the socio-ecological landscape along the Ankobra River, driven by the expansion of gold mining activities. The evidence demonstrates that gold mining-particularly unregulated and small-scale mining (ASM)-has become a central force undermining both the ecological integrity of the river and the

viability of traditional fishing livelihoods. Across all communities, respondents consistently reported a marked deterioration of water quality, with the Ankobra River now characterized by increased turbidity, foul odors, and visible pollution. These changes are widely attributed to gold mining, which introduces heavy metals and sediments into the water. The direct link between mining and declining fish populations is evident not only in the reported reduction in overall fish catch but also in changes to fish quality and species composition. The loss of critical habitats-such as breeding grounds and mangrove stands-further compounds the ecological crisis, as echoed in both community testimonies and official statements. The survey data reinforce these observations: a majority of respondents in all three communities perceive that over half of their fishing areas have been rendered unusable or severely degraded. This widespread loss of productive fishing grounds has immediate consequences for food security and the sustainability of local fisheries. The ecological impacts of mining have translated directly into economic hardship for fishing-dependent households. The overwhelming majority of respondents reported significant declines in fish catch frequency and household income, with many forced to abandon fishing altogether or seek alternative livelihoods. This shift is evidenced by the abandonment and sale of fishing equipment, increased reliance on commercial cold store fish, and migration for work in mining or petty trading.

The ripple effects extend throughout the community, affecting not only fishers but also processors, traders, and families. The decline in income has led to reduced access to education, increased food insecurity, and a general sense of economic instability. Perceptions of health impacts are widespread, with a substantial proportion of respondents describing severe or moderate negative effects linked to gold mining. The contamination of water sources, loss of clean drinking water, and increased exposure to pollutants have heightened community concerns about disease and

overall wellbeing. These health threats are particularly acute in downstream communities, which receive cumulative pollution from upstream mining operations. The compounded ecological and economic pressures are driving notable social changes. There is evidence of a shift away from fishing among the youth, increased migration, and the fragmentation of extended family structures as households seek to adapt to new realities. The loss of traditional livelihoods and the erosion of community cohesion are likely to have lasting consequences for social capital and resilience. The findings highlight an urgent need for targeted interventions to mitigate the impacts of gold mining on riverine communities. This includes strengthening environmental regulation and enforcement, providing alternative livelihood opportunities, and enhancing access to technical and financial support for affected households. The disparities in support mechanisms observed across communities underscore the importance of equitable and inclusive policy responses.

Overall, the chapter underscores the interconnectedness of ecological health, economic stability, and social wellbeing in the Ankobra River region. The cascading impacts of gold mining have created a cycle of environmental degradation, livelihood disruption, and social vulnerability. Addressing these challenges will require a holistic approach that integrates ecological restoration, livelihood diversification, and community empowerment.

Chapter 6

Exploring coping and adaptive strategies of Ankobra small-scale fishers to illegal ASGM impacts

6.0 Introduction

The increasing encroachment of illegal artisanal and small-scale gold mining (ASGM) activities in the Ankobra region of Ghana has significantly disrupted the social, economic, and ecological stability of small-scale fisheries communities. Globally, small-scale fisheries support the livelihoods of over 200 million people and embody diverse structures, practices, and cultural dynamics (Chuenpagdee & Jentoft, 2018). However, these communities face multifaceted challenges such as weak institutional support, political instability, limited economic resources, market pressures, illegal fishing practices, and poor infrastructure (Bennett et al., 2022). These factors deepen their vulnerability and highlight the need for a transdisciplinary approach to address the ecological, economic, and social drivers of change (Berkes & Nayak, 2018). Particularly in developing nations, fisherfolk often encounter compounded environmental and socio-economic issues, including ecological degradation and conflicts over diminishing natural resources (Sowman, 2015). While extractive industries like gold mining contribute to national economies, they also pose significant environmental and health risks. Notably, the use of mercury and other pollutants in mining contaminates water bodies, degrades ecosystems, and enters the food chain, threatening both human and aquatic life (Fischer et al., 2015; Páez-Osuna et al., 2017). Studies by Franco-Hernández et al. (2010) and Sowman (2015) similarly emphasize that although economically beneficial, gold mining often compromises the livelihoods of fisherfolk and calls for robust governance systems to balance economic interests with community well-being.

Over the past 30 years, fishing activities in Sanwoma (a community in Ankobra) as well as nearby communities have declined substantially, with gold mining emerging as a major contributing factor (Effah et al., 2021; Bansah et al., 2018). These environmental disturbances—affecting water quality, soil, vegetation, and fish stocks—have eroded the primary means of livelihood for many households. Central to understanding these intersecting challenges is the concept of vulnerability and viability within socio-ecological systems. Vulnerability refers to a system's susceptibility to external stressors—including environmental change, limited access to capital, and socio-political instability—while viability reflects a community's capacity to adapt and sustain livelihoods despite such stressors (Berkes & Nayak, 2018). The impacts of gold mining on Small-Scale fisheries (SSF) expose them to economic hardship and social instability (Girard et al., 2022). In response, some community members have turned to illegal mining, compounding social vulnerabilities. Azumah et al. (2021) report that this shift has had far-reaching consequences, including youth disengagement from education, rising cases of sexually transmitted diseases, drug use, teenage pregnancies, and accidental deaths. Women in particular, face heightened vulnerability due to declining fish stocks, which result in loss of income and push some to engage in illegal gold mining (Owusu & Andriesse, 2020; Eduful et al., 2020). These social disruptions underscore the urgent need for interventions that restore both environmental health and community resilience. Bene (2009) adds that poverty exacerbates these conditions, reinforcing cycles of hunger, exclusion, and precarious survival.

Communities that rely heavily on a single natural resource for their livelihoods—such as fishing—are often the most vulnerable to external stressors like environmental degradation, climate change, or extractive activities. When such stressors occur, some communities manage to withstand the shock and recover, while others are severely affected, lacking the coping mechanisms necessary

to adapt. In this context, resilience becomes a critical concept. Resilience refers to the ability of a community to absorb disturbances, adapt to changing conditions, and continue functioning effectively (Folke et al., 2010; Ommer et al., 2014). Folke et al. (2010) highlight adaptive strategies such as diversifying livelihoods and promoting community-based resource management as essential to building resilience. On the other hand, Ommer et al. (2014) stress the importance of proactive measures—like preventing harmful activities such as unregulated mining—that aim to reduce the occurrence of such stressors in the first place. Together, these perspectives underscore that enhancing community resilience requires integrated governance, inclusive decision-making, and support systems that empower local actors to both respond to and prevent threats to their way of life. Savo et al. (2017) further emphasize that adaptation in coastal communities is shaped by an interplay of social and ecological factors—including worldviews, norms, gender roles, age, socio-economic status, and experiences of marginalization. Their findings reveal the importance of culturally grounded strategies that promote both environmental stewardship and social equity. In this feedback loop, adaptation builds resilience, and increased resilience supports more effective adaptation (Adger, 2000). For communities in Ankobra, adaptive strategies that foster social cohesion, improve resource management, and strengthen local governance are essential for navigating the challenges posed by gold mining.

In Ankobra, the interplay of social and ecological factors makes adaptation a complex and multifaceted process. Social norms, worldviews, age, gender, and socioeconomic status all influence the adaptability of the community. Research shows that understanding these factors and addressing the underlying issues of marginalization and inequality are crucial for strengthening resilience. The adaptation process is not only about responding to immediate environmental challenges but also about fostering long-term socio-economic stability (Savo et al., 2017). The

relationship between adaptation and resilience is a feedback loop—adaptation strategies contribute to resilience, and increased resilience, in turn, enables more effective adaptation (Adger, 2000). In coastal communities like those in Ankobra, adaptation actions that strengthen social cohesion, improve resource management, and enhance governance structures can increase resilience, enabling the community to better withstand future disturbances. These dynamic highlights the importance of developing comprehensive strategies that not only address the environmental and economic challenges posed by gold mining but also restore and strengthen the social fabric of these communities. The objective of this research is to explore the adaptive strategies employed by small-scale fisheries in the Ankobra region to reduce the vulnerability arising from gold mining operations and increase the viability of their livelihoods.

6.1 Materials and Methods

The methodological approach for this objective is as described in **Chapter 3 (General Methodology)**. The sampling procedures, data collection techniques, and analysis methods outlined therein were applied to address **(Objective 3)**. No additional methods were employed for this objective.

6.2 Results

6.2.1 Vulnerabilities and coping livelihood responses to illegal ASGM impacts

Illegal mining activities along the Ankobra river have introduced a complex set of vulnerabilities that threaten the ecological integrity and socio-economic wellbeing of fishing communities in Sanwoma, Eziome, and Ajomoro Eshiem. As detailed in **Chapter 2 (literature review)** and **Chapter 5 (results)** and supported by the empirical data collected in this study, these vulnerabilities can be categorized into five broad themes **(Table 27)**:

Table 26 Summary of key vulnerabilities facing Ankobra river fishing communities

Theme	Description
Environmental Impacts	Water pollution, land degradation, and associated health risks caused by mining byproducts such as mercury and sedimentation.
Livelihood Impacts and Adaptation	Loss of fishing income, food insecurity, and the necessity for households to adopt new coping and survival strategies.
Governance and Institutional Response	Weak enforcement of mining regulations, inadequate compensation mechanisms, and limited institutional support for affected communities.
Social Structure and Inequality	Marginalized groups-such as women and youth-face disproportionate risks and reduced access to resources.
Knowledge and Communication	Information gaps, miscommunication, and barriers to justice that hinder community advocacy and adaptation.

Section (6.4) presents the diverse adaptive livelihood strategies adopted by fishers and community members across the three communities. These responses reflect efforts to mitigate the socio-economic impacts of gold mining and sustain household wellbeing amid ongoing environmental and institutional challenges.

6.3 Adaptive livelihood response mechanisms across the three Communities

6.3.1 Perceptions from in-depth Interviews

This section presents qualitative findings on how fishers in Sanwoma, Eziome, and Ajomoro Eshiem have developed coping and adaptive strategies in response to the impacts of illegal ASGM along the Ankobra River. The summary table below (**Table 28**) synthesizes the main adaptive and coping strategies reported by respondents and how these were described in their own words.

Table 27 Summary of key coping livelihood strategies adopted by fishers in Ankobra river

Strategy Type	Reported Strategy/Activity	Description / Respondent Quote
Adaptive	Shift to farming (cassava, other crops); use of new skills	<i>“We have focused more on farming now and cultivating cassava.”</i> <i>“The Hen Mpoano group have taught us some skills such as soap making... but the capital to start has been the biggest challenge.”</i>
Adaptive	Fish farming and animal rearing	<i>“We have started small fishponds to raise tilapia, since the river is not reliable anymore.”</i>
Adaptive	Collective action and savings groups	<i>“We are trying to form a group to save money together and support each other when someone wants to start a new business.”</i>
Adaptive	Advocacy and participation in training	<i>“We attend workshops organized by NGOs to learn new skills and about our rights, hoping it will help us adapt.”</i>
Adaptive	Growing coconut and cocoa	<i>“We grow coconut and cocoa to survive in this community since we lost our livelihoods.”</i>
Coping	Migration	<i>“Some of us have moved to other towns to find work or fish in less polluted waters.”</i>
Coping	Fish processing and trading	<i>“Now I buy fish from other places and smoke them to sell here, since our own river cannot provide enough.”</i>
Coping	Temporary housing and seasonal relocation	<i>“During the floods, we build temporary shelters and move inland until the water goes down.”</i>
Coping	Tree felling, chainsaw operation	<i>“I have lost my livelihood and currently I have to resort to tree felling and packing to make a living.”</i> <i>“I am into chainsaw operation, and it been helping me a little.”</i>
Coping	Buying fish from other towns	<i>“I have had to spend extra income in purchasing cold store fish from the main town (Axim) since there are no fishes in the Ankobra river.”</i>

Narrative Expansion

Fishers in Sanwoma reported a significant shift from fishing to farming, particularly cassava cultivation, as a primary means of survival. One fishmonger explained,

“We have focused more on farming now and cultivating cassava.” (Fishermonger, Sanwoma).

A respondent from Hen mpoano also mentioned attempts to utilize new skills acquired through training programs, such as soap making, though financial constraints limit their ability to fully transition:

“The Hen Mpoano group have taught us some skills such as soap making and others and I try to utilize them to get another work but the capital to start has been the biggest challenge.” (Representative NGO, Hen Mpoano). Others also mentioned venturing into animal rearing and aquaculture.

“We have started small fishponds to raise tilapia, since the river is not reliable anymore.” (Fisher, Sanwoma). Some women are trying to adapt a means to financially support each other by forming groups in Sanwoma.

“We are trying to form a group to save money together and support each other when someone wants to start a new business.” (Fishmonger, Sanwoma).

In Eziome, the loss of fishing livelihoods has led many to engage in tree felling and chainsaw operations as alternative sources of income. As one fisher described,

“I have lost my livelihood and currently I have to resort to tree felling and packing to make a living.” (Fisher, Eziome)

Another added,

“I am into chainsaw operation, and it been helping me a little.” (Fisher, Eziome). The devastating issue has also caused youth migration from the community.

“Some of us have moved to other towns to find work or fish in less polluted waters.” (Fisher, Eziome).

Respondents in Ajomoro Eshiem highlighted a shift toward growing coconut and cocoa as a key adaptive response. A fishmonger noted,

“We grow coconut and cocoa to survive in this community since we lost our livelihoods.” (Fishmonger, Ajomoro Eshiem).

She also described the challenges of continuing her trade as a fishmonger, given the scarcity of local fish:

“In some instances, I have had to spend extra income in purchasing cold store fish from the main town (Axim) since there are no fishes in the Ankobra river. (Fishmonger, Ajomoro Eshiem).

Across all three communities, the decline of fishing as a viable livelihood due to illegal ASGM has forced fishers and fishmongers to adopt diverse and sometimes precarious survival strategies. These include shifting to crop farming, engaging in timber-related activities, acquiring new vocational skills, and sourcing fish from distant markets. The testimonies highlight both the resilience and the challenges faced by affected households as they navigate the socio-economic disruptions caused by environmental degradation of the Ankobra River.

6.3.2 Forms of infrastructural support provided by internal and external sources to fishers affected by illegal ASGM

An assessment of the infrastructural support provided to community members by both internal and external organizations in response to the impacts of illegal gold mining revealed notable disparities across the three study communities—Ajomoro Eshiem, Eziome, and Sanwoma. The forms of assistance received, such as the construction of boreholes, provision of storage facilities, and rehabilitation of landing sites, varied considerably, reflecting differences in the level and type of

intervention from government agencies, NGOs, and local associations. This uneven distribution of support has influenced the communities' capacity to cope with and adapt to the environmental and livelihood challenges posed by illegal mining (**Figure 24**). Overall, the most commonly reported response across all three communities was the absence of any form of support. In Ajomoro Eshiem, a total of 80 respondents reported receiving no support at all, making this the dominant response in the community. Only a marginal number (less than 10) indicated receiving alternative livelihood support, while no respondents reported obtaining emergency relief or financial assistance. In Eziome, the situation was similarly bleak. Nearly 30 respondents indicated that they had not received any support, and only a negligible number—approximately 2 individuals—reported receiving alternative livelihood interventions. No other forms of support were reported by respondents in this community. In stark contrast, Sanwoma exhibited a relatively higher level of diversity in support types, although the majority of responses (n=180) still indicated a complete absence of support. Nonetheless, about 65 individuals in this community reported receiving alternative livelihood support, and a smaller subset (approximately 10 individuals) noted that they had received some form of financial assistance. As with the other communities, emergency relief or aid was entirely absent in the responses. These results suggest a widespread lack of institutional or external support across the surveyed communities, with limited interventions focused on alternative livelihoods and almost no presence of emergency aid or financial assistance. The data also point to a spatial disparity, with Sanwoma receiving relatively more support—albeit still insufficient—compared to Eziome and Ajomoro Eshiem.

In confirmation to the survey responses, an official from the Ministry of Fisheries in the Ellembele district who said

“In the light of the current gold mining challenges on the livelihoods of the fishers, we have not or let me say the ministry has not offered any support to the fishers to cushion them but we have tried as a ministry and have a collaboration with the Hen mpoano and the Maame water project to educate the fishermen on the impacts of using chemicals in fishing in their fishing but with regards to gold mining, we have not done anything yet. The government has made some efforts by organizing task force and the military to invade those areas and secure the river from illegal miners. That, I can assure you that the government is doing”. (Representative, Ministry of Fisheries).

Table 28 Summary of internal or external support received to cope with illegal gold mining impacts

Number (%)	Reported Support Type	Definition/Description from Respondents
290 (73.6%)	No support received	No institutional or external support; households rely on their own coping strategies; “the ministry has not offered any support to the fishers to cushion them.”
77 (19.5%)	Alternative livelihood support	Occasional training or interventions (e.g., skills training, small-scale projects); limited reach and not sustained
10 (2.5%)	Financial assistance	Small subset received some financial aid, mostly in Sanwoma; described as insufficient and irregular
0 (0%)	Emergency relief	No respondents reported receiving emergency or relief aid
17 (4.3%)	Not applicable/Other	Question not relevant or support type unspecified

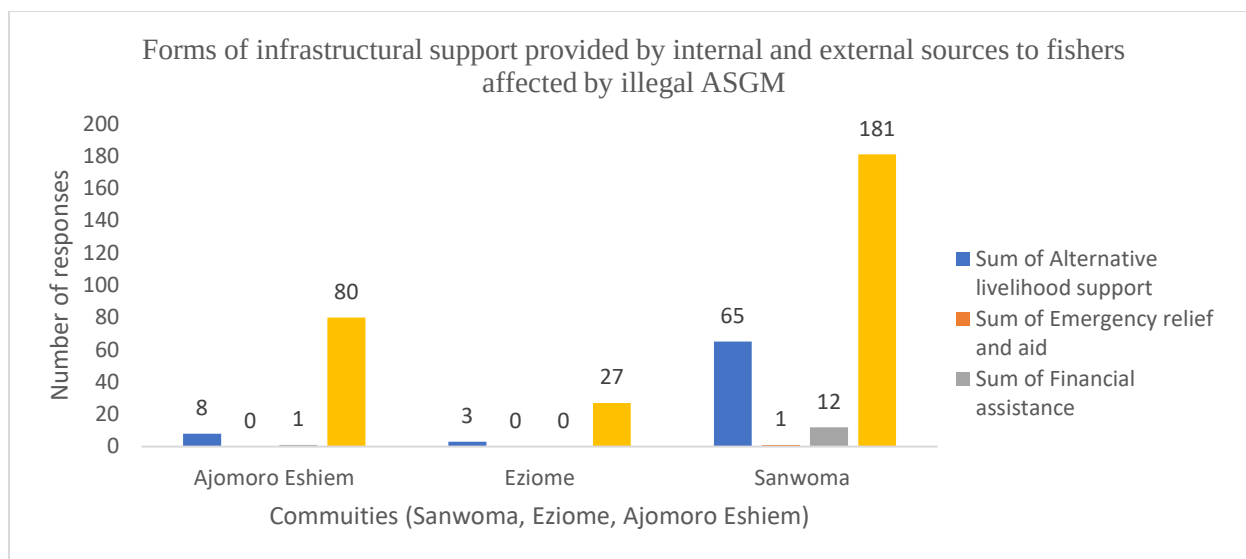


Figure 23 Forms of infrastructural support provided by internal and external sources to fishers affected by illegal ASGM

6.3.3 Type of social capital (e.g., networks, relationships) communities members rely on to cope with the impacts of illegal ASGM

The types of social capital that community members rely on to cope with the impacts of gold mining were assessed across Ajomoro Eshiem, Eziome, and Sanwoma (**Figure 25**). Respondents identified a range of support networks, including community organizations, family and friends, government agencies, loans from financial institutions. In Sanwoma, the majority of respondents ($n = 111$) reported relying on community organizations as their primary source of support. Family and friends constituted the second most cited resource ($n = 70$), followed by government agencies ($n = 45$). A small number of respondents indicated reliance on loans from financial institutions ($n = 3$) or reported having no support at all ($n = 2$). This outcome in Sanwoma was evident as the community had a fisher group functioning hence playing some roles in addressing the issues spurning from gold mining. Ajomoro Eshiem exhibited a similar pattern, with 51 respondents indicating community organizations as their main support network. Family and friends were also frequently cited ($n = 35$), while government agencies ($n = 3$) and loans from financial institutions

(n = 0) were mentioned infrequently. No respondents in this community reported having no support. In Eziome, responses were more evenly distributed but overall numbers were lower. Community organizations (n = 11) and family and friends (n = 8) were the most commonly reported sources of support, followed by government agencies (n = 5), loans from financial institutions (n = 3), and no support (n = 2).

During the community visits to Eziome and Ajomoro Eshiem, it was observed that majority of the fishers lacked groups and organizations where they can rely on in dire circumstances. Overall, the results indicate that community organizations and personal networks (family and friends) are the predominant forms of social capital leveraged by community members to cope with the adverse effects of gold mining. Reliance on government agencies and formal financial institutions remains limited, and only a small minority of respondents reported having no support at all.

The results in Sanwoma aligned with an interview conducted with the chief fisher who shared that fisher group or organization does exist in the community. He said that

“Yes, we have it. It is called group ABCD, and the group heads take contributions every month to help with funerals and other expenses”. (Chief fisher, Sanwoma).

Unfortunately, when asked how the organization has assisted the fishers or members during the challenges, he consented that the group had not made any efforts to address gold mining issues.

Table 29 Summary of social capital types used to cope with illegal ASGM impacts

Number (%)	Social Capital Type	Definition/Description from Respondents
173 (56.9%)	Community organizations	Reliance on local groups (e.g., fisher groups) for mutual aid, contributions for social needs; not always addressing mining issues directly
113 (37.2%)	Family and friends	Support from kinship and personal networks, especially where formal groups are weak or absent
53 (17.4%)	Government agencies	Occasional mention of support or information from local authorities; generally limited and not a primary coping resource
6 (2.0%)	Loans from financial institutions	Small number access formal credit; rarely used and not a significant resource in most communities
4 (1.3%)	No support	Respondents report lacking any social or institutional support; often in communities with fragmented networks

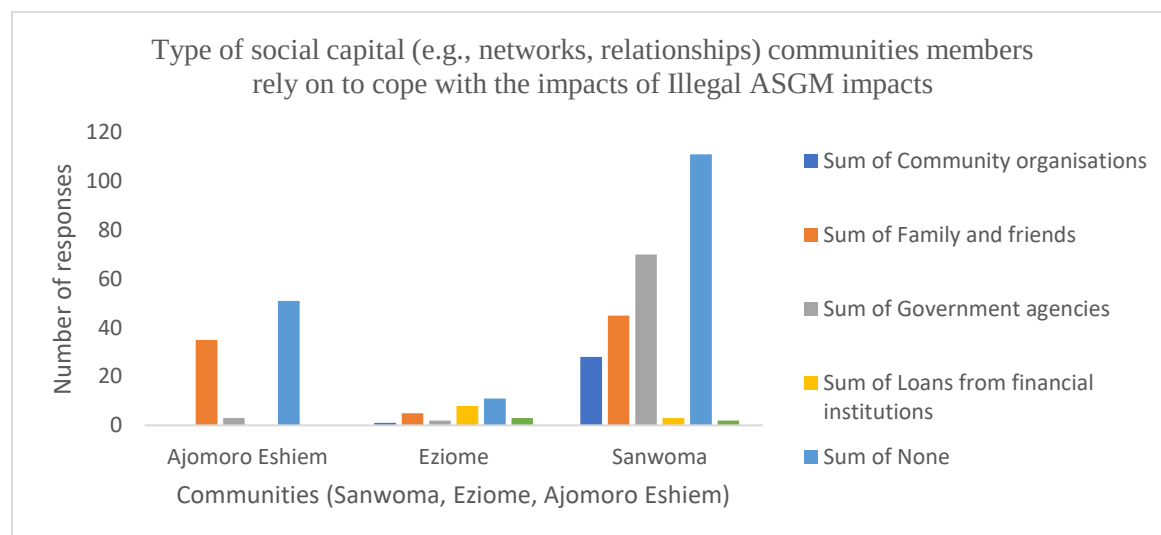


Figure 24 Types of social capital community members rely on to cope with the impacts of illegal ASGM

6.3.4 Most common form of assistance provided by local organizations to support fishers affected by illegal ASGM

The most common forms of assistance provided by local organizations to support fishers affected by gold mining were assessed in Ajomoro Eshiem, Eziome, and Sanwoma (**Figure 26**). Respondents identified a range of support types, including fishing equipment supply, health support, livelihood training, advocacy, financial support, and the absence of any assistance. In Sanwoma, the predominant form of assistance reported was livelihood training, with 121 respondents indicating receipt of this support. This was followed by a substantial number of respondents ($n = 83$) who reported receiving no assistance at all. Other forms of support were less frequently cited: 20 respondents reported receiving financial support, 15 received health support, 11 received advocacy, and 9 received fishing equipment supply. Reasons for the increased number of responses in livelihood supports stems from occasional training and education offered by the NGO (Yen Mpoano) for most fisher communities especially those along the coast. This has contributed to a significant number of fishers equipped with technical and vocational skills. The trainings were more predominant in Sanwoma as it falls along the coast and close to the principal towns.

A similar but less pronounced trend was observed in Ajomoro Eshiem. Here, 41 respondents indicated that they received no assistance, making it the most common response. Livelihood training was the next most frequently reported form of support ($n = 20$), followed by health support ($n = 13$), advocacy ($n = 9$), financial support ($n = 5$), and fishing equipment supply ($n = 1$). In Eziome, the overall number of responses was lower. The most common form of assistance was no assistance ($n = 19$), followed by livelihood training ($n = 6$), health support ($n = 4$), financial support ($n = 1$), and advocacy ($n = 1$). No respondents reported receiving fishing equipment supply. Other forms of support, such as fishing equipment supply, health support, advocacy, and financial

support, were reported far less frequently. This suggests notable gaps in the support provided to fishers affected by gold mining, with many individuals not receiving any form of assistance from local organizations. Overall, these findings indicate that livelihood training is the most commonly provided form of assistance by local organizations, particularly in Sanwoma. However, a significant proportion of respondents across all communities-especially in Ajomoro Eshiem and Eziome-reported receiving no assistance. The account of no assistance has compelled some fishers to migrate to other towns to search for other livelihoods.

This result also aligned with interview with the chief fisher in Eziome who said that

“This community does not have a well-structured organization. We have not been able to provide any form assistance to our members because we don’t have it”. (Chief fisher, Eziome)

Table 30 Summary of assistance provided by local organizations to support fishers affected by illegal gold mining

Number (%)	Assistance Type	Definition/Description from Respondents
148 (46.2%)	Livelihood training	Training in alternative skills (e.g., soap making, vocational skills), mostly in coastal communities; helps some diversify income
143 (44.7%)	No assistance	No support received; many fishers feel neglected or compelled to migrate for other livelihoods
20 (6.2%)	Financial support	Limited monetary aid, often described as insufficient and irregular
19 (5.9%)	Health support	Occasional health-related assistance, generally not sustained or widespread
11 (3.4%)	Advocacy	Some awareness-raising or advocacy efforts, but not perceived as effective or impactful
10 (3.1%)	Fishing equipment supply	Rare provision of gear or equipment, reported by very few respondents

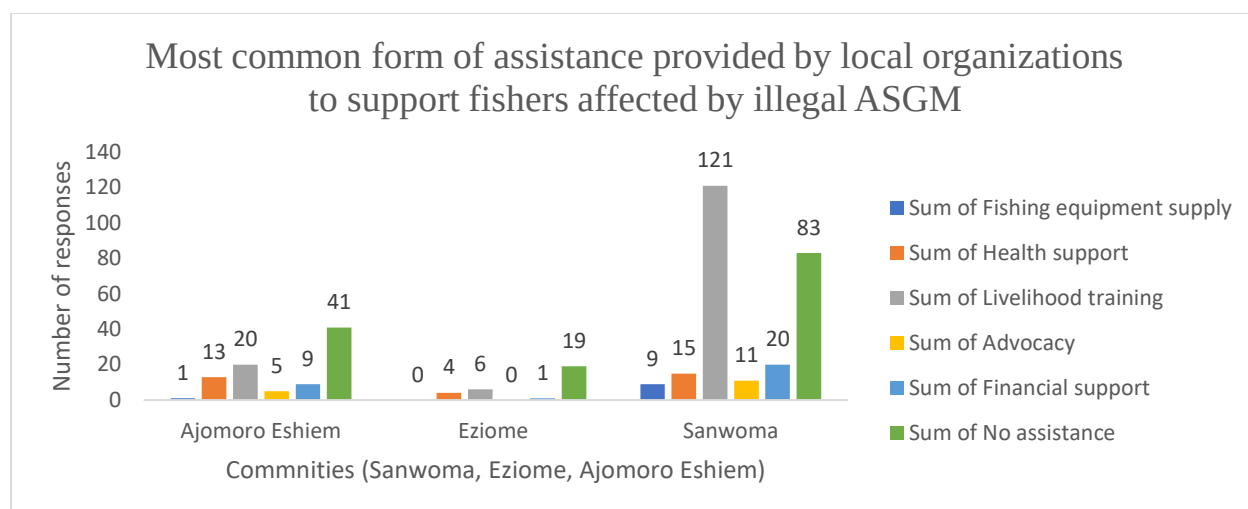


Figure 25 Most common form of assistance provided by local organizations to support fishers affected by illegal ASGM

6.4 Institutional support and effectiveness

6.4.1 Local organizations in supporting fishers affected by illegal ASGM

The perceived effectiveness of local organizations in supporting fishers affected by gold mining varied significantly across the three study communities (**Figure 27**). Respondents were asked to rate the support provided by local organizations as highly effective, moderately effective, slightly effective, not effective, or indicate if they were unsure. In Ajomoro Eshiem, the majority of respondents (n=53) rated the efforts of local organizations as *moderately effective*. This was followed by 20 respondents who viewed these efforts as *not effective*. A limited number reported the support as *slightly effective* (n=5) or *highly effective* (n=3), while very few (n=2) indicated that they were *not sure* of the effectiveness. In Eziome, responses were generally low across all categories, reflecting either low engagement by local organizations or limited awareness of their activities. The highest number of responses (n=12) indicated that the support was *slightly effective*, followed by small numbers indicating *moderately effective* (n=8), *not effective* (n=7), and *highly effective* (n=2). Only one respondent was *not sure*. In Sanwoma, respondents reported a broader spectrum of experiences with local organizational support. A significant majority (n=135) rated

the efforts as *moderately effective*, followed by a sizable number (n=70) who considered the efforts to be *not effective*. Smaller groups of respondents reported the support as *slightly effective* (n=28), *highly effective* (n=15), or expressed uncertainty (n=8). Taken together, these findings suggest that while some local organizations are playing a role in supporting fishers—particularly in Sanwoma and Ajomoro Eshiem—their efforts are largely perceived as falling short of being fully effective. Very few respondents in any of the communities rated the support as *highly effective*, and a considerable number still found these efforts to be ineffective, pointing to a need for better-targeted, more impactful interventions.

A young fish processor in Sanwoma during an interview mentioned that

“We have community organizations, but I don’t see them making a significant impact in our community. I believe we need to meet regularly to address issues, such as making effective contributions. Additionally, I suggest that all monthly contributions should be saved in the bank rather than kept by individuals”. (Fish processor, Sanwoma).

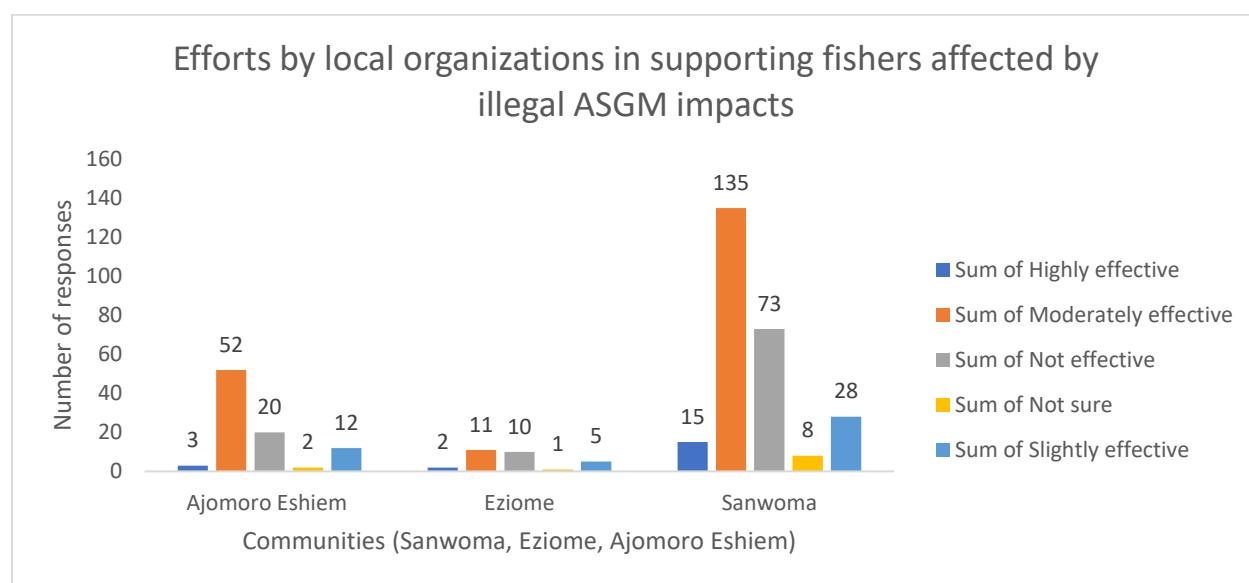


Figure 26 Efforts by local organizations in supporting fishers affected by illegal ASGM

6.4.2 Role of local leaders in addressing the challenges posed by illegal ASGM

The analysis on the role of community leaders in addressing the current situation and damage caused by gold mining among the three communities showed variations (**Figure 28**). Respondents were asked their opinions on the roles their community leaders have played to help them as effective, ineffective, moderately effective, slightly effective and very effective. In Ajomoro Eshiem, 53 individuals rated the role of local leaders as ineffective, which was the highest category recorded. This was followed by 22 responses who said the roles of local leaders were effective in tackling the situation. Again, moderately effective and slightly effective were 11 and 1 respectively. Only two individuals rated the role of local leaders as very effective. This shows how much efforts local leaders are putting in to combat the situation. In Eziome, 25 respondents rated the role of local leaders in dealing with the issues of gold mining and its related challenges as ineffective. 3 individuals rated it as effective, whereas for moderately effective and slightly effective, 1 individual each was recorded. No one rated the role of local leaders in dealing with the gold mining challenges as very effective.

In Sanwoma, 90 fishers rated the role of local leaders in addressing the gold mining challenges as ineffective. This was followed by 87 responses rating the role of local leaders as effective. Moderately effective and slightly effective followed with 30 and 23 responses respectively. Interestingly, 29 fishers rated the role of local leaders as very effective. This showed clearly varying responses across the three communities.

A fisher in Eziome categorically stated that

“No, we have not had any community-led initiative geared towards controlling the issue surrounding gold mining”. (Fisher, Eziome).

Meaning, some group interventions have been carried out but, on the issues, related to gold mining, they have not been effective or carried out. This statement confirmed with a statement from the chief fisherman, who said that

“In relation to the gold mining issues, no” (Chief fisher, Sanwoma) showing that there have not been effective efforts especially with gold mining on the impacts of fishing in the community.

A fisher in Eziome in an interview said that

“The community heads have not helped us in any way.” (Fisher, Eziome).

This shows how much displeased members of the community are with regards to efforts by community leaders in tackling the issue. In Sanwoma, women in a focus group discussion lamented that even though groups exist in the community, opinions are not taken in consideration. They said:

“There are groups in these community but sometimes the leaders fail to take our ideas anytime we have meetings. They treat us as though we don’t know anything regarding gold mining”. (Women FGDs, Sanwoma).

Official from the Ministry of fisheries in an interview said

“Honestly, there are no stronger associations that will help the fisherfolks to have their voices heard. We encourage them to form stronger associations to promote social resilience”. She further added that

“There should be community engagements to educate the people on the impact of mining near water and also they have to form strong social groups so that, they can make their grievances known to the right people”. (Representative, Ministry of fisheries).

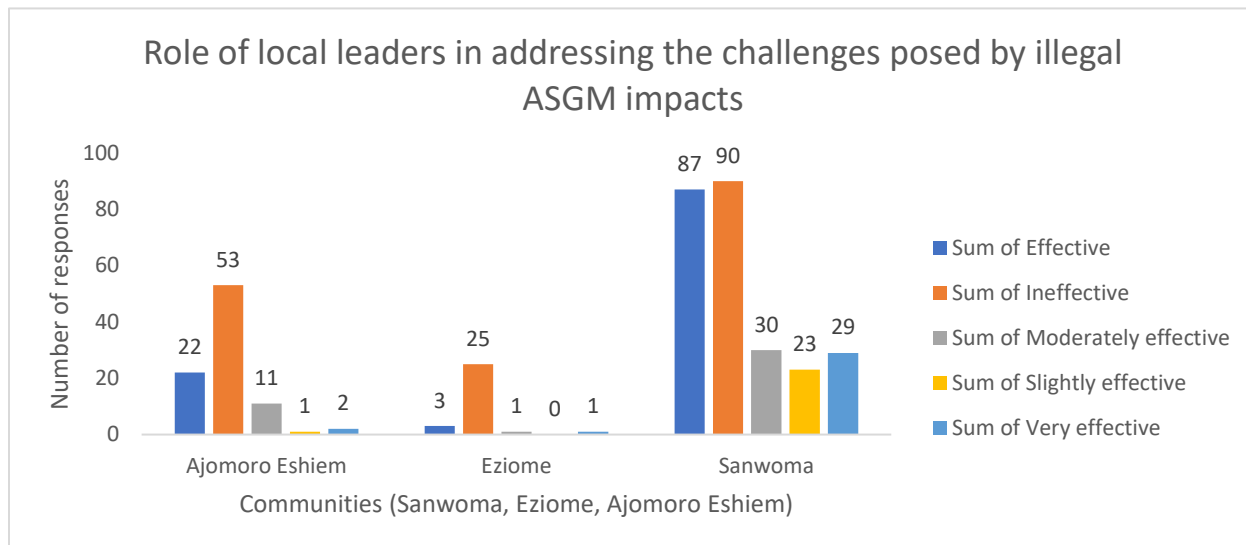


Figure 27 Role of leaders in addressing the challenges posed by illegal ASGM

6.4.3 Accessibility of support services provided by local community organizations for fishers affected by illegal ASGM

The accessibility of support services provided by local community organizations to fishers affected by gold mining was assessed across three communities: Ajomoro Eshiem, Eziome, and Sanwoma (Figure 29). The findings indicate a pronounced perception of inaccessibility to these services among respondents in all communities surveyed. In Sanwoma, the majority of respondents ($n = 186$) reported that support services were inaccessible, with only a minority ($n = 15$) indicating that services were accessible. Additionally, 30 respondents described their experience as neutral, while 28 characterized the services as very inaccessible. A similar trend was observed in Ajomoro Eshiem, where 61 respondents identified support services as inaccessible. Only 2 respondents considered the services accessible, while 8 reported a neutral stance and 18 described the services as very inaccessible. Eziome exhibited the lowest overall response numbers, but the pattern persisted: 27 respondents reported services as inaccessible, none found them accessible, 1 was neutral, and 2 described the services as very inaccessible. Collectively, these results demonstrate

that fishers in all three communities predominantly perceive support services from local organizations as inaccessible, with very few reporting positive experiences regarding accessibility.

In a men's focus group interview, they shared that *"We don't have any support in the community"*.

Others also ascertained that

"We don't have any group strategies. Each individual develops his own way to survive". (Men FGDs, Eziome).

A chief fisherman in Eziome lamented that the community does not have any facility to offer services to the members who may be impacted by gold mining problems. In the interview He said *"This community has no school, no portable drinking water, no hospital and no electricity. During emergencies especially in the case of health when someone is contracts a disease after consuming fish or the water, we don't even have boats available to carry them to the nearby health facility. We are really in danger here as we don't have any form of accessible facility we can depend on particularly during this current situation". (Chief fisher, Eziome).*

Table 31 Summary of accessibility of support services from local community organizations

Number (%)	Accessibility Rating	Definition/Description from Respondents
274 (81.7%)	Inaccessible	Services are difficult or impossible to access; community members report no support, lack of group strategies, and inadequate facilities.
48 (14.3%)	Very inaccessible	Severe barriers to access; absence of basic infrastructure (e.g., no schools, water, hospitals, electricity), especially during emergencies.
39 (11.6%)	Neutral	Neither accessible nor inaccessible; some respondents indifferent or unsure about service availability.
17 (5.1%)	Accessible	Few respondents find services reachable; positive experiences are rare and not widespread.

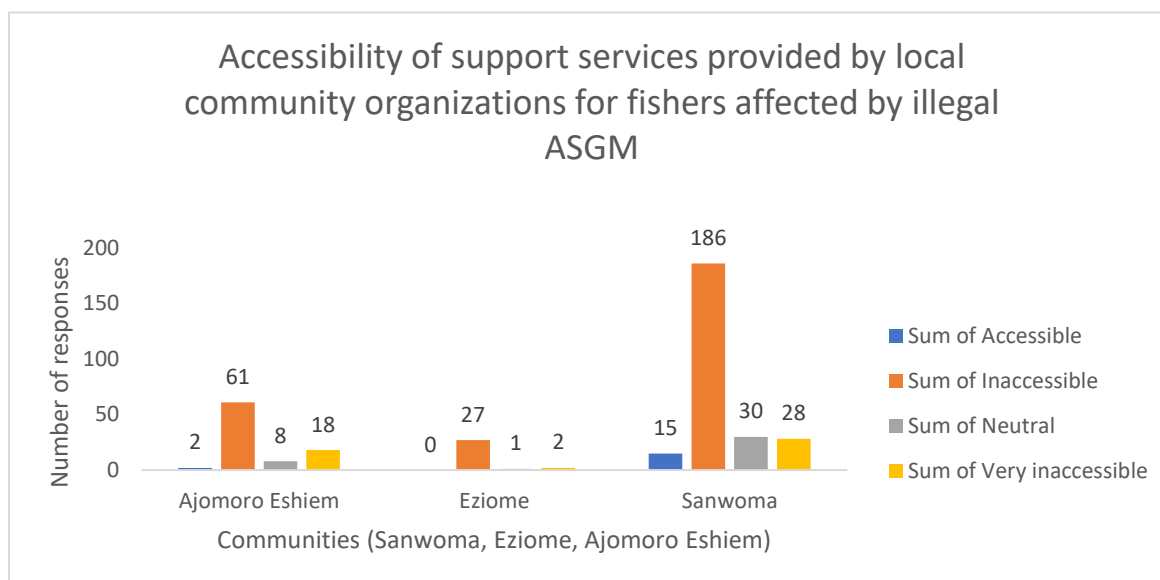


Figure 28 Accessibility of support services provided local community organizations for fishers affected by illegal ASGM

6.4.4 Frequency of information about the impacts of illegal ASGM from local leaders or authorities to fishers

The analysis on the perceived frequency of information about the issues surrounding gold mining impacts from local leaders or authorities showed varying perspectives across the three communities (**Figure 30**). The responses were rated as always, never, often, rarely and sometimes. In Ajomoro Eshiem, 59 fishers responded sometimes, indicating that even though there are efforts by community leaders to circulate the menace, it is not done consistently. The next rated option was often (n=17). The least responses were never from one fisher, showing clearly some information being circulated amongst members of the community on gold mining impacts. In Eziome, the highest response was often (n=14), followed by sometimes (n=11). No fisher responded never, as this result reflects some level of information or awareness of the issues surrounding gold mining in the community. The situation was quite similar in Sanwoma as 104 fishers responded to sometimes receiving information about the issues surrounding gold mining. Often followed next with 54 responses. The least response was always, as 10 fishers expressed

having received frequent information from local leaders on the issues of gold mining menace on their livelihoods.

In a focus group discussion, a woman in Eziome mentioned that

“We have heard of news regarding the gold mining ‘galamsey’ and its impacts on our river. We also see it on the news and also sometimes on the radios because its been a major issue confronting the country now”. Another woman in the group also added that

“Our local leaders don’t do the news circulation or information about the galamsey often. For me, I only hear it more on the radio”. (Women FGDs, Eziome).

In Sanwoma, the chief fisher added that

“We the leaders try our best to inform members of the community of the situation and advice them not to eat fish from the river nor drink from the river as well”. (Chief fisher, Sanwoma).

Table 32 Summary of frequency of information provided by local leaders/authorities on ASGM impacts

Number (%)	Frequency Category	Definition/Description from Respondents
174 (46.8%)	Sometimes	Information is shared occasionally but not consistently; community members often rely on radio or external news sources.
85 (22.9%)	Often	Updates are provided with some regularity, but not always directly from local leaders; awareness is present but not pervasive.
25 (6.7%)	Rarely	Information is infrequent; many feel uninformed about ongoing risks and consequences.
10 (2.7%)	Always	Very few report frequent and proactive communication from local leaders or authorities.
1 (0.3%)	Never	Almost all respondents receive at least some information; total lack of communication is rare.

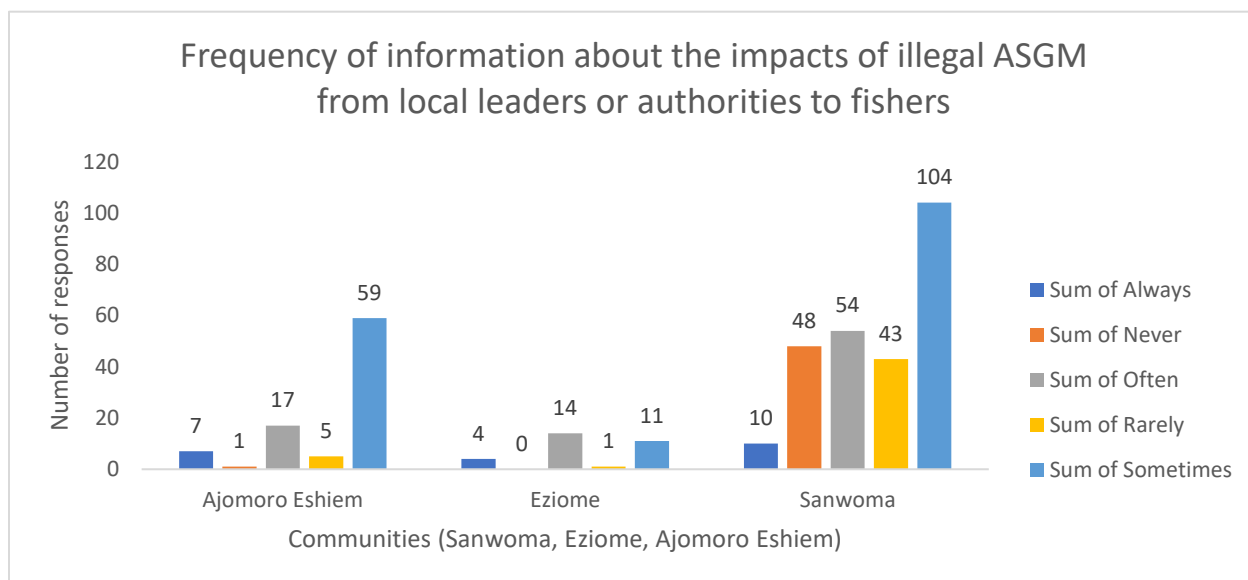


Figure 29 Frequency of information about the impacts of gold mining from local leaders or authorities to fishers

6.4.5 level of confidence in the ability of local authorities to manage the impacts of illegal ASGM in your community

The level of confidence in the ability of local authorities to manage the impacts of gold mining was evaluated across the three communities: Ajomoro Eshiem, Eziome, and Sanwoma (**Figure 31**). The data reveal varied perceptions of local authority effectiveness among respondents. In Sanwoma, responses were relatively evenly distributed between those who perceived local authorities as ineffective ($n = 90$) and effective ($n = 87$). Additionally, 30 respondents rated the authorities as moderately effective, 23 as slightly effective, and 29 as very effective, indicating a broad range of opinions but with a slight leaning toward skepticism. Ajomoro Eshiem showed a different pattern, with a majority of respondents ($n = 53$) considering local authorities ineffective in managing gold mining impacts. Furthermore, Only 22 respondents viewed them as effective, while 11 rated them as moderately effective. Very few respondents perceived local authorities as slightly effective ($n = 1$) or very effective ($n = 2$). In Eziome, the majority of respondents also expressed low confidence in local authorities, with 25 rating them as ineffective and only 3 as

effective. Minimal responses indicated moderate, slight, or very effective confidence levels. This plainly explained why they have had very low confidence in their local leaders in tackling the issues surrounding gold mining. Overall, these findings suggest that confidence in local authorities' capacity to manage the impacts of gold mining is generally low across the communities, particularly in Ajomoro Eshiem and Eziome. Sanwoma exhibits a more divided perception, with nearly equal numbers of respondents expressing confidence and lack thereof.

A fishmonger in an interview added that

“No I don't think my contributions are recognized in this community because we mostly share our opinions but they are not taken into consideration. If they don't take our concerns and opinions, how can we have confidence in them”.(Fishmonger, Ajomoro Eshiem).

She expressed that she think the confidence is low since leaders fail to show any form readiness to address the issue by first gathering their views.

A fisher from Eziome in an interview remarked that the leaders do not show any concern in taking their views on the issue. He expressed his opinion that

“No, they are not heard by our leaders in this community, especially on the issue of Gold mining”.(Fisher, Eziome).

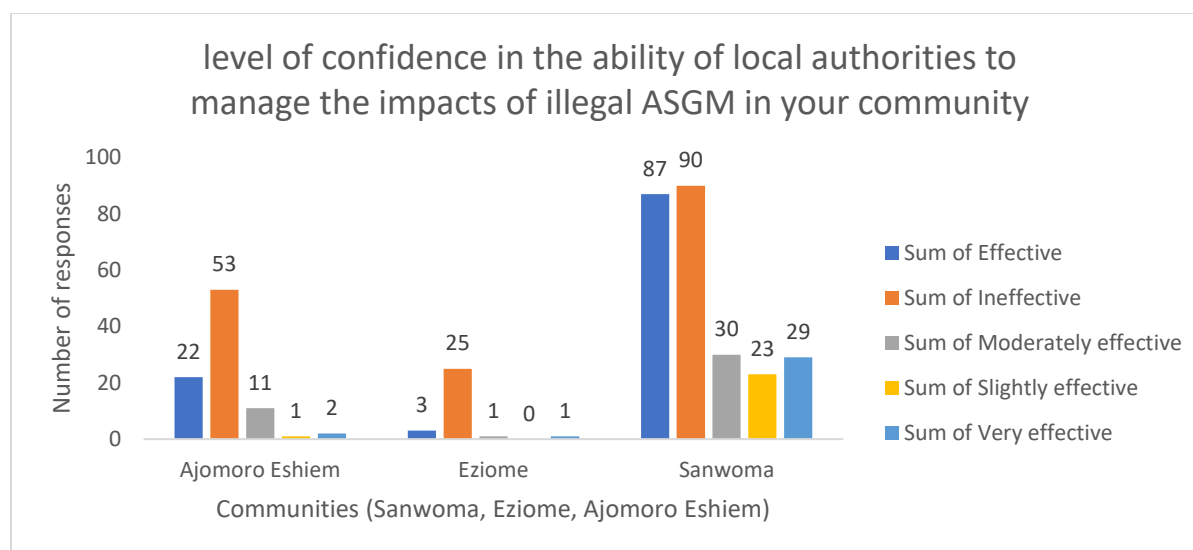


Figure 30 Level of confidence in the ability of local authorities to manage the impacts of illegal ASGM in your community

6.5 Economic coping mechanisms

6.5.1 Percentage of fishers' income spent to contain the impacts caused by illegal ASGM

This subsection is most closely linked to *consumption-based coping*, as it quantifies how much of household income is redirected to address the direct and indirect impacts of gold mining. The analysis of income expenditure to mitigate the effects of gold mining on livelihoods revealed stark variations across the three communities—Ajomoro Eshiem, Eziome, and Sanwoma (**Figure 32**). Respondents were asked to estimate the proportion of their income allocated to addressing the consequences of gold mining, categorized into five expenditure brackets. In Ajomoro Eshiem, the majority of respondents (n=62) reported spending between 51–75% of their income to cope with mining-related impacts, while a smaller proportion (n=16) indicated expenditures in the 26–50% range. Only 10 respondents reported spending more than 75%, and none reported allocations in the lower ranges of 0–10% or 11–25%. These figures highlight a heavy financial burden among affected households in this upstream community. In Eziome, the financial impact appeared relatively moderate. Most respondents (n=23) reported spending only 0–10% of their income to

manage mining-related disruptions, with a handful (n=6) spending within the 51–75% bracket. The remaining categories saw negligible or no responses, indicating a limited economic strain relative to the other two communities. Sanwoma, located downstream, showed the highest concentration of responses in the upper expenditure brackets. A large number of respondents (n=90) reported spending 51–75% of their income, while 72 individuals indicated allocations in the 26–50% range. Additionally, 48 respondents reported spending 76–100% of their income to cope with mining impacts, suggesting extreme financial vulnerability in this community. Moderate spending between 11–25% was reported by 39 individuals, and only a few (n=8) indicated expenditures in the lowest bracket (0–10%). These findings point to a significant economic toll, particularly in Sanwoma and Ajomoro Eshiem, where households are dedicating substantial portions of their income to mitigate the adverse effects of gold mining. The pattern underscores the deepening financial vulnerability of affected fishing communities and the pressing need for structural interventions and compensatory mechanisms.

In an interview a fish monger in Sanwoma mentioned that

“Some strange diseases and sickness have risen in this community. Recently, my little boy got sick, and he was rushed to the health center. Upon diagnosis, we found out he had eaten fish from the Ankobra river, and the doctor said it was food poisoning. I spent huge sums of money to settle his hospital bills. That took a lot of money from me especially in my current situation where I am not working.” (Fishmonger, Sanwoma).

A fishmonger in Ajomoro Eshiem community during an interview shared that

“We spend money to buy fishes from cold store in the towns now and bring them here to sell. It was not so before but now we have no other choice”. (Fishmonger, Ajomoro Eshiem).

In a focus group discussion of some women in Sanwoma, they mentioned that

“We now have to spend money to buy purified water to drink and use for domestic activities since we can no longer use the Ankobra river”. (Women FGDs, Sanwoma).

Table 33 Summary of percentage of income spent to contain illegal ASGM impacts

Number (%)	Income Spent Bracket	Definition/Description from Respondents
152 (38.6%)	51–75%	Majority in Sanwoma and Ajomoro Eshiem spend more than half their income on coping, including medical bills, clean water, and alternative livelihoods.
88 (22.4%)	26–50%	Significant share spent on buying food, water, or adapting businesses due to reduced fish catch or pollution.
48 (12.2%)	76–100%	Extreme financial vulnerability: some households spend nearly all their income on health, food, and water needs.
39 (9.9%)	11–25%	Moderate costs, often for supplementary food or water, but not as overwhelming as higher brackets.
31 (7.9%)	0–10%	Minimal impact, mostly in Eziome; some only occasionally purchase alternatives.

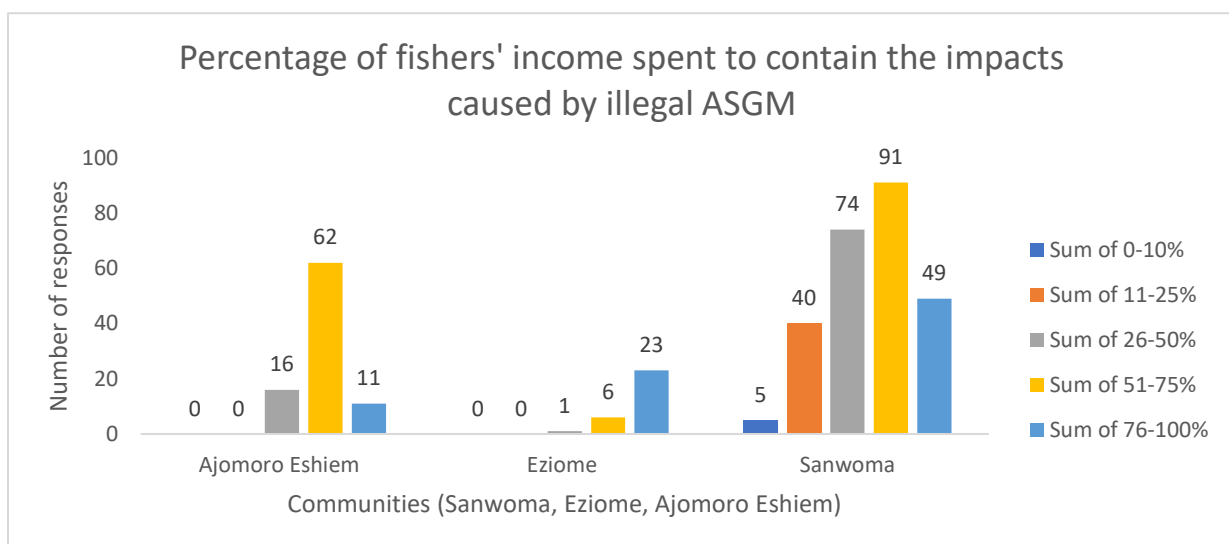


Figure 31 Percentage of income spent to contain the impacts caused by gold mining

6.5.2 Level of fishers' resilience to the impact of illegal ASGM

The subsection "*level of resilience to the impact of gold mining*" addresses the resilience aspect of coping, specifically focusing on the capacity of individuals, households, or communities to absorb, adapt to, and recover from the economic, social, and environmental shocks associated with gold mining. The analysis of level of resilience to the effects of gold mining on livelihoods revealed stark variations across the three communities—Ajomoro Eshiem, Eziome, and Sanwoma (**Figure 33**). Respondents were asked to express their level of resilience in the phase of the consequences of gold mining, categorized as high, low and moderate. In Ajomoro Eshiem, 73 respondents showed a low level of resilience to the impacts of gold mining on their livelihoods. On the contrary, only 10 individuals responded to have a high resilience to the impacts of gold mining, whereas 6 responded moderate resilience. The situation was different in Eziome as 21 of the individuals responded to have a low level of resilience to the impact of the gold mining. Again, 8 individuals also said they had a high resilience to the menace caused by gold mining that has affected their livelihoods. Only one individual asserted to have a moderate level of resilience. In Sanwoma, 154 of the individuals surveyed responded to have a low level of resilience, whereas 55 responses showed a high level of resilience to the impacts of gold mining. Lastly, 50 responses also were moderate as they were either having high resilience or low resilience.

A youth fisher in Eziome said:

“As for me, I don't have any form of resilience to withstand this shock. My only option is to migrate out of this community. I cannot do anything anymore”. (Fisher, Eziome).

A similar sentiment was expressed by a fishmonger in Ajomoro Eshiem who said that

“As it stands now, we don’t know what will happen next because we have nothing to fight this. Our only hope is in the government”. (Fishmonger, Ajomoro Eshiem).

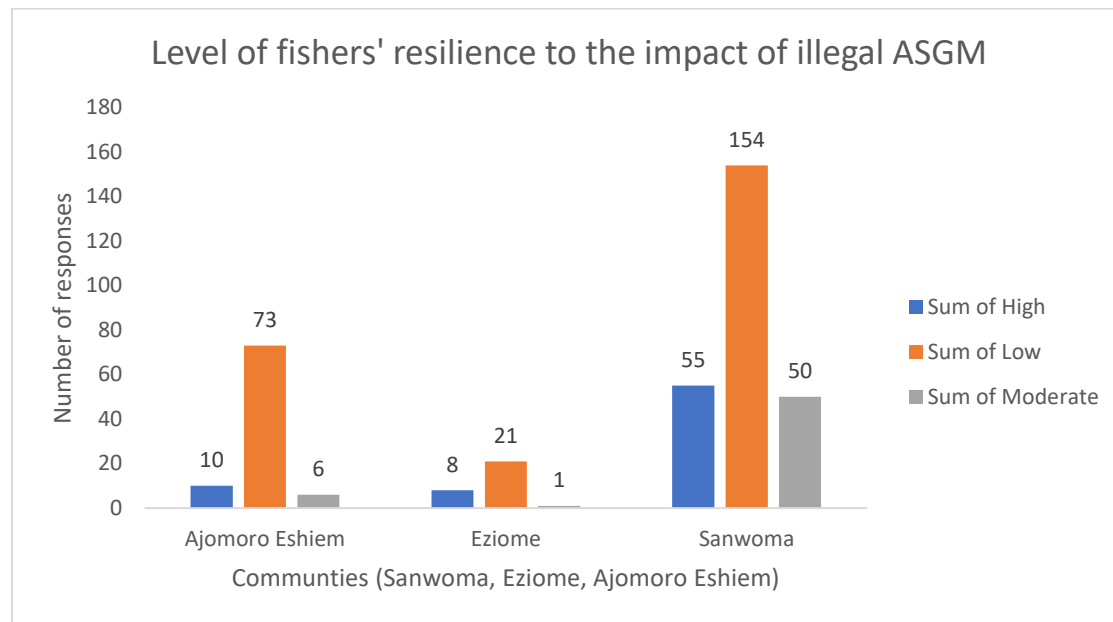


Figure 32 Level of fishers’ resilience to the impacts of gold mining

6.5.3 Current compensation mechanisms provided by leaders and government for losses incurred due to illegal ASGM activities

The perceptions of current compensation mechanisms provided for losses incurred due to gold mining activities were examined across the three communities: Ajomoro Eshiem, Eziome, and Sanwoma (Figure 4). The data reveal a predominantly negative assessment of compensation efforts among respondents. In Sanwoma, the majority of respondents expressed dissatisfaction with the compensation mechanisms, with 167 indicating they were dissatisfied and 14 reporting being very dissatisfied. A smaller number of respondents reported neutral feelings (45), while very few were satisfied (1) or very satisfied (32). Ajomoro Eshiem showed a similar pattern, where 56 respondents were dissatisfied, 21 were neutral, and only 1 respondent reported satisfaction. No respondents indicated being very satisfied, while 11 reported very dissatisfied. Eziome had the

lowest number of responses overall. Among these, 24 respondents were dissatisfied, 6 were very dissatisfied, and none reported neutral, satisfied, or very satisfied responses. Overall, these findings suggest that compensation mechanisms for losses caused by gold mining are largely viewed as inadequate or unsatisfactory by community members across all three locations. Sanwoma, with the largest respondent base, exhibited the strongest dissatisfaction, highlighting a significant concern regarding the effectiveness of current compensation efforts (**Figure 34**)

In a women's focus group discussion, a processor also said that

"Hen mpoano people come here for small support". She further added that "They have taught us some skills such as soap making and others". (Women FGDs, Sanwoma).

An official from Environmental Protection Agency in an interview mentioned that

"We advise them to engage in aquaculture to support their livelihoods". (Representative, Environmental Protection Agency). Highlighting the need for alternative livelihoods as a compensation mechanism in the phase of gold mining menace. He further added that

"by training them in alternative livelihoods like soap making, mushroom growth and others since their source of livelihood which is fishing is destroyed by the illegal miners". (Representative, Environmental Protection Agency).

In addition to this, a member from an NGO (Hen Mpoano) added that

"We train them in soap making, mushroom growth and many others" (Representative NGO, Hen Mpoano) but in the phase of gold mining issues, there hasn't been any form of training done to equip the fishers"

Table 34 Summary of community perception of compensation mechanism for illegal ASGM impacts

Number (%)	Response Category	Definition/Description from Respondents
247 (72.0%)	Dissatisfied	Compensation seen as inadequate, delayed, or not reaching most affected households; support often limited to minor skills training or alternative livelihood advice.
31 (9.0%)	Very dissatisfied	Respondents report no meaningful compensation, with some expressing frustration over lack of direct financial or asset restoration.
66 (19.2%)	Neutral	Some neither satisfied nor dissatisfied, often due to lack of engagement or awareness of compensation mechanisms.
2 (0.6%)	Satisfied	Very few reports receiving satisfactory compensation, usually tied to specific alternative livelihood interventions.
32 (9.3%)	Very satisfied	A small minority, mostly in Sanwoma, report positive experiences, often linked to NGO-led training or support.

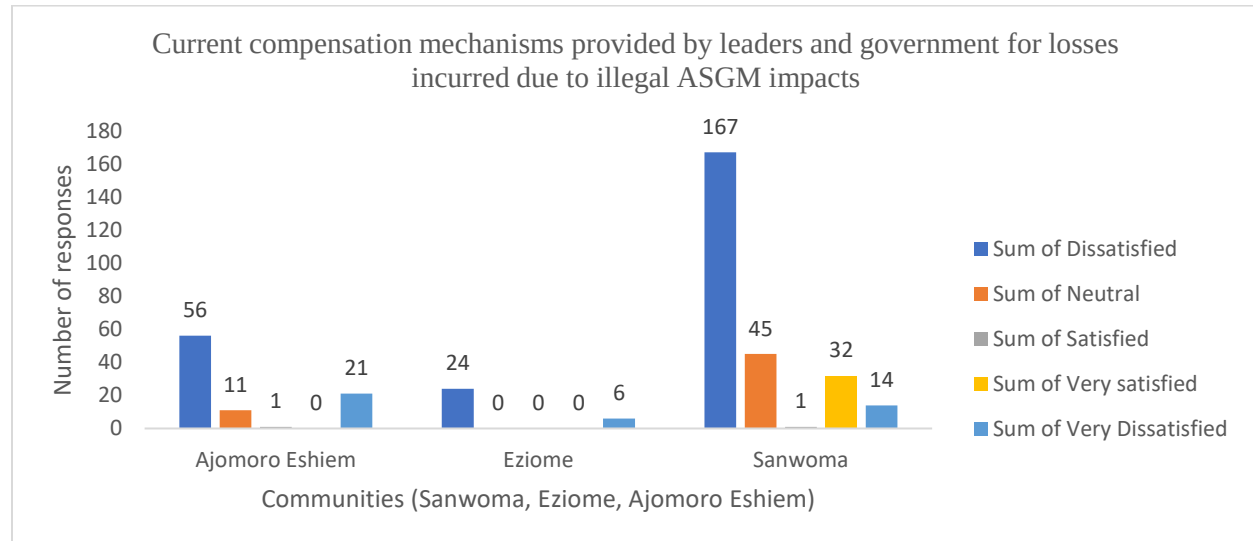


Figure 33 Current compensation mechanisms provided by leaders and government for losses incurred due to illegal ASGM

6.6 Community engagement and participation

The survey revealed varying levels of engagement among the three communities—Sanwoma, Eziome, and Ajomoro Eshiem—in discussions and forums related to gold mining and fishing (**Figure 35**). Sanwoma stood out with the highest level of participation, especially under the category "Occasionally," where 137 respondents indicated some level of involvement. Additionally, Sanwoma recorded a noticeable number of individuals who engaged "Often" (36), "Rarely" (34), and "Very Often" (23), suggesting a generally active community with respect to mining-related issues. Ajomoro Eshiem showed a relatively balanced but modest level of engagement. While 38 individuals reported participating "Occasionally," and 35 said "Rarely," only a few indicated more regular involvement, with 8 stating "Often" and just 5 "Very Often." Interestingly, 4 respondents claimed they had "Never" engaged at all. Eziome, being the smallest community, recorded the least engagement across all categories. The majority of responses fell under "Occasionally" (15) and "Never" (9), with very minimal numbers for "Rarely" (2), "Often" (4), and "Very Often" (2). This could reflect either lower community mobilization, limited access to forums, or lower perceived relevance of the issues. Overall, the results suggest that Sanwoma is the most actively engaged community when it comes to issues surrounding gold mining and fishing. In contrast, Eziome shows limited participation, potentially signaling a need for increased awareness and inclusion in community-level dialogue and decision-making processes.

The chief fisher in Eziome in an onterview shared that

“We haven’t really had any form of engagement with the fishers regarding the galamsey. We have told them what the issues are but haven’t really had engagement or meeting specifically to tackle it”. (Chief fisher, Eziome)

In a focus group discussion, all the men agreed to this. They shared that

“This community is different. Nothing seem to be happening here. We don’t even have functioning community leaders hence, the reasons for no engagements in this situation. We haven’t had any form of engagement with any leader here regarding galamsey”. (Men FGDs, Eziome).

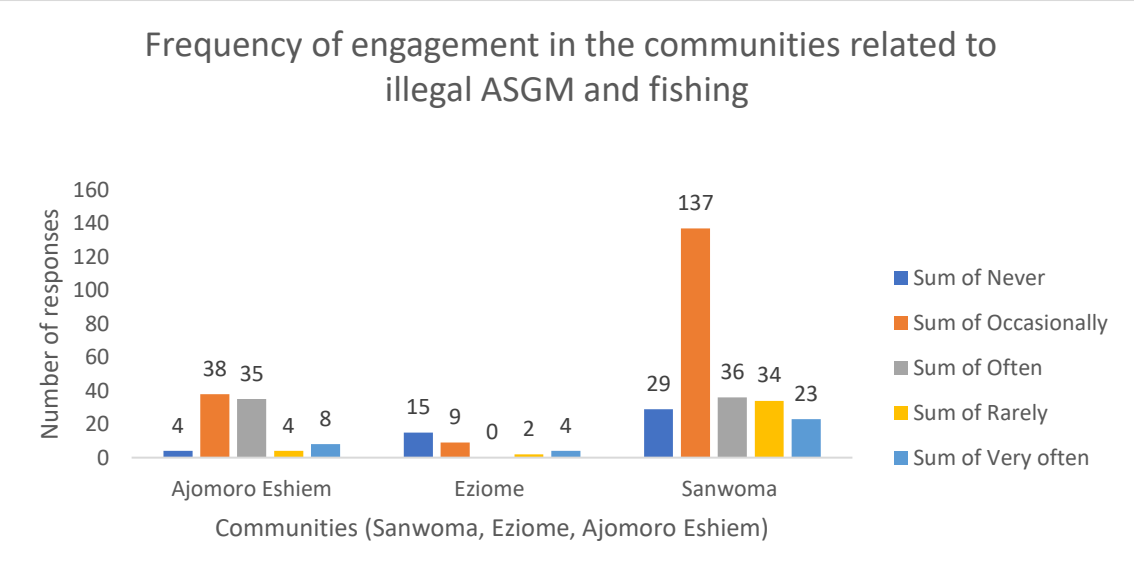


Figure 34 Frequency of engagement in the community related to gold mining and fishing

6.6.1 Involvement of women in decision making regarding illegal ASGM impacts on small scale fisheries

The analysis presents the extent of women’s involvement in decision-making processes concerning gold mining-related issues across the three study communities—Ajomoro Eshiem, Eziome, and Sanwoma. Respondents categorized women’s involvement into four levels: *Highly involved*, *Somewhat involved*, *Rarely involved*, and *Not involved at all*. In Ajomoro Eshiem, women’s participation in decision making is notably low. A significant majority of respondents (39) reported that women are “Not involved at all” in decisions related to gold mining. This is followed by 37 who stated that women are “Rarely involved.” Only 12 respondents perceived women as being “Highly involved,” and just one individual indicated that women are “Somewhat involved.” These

findings suggest a largely exclusionary environment where women face substantial barriers to engagement in community decision-making processes regarding mining activities. A similar trend is observed in Eziome. The highest number of respondents (15) reported no involvement of women in decision making, while 8 respondents noted rare involvement. A limited number viewed women as being more actively engaged, with 6 describing them as “Somewhat involved” and only 5 indicating “Highly involved.” This points to a general marginalization of women in community governance related to gold mining, reinforcing the pattern of limited participation seen in Ajomoro Eshiem.

Sanwoma, by contrast, demonstrates relatively greater inclusion of women in decision-making. Although 63 respondents still indicated that women are “Not involved at all,” a substantial number (121) reported that women are “Somewhat involved.” Furthermore, 42 respondents viewed women as “Rarely involved,” and 33 identified them as “Highly involved.” While exclusion is still present in Sanwoma, the distribution of responses indicates a more progressive trend toward involving women in community-level discussions and decisions related to mining activities. When comparing the three communities, Sanwoma clearly stands out as having the highest number of respondents acknowledging women’s “Somewhat” and “Highly” involved status. This indicates a relatively more inclusive approach in contrast to the patterns observed in Ajomoro Eshiem and Eziome, where perceptions of exclusion dominate. The “Rarely involved” category received moderate responses across all three communities, suggesting that in some cases, women’s involvement exists but remains inconsistent and marginal. Overall, the data reveal a persistent gender disparity in community-level decision making on gold mining issues. While Ajomoro Eshiem and Eziome continue to reflect significant exclusion of women from these processes, Sanwoma shows signs of gradual progress toward inclusion. These patterns underscore the need

for targeted interventions to enhance women's participation and representation in local governance, especially in resource-related matters that directly affect their livelihoods and well-being (**Figure 36**)

In Ajomoro Eshiem, a young fish processor said that:

“The men hardly organize meetings here regarding the galamsey so we don't know how to add our voice and share our opinion in the subject matter”. (Fish processor, Ajomoro Eshiem).

In Sanwoma, women focus group, some women argued that men do not take their opinions in decision making especially on the issues of gold mining. They said:

“The men do not regard us as having any form of knowledge in the current galamsey issues. When we share our opinions, they don't regard it and even when they do, it doesn't yield any positive results.” (Women FGDs, Sanwoma).

The chief fisher in Ajomoro Eshiem shared opposite opinion on this that:

“Oh yes, we give them equal platform like the men and they share their opinions on the matter. We really regard them as key members of this community”. (Chief fisher, Ajomoro Eshiem).

Table 35 Summary of women's involvement in decision making on illegal ASGM impacts on fisheries

Number (%)	Involvement Level	Definition/Description from Respondents
117 (38.8%)	Not involved at all	Women are excluded from decision-making; meetings rarely organized for or by women; their opinions are often disregarded.
87 (28.8%)	Rarely involved	Women's participation is inconsistent and marginal; when present, their input is often undervalued or ignored.
39 (12.9%)	Somewhat involved	Some women are included in discussions, but their influence on decisions is limited.

Number (%)	Involvement Level	Definition/Description from Respondents
50 (16.6%)	Highly involved	More common in Sanwoma; women actively participate, and their voices are considered in community decisions.

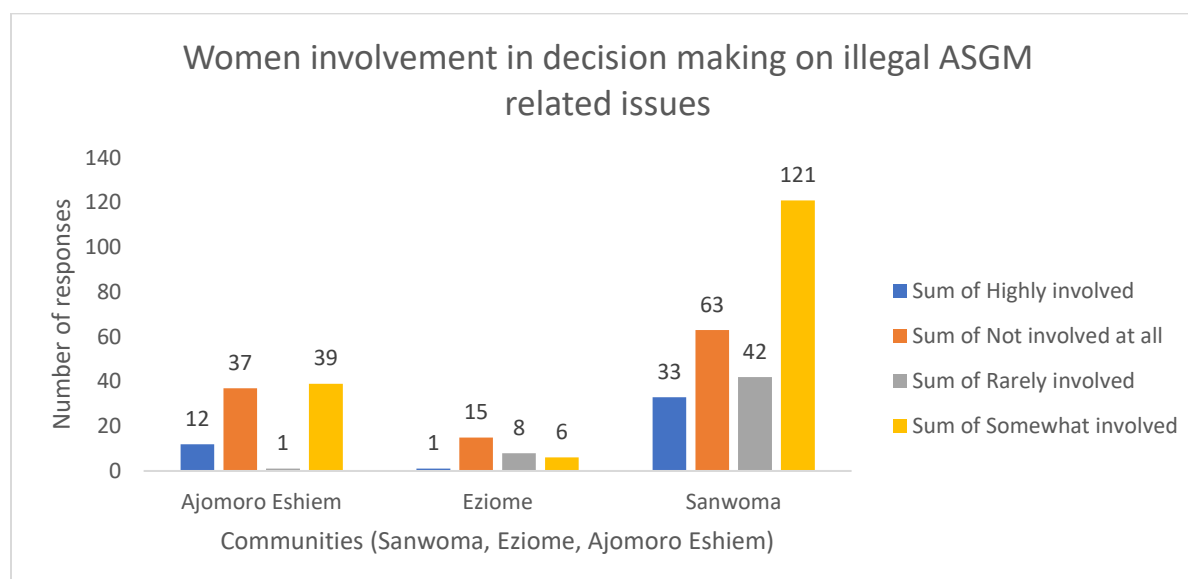


Figure 35 Women involvement in decision making on illegal ASGM related issues

6.7 Summary discussion of emerging findings from chapter results

The findings from this chapter illuminate the profound and complex vulnerabilities facing fishing communities along the Ankobra River as a result of gold mining activities, as well as the diverse-yet often constrained-adaptive responses these communities employ. The data reveal that gold mining introduces a web of interlinked vulnerabilities. Environmental impacts, including water pollution, land degradation, and health risks from mercury and sedimentation, undermine both ecosystem services and human wellbeing. These environmental pressures directly translate into livelihood insecurity, as declining fish stocks and deteriorating river health erode the economic base of fishing-dependent households. Weak governance, inadequate compensation, and limited institutional support further exacerbate these vulnerabilities, leaving communities with few formal

avenues for redress. Social inequalities are also accentuated, with women and youth disproportionately affected and facing reduced access to resources and opportunities. Finally, knowledge gaps and communication barriers hinder effective advocacy and adaptation, perpetuating cycles of marginalization and vulnerability. Despite these challenges, communities have demonstrated notable resilience by diversifying their livelihoods. The most common adaptive strategies include shifting to farming (especially cassava, coconut, and cocoa), fish farming, animal rearing, petty trading, and migration to less affected areas. Some have pursued new vocational skills-such as soap making or chainsaw operation-often facilitated by sporadic NGO-led training programs. However, these transitions are not without obstacles: lack of capital, limited access to markets, and the precarious nature of many alternative activities constrain the effectiveness and sustainability of adaptation. The move to collective action, such as forming savings groups, reflects both the strength of social capital and the need for mutual support in the face of institutional neglect.

A striking pattern across all three communities is the widespread absence of meaningful institutional or external support. The majority of respondents report receiving no assistance from government agencies or NGOs. Where support does exist, it is typically limited to occasional livelihood training or small-scale interventions, with financial assistance and emergency relief virtually nonexistent. This lack of sustained, comprehensive support leaves households to rely primarily on their own coping strategies, deepening their vulnerability and limiting their capacity to recover from shocks. In the absence of robust institutional support, social capital-particularly community organizations and networks of family and friends-emerges as the primary coping resource. These networks provide mutual aid, emotional support, and, in some cases, limited financial assistance. However, their capacity to address the systemic impacts of gold mining is

limited, especially when formal organizations are weak or absent. The reliance on informal networks underscores both the resilience and the fragility of community-based coping mechanisms in the face of large-scale environmental and economic disruption.

While livelihood training stands out as the most common form of assistance provided by local organizations, access to this and other forms of support is highly uneven across communities. Sanwoma, due to its proximity to coastal towns and NGO activities, has benefited more from training and support than Eziome or Ajomoro Eshiem. Nevertheless, the majority of fishers in all communities-especially those in more remote areas-remain underserved, with many reporting no assistances at all. This spatial disparity highlights the need for more equitable and targeted interventions. The emerging findings point to the urgent need for integrated, multi-level responses that address both the immediate and structural drivers of vulnerability. Strengthening environmental regulation and enforcement, improving access to financial and technical support, and enhancing the reach and effectiveness of livelihood interventions are critical. Efforts should also focus on empowering marginalized groups, bridging knowledge gaps, and fostering inclusive community participation in decision-making processes.

In summary, the chapter underscores the adaptive capacity and resilience of Ankobra River fishing communities but also exposes the persistent and deep-rooted vulnerabilities that threaten their long-term wellbeing. Without more robust and inclusive support mechanisms, these communities will remain trapped in cycles of environmental degradation, economic insecurity, and social marginalization. Addressing these challenges requires coordinated action from government, NGOs, and community stakeholders to build more sustainable and resilient livelihoods in the face of ongoing gold mining impacts.

Chapter 7

Discussion

7.1 Thematic analysis

The adaptive strategies adopted by Small-Scale fisheries in Sanwoma, Eziome, and Ajomoro Eshiem reflect a complex interplay of environmental degradation, socio-economic pressures, and institutional neglect. These responses highlights both resilience and systemic vulnerabilities, offering critical insights into how marginalized communities navigate industrial encroachment. Gold mining along the Ankobra river has transformed the ecosystem, rendering traditional fishing livelihoods unsustainable. The river's contamination with mercury, arsenic, and sedimentation as reported in Prestea and nearby areas-has degraded water quality, reduced fish stocks, and introduced health risks (Donkor et al., 2006; Modern Ghana, 2015). Respondents' reliance on boreholes and wells (Armah et al., 2011) underscores the severity of pollution, yet groundwater in mining zones often remains unsafe due to leaching heavy metals (Water Research Institute, cited in Modern Ghana, 2015). This environmental collapse mirrors trends in Lake Victoria, Kenya, where gold mining (ASGM) polluted waters, disrupted fish habitats, and intensified conflicts between fishers and miners (Abura & Onyango, 2016). Fishers' shift to farming (cassava, cocoa), tree felling, and petty trading aligns with global patterns where environmental shocks force communities into precarious survival strategies. For instance, 35–52% of Mexican Small-Scale fisheries opted to exit fisheries or diversify livelihoods under catch declines (Ecology & Society, 2024). However, in Ankobra, diversification is less a choice than a necessity. As one respondent noted in Eziome that, he had to resort to tree felling, which has been helping him a little, echoed similar findings among some Ghanaian fishers in Akwidaa, who turned to aquaculture and trading amid oil-industry disruptions (Sekyi, 2021)). These strategies, however, often lack sustainability.

Soap-making and coconut farming require capital and markets, which are scarce in rural Ghana (Hilson et al., 2018), perpetuating cycles of poverty. Seasonal migration to less polluted areas or urban centers (e.g., Axim) is a common response, yet it exacerbates social fragmentation. Similar to Tanzanian coastal fishers who migrated inland for alternative work (Yang et al., 2019), Ankobra migrants face risks: loss of communal support, exposure to hazardous mining labor, and conflicts over resources in host communities. Youth like *Nana Danse* (16), who abandoned school for mining, exemplify how migration traps vulnerable groups in informal sectors, undermining long-term resilience (Modern Ghana, 2015).

Weak enforcement of mining regulations and inadequate compensation mechanisms have left communities to fend for themselves. While advocacy groups like *Hen Mpoano* provide training, their impact is limited by systemic issues: corruption, lack of political will, and exclusion from decision-making bodies (Abura & Onyango, 2016). For example, Beach Management Units (BMUs) in Kenya excluded miners from fisheries committees, worsening resource conflicts (AJOL, 2016). Similarly, Ankobra's traditional leaders lament the unchecked rise of *galamsey* (illegal mining), which degrades land and water with impunity (Modern Ghana, 2015). This governance vacuum contrasts with successful cases in Tanzania, where co-management and collective action improved adaptive capacity (Yang et al., 2019). Women and youth bear disproportionate burdens. Women, often excluded from mining labor, face heightened food insecurity as fish supplies dwindle. Youth in *Nana Danse* are pushed into risky mining jobs due to limited education and economic alternatives—a trend also observed in Akwidua, where youth turned to illegal fishing and mining amid declining opportunities (Sakyi, 2021). These inequalities are compounded by poor access to credit and training, hindering transitions to safer livelihoods petty trading by the women.

7.1 Socio-demographic characteristics of small-scale fisheries

This study was conducted to assess the effects of gold mining on fishing activities and water quality in the Ankobra River within the Ellembele District of Ghana. The findings indicate that fishing remains a male-dominated activity in the Ankobra region, a trend that can be attributed to multiple socio-economic and cultural factors. One primary reason for this male dominance is the physically demanding nature of fishing, which often requires long hours at sea and considerable physical exertion. As a result, women tend to take on other roles within the fishing industry, such as fish processing and trading, as observed in Sanwoma. This aligns with broader patterns in Small-Scale fisheries, where gendered divisions of labor dictate that men engage in primary harvesting while women contribute to post-harvest activities. Another possible explanation for the gender disparity in fishing participation is male migration. In communities like Eziome and Ajomoro Eshiem, male fishers may seek alternative livelihoods due to the adverse effects of gold mining on fishing activities. The decline in fish stocks, coupled with the deteriorating water quality of the Ankobra River, has forced some men to migrate in search of better economic opportunities. This demographic shift leads to a reduced male population in these communities, further altering the structure of the local fishing industry. Similar findings were reported by Boateng (2023) in his study of lower Ankobra communities such as Adelekazo and Eziome, where male migration was observed as a response to declining fishing productivity as a result of illegal ASGM activities.

The study also found variations in the age distribution of fishers across the three communities. In Sanwoma and Ajomoro Eshiem, the majority of fishers were within the 41–50 age range, whereas in Eziome, most fishers were between 51–60 years old. This disparity may be influenced by the geographical location of each community. Sanwoma's proximity to a major road and well-known towns within the district could attract a relatively younger workforce, as access to markets and

alternative employment opportunities may be more viable. Similarly, Ajomoro Eshiem, located upstream near principal towns, may have better infrastructure and economic connections, supporting a more balanced age distribution among fishers. The situation is different at Eziome, where majority of its youth have migrated leaving the older ones due to severe impacts they face. The study revealed that the educational background of fishers in the Ankobra region is predominantly low, with a significant proportion of respondents having no formal education. Across the three study communities—Sanwoma, Eziome, and Ajomoro Eshiem—168 respondents (49.1%) reported having no formal education, while only a small fraction (17 individuals, 5.0%) attained higher education. These findings reflect broader trends observed in Small-Scale fisheries communities, where access to education is often constrained by socio-economic and structural barriers (Bene et al., 2016; Mensah & Antwi, 2023). Particularly in Eziome, which exhibited the lowest educational attainment levels across all categories, with only one respondent reaching secondary school and none attaining vocational or technical education. This may be linked to the community's small population and limited access to educational infrastructure, reinforcing the argument that rural isolation contributes to lower educational attainment (Gyan et al., 2020). Additionally, with gold mining significantly affecting fishing activities in Eziome, children and youth may be drawn into alternative livelihood strategies, further reducing school participation. The predominance of low education levels in the study communities has significant implications for the livelihoods and resilience of fishers. Limited formal education restricts access to alternative income-generating activities, reduces awareness of sustainable fishing practices, and constrains engagement with policies and regulatory frameworks affecting fisheries (Torell et al., 2021).

The study revealed a significant variation in the years of fishing experience among respondents across the three communities. A considerable proportion of fishers had been engaged in fishing for

more than a decade (180 respondents, 52.6%), while relatively fewer respondents had less than one year of fishing experience (20 respondents, 5.8%). These findings suggest that fishing in the Ankobra region is a long-established livelihood, often spanning multiple generations, aligning with broader research on Small-Scale fisheries in Ghana and West Africa (Bene et al., 2016). Sanwoma recorded the highest number of fishers with over ten years of experience (115), reflecting its prominence as a major fishing hub. The high retention rate in Sanwoma suggests a relatively stable fishing industry which may be due to the presence of the ocean and the river, where generational transfer of skills is deeply embedded within the community. In Eziome, fishing experience was significantly lower, with only 15 individuals reporting more than ten years in the industry. A majority of respondents (6 out of 15) had between one and five years of experience, and four had less than a year, indicating a trend of relatively recent entry into fishing. This could be linked to the disruptions caused by gold mining activities, which may have led to a shift in traditional fishing livelihoods. Similar findings were reported by Asiedu et al. (2023), who highlighted how mining-related challenges push fishers toward alternative livelihoods, reducing long-term engagement in fishing. Ajomoro Eshiem, located upstream, had a relatively balanced distribution of fishing experience, with 50 respondents having more than ten years of experience and 25 with six to ten years. The moderate experience levels could be attributed to the area's exposure to mining-related disruptions while still retaining some traditional fishers. This observation is in line with research by Torell et al. (2021), which found that proximity to environmental disturbances, such as pollution from mining, influences the duration of fishing careers in affected communities.

The socio-economic composition of respondents in the three studied communities Sanwoma, Eziome, and Ajomoro Eshiem—reflects the dominant livelihood activities and their interconnection with fishing and other economic sectors. The findings indicate that fishing remains

the most prevalent occupation (197 respondents, 57.6%), followed by farming (120 respondents, 35.1%), while a smaller proportion of individuals were engaged in fish processing and trading (9 respondents, 2.6%), fish mongering (20 respondents, 5.8%), or were not actively engaged in fishing-related activities (32 respondents, 9.3%). These results align with broader research on coastal and riverine economies in Ghana, where fishing and farming serve as the primary sources of livelihood for many households (Bene et al., 2016; Asiedu et al., 2023).

Sanwoma exhibited the highest number of respondents engaged in fishing (171), reinforcing its status as a key fishing hub in the Ankobra region. This aligns with studies by Quartey et al. (2020), who emphasized that communities with direct access to riverine and coastal waters typically have a higher concentration of full-time fishers. Eziome presented a contrasting socio-economic structure, with a significant portion of respondents (16) engaged in farming rather than fishing (8). The limited fishing activity in Eziome can be attributed to its geographical position and the increasing impact of mining-related disturbances on water quality, which may have discouraged full-time engagement in fishing. This trend aligns with findings by Mensah and Antwi (2021), who noted that inland communities often shift toward farming when fishing conditions deteriorate. In Ajomoro Eshiem, the largest proportion of respondents (68) were engaged in farming, surpassing the number of fishers (18). This pattern can be linked to the community's upstream location, where environmental degradation from gold mining has severely impacted fishing productivity. Research by Asiedu et al. (2023) supports this observation, noting that communities near gold mining sites often face challenges such as water pollution, leading many to adopt alternative livelihoods like farming. The limited participation in fish-related trading activities (no respondents in fish processing, fish mongering, or trading) suggests that Ajomoro Eshiem lacks a structured fish market, further discouraging reliance on fisheries as a primary economic activity.

The minimal involvement in fish processing and trading (9 respondents in Sanwoma, none in Eziome or Ajomoro Eshiem) suggests a weak value-chain integration in these communities. This aligns with research by Quartey et al. (2020), who noted that small-scale fisheries in Ghana often struggle with inadequate infrastructure for processing and market access, limiting opportunities for value addition. Strengthening the fishery value chain through improved processing facilities and market linkages could provide alternative livelihood options, particularly for women, who are traditionally involved in fish trading. Furthermore, the presence of individuals not currently engaged in fishing-related activities across all three communities raises concerns about unemployment and economic vulnerability. Studies by Torell et al. (2021) emphasize that declining fish stocks, environmental degradation, and competition from other sectors (such as mining) often result in increased livelihood insecurity, compelling affected individuals to seek alternative employment opportunities outside their communities.

7.1.1 Size of fishers' fishing operations within the Ankobra region

The findings indicate significant variations in the size of fishing operations across the three communities, with Sanwoma exhibiting the highest engagement in small-scale fisheries. The predominance of small-scale fisheries in Sanwoma aligns with studies that highlight the role of fisheries in supporting rural livelihoods, particularly in coastal and riverine communities (Béné et al., 2016). Ajomoro Eshiem also demonstrates considerable participation in small-scale fisheries, though at a lower level compared to Sanwoma. The near absence of medium-scale fishing in this community may indicate constraints such as limited access to financial capital, fishing equipment, or declining fish stocks due to environmental pressures (Pauly & Zeller, 2016). The presence of individuals categorized under "Not Applicable" suggests the existence of alternative livelihoods, which may include agriculture, petty trading, or non-fishing-related activities. Diversified income sources can contribute to livelihood resilience, particularly in the face of environmental and

economic shocks (Allison & Horemans, 2006). Eziome, in contrast, has the lowest participation in fishing activities, with no respondents engaged in medium-scale fishing. This may be attributed to multiple factors, including reduced fish availability, restrictive access to fishing grounds, or economic shifts that have pushed community members toward other forms of livelihood (Béné, 2009). The limited fishing operations in Eziome could also suggest challenges related to declining fish stocks, habitat degradation, or the impact of external stressors such as gold mining, which has been shown to negatively affect freshwater fisheries through pollution and habitat destruction (Kpan et al., 2022).

7.1.2 Fishers' Ownership of fishing equipment

The distribution of fishing equipment ownership among fishers in the three communities—Sanwoma, Eziome, and Ajomoro Eshiem—reveals a pattern of mixed ownership, dependency on shared resources, and financial constraints. Across all three locations, full ownership of fishing equipment is relatively low, highlighting the economic challenges faced by small-scale fishers. Many rely on renting, borrowing, or sharing tools, reflecting both communal strategies and financial limitations. These findings align with previous research on Ghana's small-scale fisheries, which emphasizes the role of cooperative resource-sharing in sustaining livelihoods amid economic and environmental pressures (Bene et al., 2016; Quartey et al., 2020). The findings highlight a widespread reliance on renting, borrowing, and shared fishing resources across all three communities, reflecting both financial constraints and cooperative strategies. While Ajomoro Eshiem has a slightly stronger fishing asset base, full ownership of equipment remains limited in all locations. The dependence on rented and borrowed equipment suggests that many fishers operate within an economic environment where acquiring fishing tools independently is difficult. This trend aligns with broader research on Small-Scale fisheries in Ghana, where economic hardships, declining fish stocks, and external pressures (such as mining) often hinder investment

in fishing equipment (Bene et al., 2016). Strengthening support systems, such as microfinance programs for fishing equipment acquisition or cooperative fishing gear initiatives, could help improve ownership levels and enhance economic resilience.

7.1.3 Fishers' monthly income range

Fisherfolks across the three communities shared their perspectives on the amount earned from fishing activities at the end of every month. The responses showed that many do not have a fixed amount each month. Notably, across all three communities, very few households report monthly incomes above 2,000, and virtually none exceed 3,000. This explains the low-income nature of these areas and highlights the limited upward economic mobility available to residents. The predominance of lower income categories suggests that the majority of households are likely to face persistent economic vulnerability, with limited capacity to absorb financial shocks or invest in livelihood improvements.

These findings are consistent with existing literature on rural and mining-impacted communities in sub-Saharan Africa, where household incomes tend to cluster at the lower end of the spectrum due to limited livelihood diversification and external pressures such as environmental degradation and resource competition (Hilson, 2019; Tschakert, 2009). The observed income distribution also aligns with studies that highlight the disproportionate impact of mining activities on local economies, often resulting in reduced access to traditional livelihoods and increased economic precarity (Obiri et al., 2016). The limited presence of higher income earners further suggests that existing economic structures may not be providing adequate opportunities for upward mobility, reinforcing the importance of policy measures that support sustainable livelihood development.

7.1.4 Number of people who depend on fishers' monthly household income

Across all three communities, the predominance of households earning between 500 and 1,000 Ghana cedis (GHS) suggests a shared experience of economic vulnerability, supported by existing literature on the economic conditions of rural populations in Ghana. Studies have documented that a large proportion of households in rural Ghana live below or near the poverty line, often struggling to meet basic needs due to limited income sources (Adu & Antwi, 2015; Pappoe et al., 2020). Furthermore, the low presence of higher-income households in all three communities reflects the broader trend of limited access to well-paying jobs, coupled with the informal or subsistence nature of most livelihoods in rural areas. The economic vulnerability observed in these communities is also exacerbated by external stressors such as illegal mining activities, which further destabilize already fragile livelihoods. Research on mining-affected communities in Ghana has shown that environmental degradation, displacement, and the depletion of natural resources due to mining operations contribute to increased economic hardship and limited recovery capacity (Hernandez et al., 2021). These findings align with the results of this study, suggesting that external economic shocks, such as those introduced by gold mining, amplify existing poverty and vulnerability in these communities.

7.1.5 Fishers' encounter of illegal ASGM near fishing sites

The spatial and social dynamics of artisanal and small-scale gold mining (ASGM) and its impacts on riverine communities are complex and often context specific. Previous research has highlighted that the presence of mining activities does not always correlate directly with the severity or visibility of their impacts on local livelihoods (Hilson, 2019; Tschakert, 2009). In some cases, communities situated in close proximity to mining operations may report limited direct interaction with miners yet still experience significant environmental and socio-economic consequences due to the interconnectedness of river systems and the mobility of both fishers and miners (Obiri et al.,

2016). This study's findings align with literature suggesting that the effects of ASGM are not confined to the immediate vicinity of mining sites. For instance, Tschakert (2009) and Obiri et al. (2016) both emphasize that downstream communities can be impacted by water pollution, sedimentation, and habitat degradation originating from upstream mining activities, regardless of whether community members directly encounter miners. Such indirect impacts may manifest as reduced fish stocks, deteriorating water quality, or changes in community health and livelihoods, even in areas where mining is not visibly present or actively opposed by local leadership. Contrastingly, some studies have found that direct encounters with mining activities tend to heighten community awareness and concern regarding environmental degradation, often prompting collective action or stricter local regulations (Hilson, 2019). However, as observed in other contexts, the absence of visible mining does not necessarily equate to a lack of impact. Communities may underestimate or misattribute environmental changes if mining activities are not immediately observable, leading to gaps in local adaptation and mitigation strategies (Tschakert, 2009).

Furthermore, the literature underscores the importance of social networks and migration patterns in shaping the spread and perception of mining-related impacts. Hilson (2019) notes that miners often move between communities, and local youth may become involved in mining either directly or through social connections, thereby extending the socio-economic effects of ASGM beyond fixed geographic boundaries. Overall, these patterns highlight the need for a nuanced understanding of ASGM impacts that goes beyond simple proximity or frequency of encounters. Effective policy and intervention strategies must consider both direct and indirect pathways of influence, as well as the role of local governance, social networks, and environmental connectivity

in shaping community vulnerability and resilience (Obiri et al., 2016; Tschakert, 2009; Hilson, 2019).

7.1.6 Fishers access to support during gold mining impacts

Among the three communities, Sanwoma stands out as the only one where a significant proportion of respondents (52.1%) report having access to some form of support. However, this support is not uniformly distributed and appears to be largely unrelated to the challenges posed by gold mining. Instead, the occasional relief efforts in Sanwoma seem to be tied to government aid provided during flood events. During the interview, the chief fisher indicated government's intervention during flooding but not related to gold mining. His statement suggested that some community members may conflate flood-related assistance with broader support mechanisms, potentially leading to a misperception that such aid is linked to mitigating the impacts of gold mining. In contrast, Eziome faces a complete absence of external support, indicating that this community is severely underserved in terms of assistance programs. Similarly, Ajomoro Eshiem experiences limited access to support, with the vast majority of respondents (84.3%) reporting no form of assistance. These disparities in support availability highlight broader structural inequalities in rural resource distribution, particularly within Small-Scale fisheries (Bennett et al., 2024). The lack of external support in both Eziome and Ajomoro Eshiem increases the vulnerability of local fishers, as they lack the necessary resources to adapt to socio-environmental and economic challenges, such as fluctuating fish stocks, declining water quality, and the encroachment of gold mining activities.

The distribution of income dependence in Sanwoma, Eziome, and Ajomoro Eshiem highlights significant economic pressures faced by households, with the majority supporting multiple dependents. The data suggests that while household sizes and dependency structures vary slightly

between communities, all three face similar challenges in managing the financial needs of dependents within low-income economies. The presence of large households, particularly those with more than 6 dependents, indicates a need for targeted interventions such as income diversification, financial literacy programs, and community-based support systems to alleviate the economic strain on households. Addressing these issues will be crucial for reducing the economic vulnerability in these fishing communities, especially in the face of external stressors like illegal gold mining and environmental degradation. Overall, the data indicates that in all three communities, majority of households (ranging from 46.7% to 62.9%) support 3-4 dependents. This suggests that a typical household in these communities is responsible for supporting several individuals, which likely strains household incomes, particularly in light of the already low-income levels reported in these communities. The financial strain observed in these households is consistent with the literature on rural economies in sub-Saharan Africa, where larger family sizes are often associated with greater economic vulnerability (Adu & Antwi, 201). The presence of households with more than 6 dependents, though relatively small in proportion, suggests that certain households face particularly heavy economic burdens. These findings align with studies that indicate households with large family sizes are more likely to experience economic stress due to the increased need for resources (Boadu et al., 2023). In contrast, the presence of a small proportion of households without dependents in each community reflects a segment of the population that may have more financial independence or alternative sources of income.

7.2 Association between gold mining activities and the nature and dynamics of Ankobra's small-scale fisheries industry.

7.2.1 Nature and characteristics of gold mining in Ankobra region

The study also highlights the diversity of mining techniques employed in ASGM, ranging from rudimentary digging to mechanized extraction. Some participants distinguished between alluvial mining (conducted within the river) and land-based mining, noting their respective environmental consequences. This reflects the dual nature of ASGM, where varying levels of mechanization contribute to differing degrees of environmental impact (Hilson et al., 2021). The identification of "small" and "big" types of mining suggests a spectrum of ASGM activities, a finding supported by Siegel and Veiga (2010), who argue that mining is not a monolithic practice but rather exists in multiple forms with unique socio-economic and ecological implications. A dominant theme in the findings is the largely unregulated nature of ASGM, which complicates monitoring and enforcement efforts. Mining officials emphasized that large-scale and small-scale operations are fully regulated and do not engage in ore washing within the Ankobra region, leaving informal ASGM as the primary source of environmental degradation. This aligns with prior studies that highlight the difficulty of regulating ASGM due to its dispersed and often hidden nature (Hilson & Maconachie, 2020). The Environmental Protection Agency (EPA) official's reliance on drones to locate illegal mining activities underscores the regulatory challenges in addressing unpermitted operations, a finding consistent with research on the limitations of state enforcement in remote and ecologically sensitive regions (Bebbington et al., 2018). Given the substantial environmental and socio-economic challenges associated with ASGM in the Ankobra region, there is an urgent need for policy interventions that promote sustainability while recognizing the economic realities of small-scale mining. Strengthening enforcement mechanisms, formalizing ASGM, and integrating local communities into decision-making processes could help mitigate some of the adverse effects

(Hilson & Maconachie, 2020). Additionally, alternative livelihood programs targeting fishers and ASGM workers may reduce dependence on environmentally harmful mining practices while fostering resilience in affected communities (Bebbington et al., 2018). As indicated in the interviews, some community members are equally engaged in illegal gold mining making the efforts to mitigate and combat the practice increasingly difficult. This is primarily due to the absence of alternative livelihood opportunities and the simultaneous destruction of traditional sources of income, such as farming and fishing, which leaves residents—especially the youth—with little choice but to turn to mining for survival. This aligns with findings by Osei (2017), who observed that many young people in Ghana’s Upper East Region engage in and small-scale mining (ASM) not out of preference but due to extreme poverty and limited employment options. Similarly, Banchirigah (2008) emphasized that poverty, coupled with the economic benefits derived from ASM, makes illegal mining deeply entrenched and hard to eradicate, especially when local leaders are also complicit. Hilson and Potter (2015) further argue that for many communities in Ghana, ASM represents a form of economic necessity rather than a mere opportunistic venture. These studies collectively underscore how socio-economic pressures, lack of viable alternatives, and the perceived short-term benefits of mining continue to drive local involvement in illegal activities, despite the environmental and health consequences.

7.2.2 Illegal ASGM activities and the change in fishers’ fish catches since gold mining activities increased

The results from Table 2 indicate a strong association between gold mining activities and the decline in fish catches. A majority of respondents (312 out of 378) reported a significant decrease in fish catches since the intensification of gold mining activities, with only a small fraction (6 respondents) noting a slight increase. Dredging, or river mining, is associated with substantial declines in fish catches, as 144 respondents (out of 170) reported a significant decrease. This is

consistent with findings from previous research indicating that dredging disturbs riverbeds, increases turbidity, and leads to sedimentation, all of which negatively impact aquatic habitats and fish populations (Kondolf, 1997; Allan et al., 2012). The removal of sediments and disruption of river flow can also affect fish spawning and feeding grounds, further exacerbating declines in fish stocks (Pelicice et al., 2014). Similarly, surface (open-pit) mining is linked to significant reductions in fish availability, with 152 out of 192 respondents reporting a decline in catches. Open-pit mining can lead to heavy metal contamination, acid mine drainage, and increased sediment load in nearby water bodies, which degrade water quality and make conditions less favorable for fish survival (Schueler et al., 2011). The presence of 36 respondents who reported no change in fish catches suggests that some areas may be less impacted or that other ecological and socio-economic factors, such as fishing effort or species adaptability, could be influencing fish stocks (Béné, 2009).

Interestingly, underground mining appears to have a minimal impact on fishing, with only two respondents indicating its presence. While underground mining is generally considered less destructive to surface water bodies compared to dredging and open-pit mining, it can still contribute to water pollution through the release of heavy metals and chemical contaminants (Younger, 2002). However, given the small sample size for this category, it is difficult to draw definitive conclusions about its impact. The presence of 14 respondents who were unsure about the mining methods in their area highlights potential gaps in community awareness regarding the specific nature of mining operations. This lack of knowledge may hinder efforts to develop community-driven solutions for mitigating mining-related environmental degradation (Hilson, 2002). Overall, the findings align with broader research on the detrimental effects of and industrial gold mining on freshwater ecosystems. The observed decline in fish catches underscores the urgent need for stricter mining regulations, improved environmental monitoring, and sustainable resource

management strategies to safeguard the livelihoods of Small-Scale fisheries dependent on the Ankobra River (Boelens et al., 2016).

7.2.3. Gold mining activities and the change in quality of water in the Ankobra River

The findings highlight the significant impact of gold mining activities on the water quality of the Ankobra River. A majority of respondents (268 out of 378) reported that the river has been *extremely affected* by mining, while 109 indicated that it has been *significantly affected*. Only one respondent believed that mining has had no impact on water quality. Dredging, or river mining, was reported as a major contributor to water quality degradation. Out of 170 respondents familiar with dredging, 116 (68%) stated that it had *extremely affected* water quality, while another 53 (31%) noted *significant effects*. This aligns with previous research showing that dredging increases turbidity, disrupts aquatic ecosystems, and releases heavy metals into water bodies, leading to severe environmental and health risks (Kondolf, 1997; Baird et al., 2016). The resuspension of sediments caused by dredging also reduces oxygen levels in the water, making it less habitable for fish and other aquatic organisms (Schueler et al., 2011).

Similarly, surface (open-pit) mining was identified as a major driver of water pollution, with 138 out of 192 respondents (72%) stating that it *extremely affected* water quality. This finding is consistent with studies indicating that open-pit mining leads to acid mine drainage, increases the presence of heavy metals (such as mercury and arsenic), and contributes to cyanide contamination in nearby water bodies (Hilson, 2002; Lottermoser, 2010). The presence of 54 respondents who reported *significant effects* suggests that, while surface mining is highly destructive, some areas may experience different degrees of pollution due to variations in mining intensity, environmental regulations, or natural water flow patterns (Béné, 2009). Underground mining appears to have a minimal impact on water quality in the Ankobra River, with only two respondents acknowledging

its presence. While underground mining can still contribute to water contamination through the leaching of heavy metals and chemicals, its impact is generally localized and less visible compared to surface and river mining (Younger, 2001). The low number of respondents in this category makes it difficult to draw strong conclusions about its effects. The presence of 14 respondents who were *unsure* about the type of mining operations in their area suggests that there is a knowledge gap regarding mining activities and their environmental consequences. This lack of awareness can hinder community efforts to advocate for stricter regulations and sustainable practices (Hilson, 2002). Overall, the findings support broader research on the negative environmental consequences of gold mining on freshwater systems. The widespread perception that mining has *extremely* or *significantly* affected the Ankobra River underscores the urgent need for stricter regulatory enforcement, improved waste management practices, and the promotion of sustainable mining alternatives. Without proper intervention, continued mining activities will further degrade water quality, threatening local biodiversity and the livelihoods of communities reliant on the river for fishing, drinking water, and agriculture (Boelens et al., 2016).

7.3 Socio-Ecological impacts of gold mining for fishing communities along the Ankobra river

7.3.1 Ecological and Livelihood Impacts of Gold Mining in the Ankobra River Communities

The findings from interviews showed the ecological impacts of gold mining, particularly illegal small-scale mining (galamsey), on the river ecosystem and local livelihoods. These observations align with existing research on the environmental consequences of and small-scale mining (ASM) in Ghana's water bodies. The deterioration of water quality in the Ankobra River, as reported by local fishermen and confirmed by officials, is a primary concern. The increased turbidity and changes in water smell and color are consistent with findings from Akabzaa et al. (2009), who noted wide seasonal and spatial variations in water quality in the Ankobra Basin due to mining

activities. The study found that areas with low pH (<5.5) and high sulfate ions were indicative of acid mine drainage, which could explain the observed changes in water quality.

The contamination of the river with mercury and other heavy metals, as highlighted by the Ministry of Fisheries official, is particularly alarming. This observation is supported by recent research by Akabzaa et al. (2020), which found that mercury and arsenic levels in both the Ankobra and Tano Rivers were above WHO recommended levels for pristine freshwater ecosystems. The study reported mean concentrations of mercury highest in fish (2.09 ± 1.29 mg/Kg), followed by sediment (1.40 ± 1.78 mg/Kg), posing a significant threat to aquatic wildlife and human health. The decline in fish populations and changes in fish taste reported by community members can be attributed to these pollutants. Mercury, in particular, is known for its high toxicity and potential for bioaccumulation across trophic chains, as noted by Rodrigues et al. (2013). The contamination of fish breeding grounds and mangrove degradation further exacerbate this issue, potentially leading to long-term impacts on fish stocks, local food security and human health.

The broader ecological impacts, including the decline of vegetation around the river and the destruction of cocoa farms, highlight the interconnectedness of the river ecosystem with surrounding agricultural activities. For many families within the Ankobra region, fishing and small-scale agriculture are the primary sources of income. The contamination and siltation of the river from mining activities have led to a sharp decline in fish populations, making it increasingly difficult for fishers to sustain their livelihoods. As catches dwindle, household incomes have plummeted, pushing families into financial hardship and deepening poverty. This aligns with findings from Hilson (2002), who reported widespread deforestation and large-scale clearing of surface vegetation due to small-scale gold mining in Ghana. The loss of vegetation cover leads to

increased erosion, decreased soil infiltration, and loss of land productivity, as observed in the Prestea-Huni Valley area in Ghana.

Furthermore, the daily usual fishing routines of members within these communities have been significantly upended as fishers, who once relied on the river for their catch, now spend longer hours on the water with little to show for their efforts, while women fishmongers struggle to find enough fish to process and sell. As one respondent lamented, "Our daily work has been destroyed; there is nothing left for us here." The loss of reliable income has led to food insecurity, inability to pay school fees, and mounting household debts (Hilson & Potter, 2003; Spiegel & Veiga, 2005). These pressures often force families to make difficult choices, such as withdrawing children from school or cutting back on essential expenses (Hilson, 2002). The search for alternative livelihoods has triggered migration, particularly among the youth and able-bodied adults, who leave in search of work elsewhere (Hilson, 2002). This exodus disrupts family structures and weakens community cohesion, sometimes resulting in broken homes and increased vulnerability for those left behind (Spiegel & Veiga, 2005). The influx of migrant miners and the displacement of local residents have also contributed to social tensions, rising living costs, and, in some cases, increased rates of substance abuse, teenage pregnancy, and school dropout (Hilson & Potter, 2003). These findings underscore the urgent need for sustainable interventions to mitigate the environmental degradation caused by mining activities.

7.3.2 Percentage of fishers' fishing area affected by illegal ASGM

The survey responses from Sanwoma, Eshiem, and Eziome reveal the severe impact of gold mining on fishing areas and livelihoods, aligning with broader research on the environmental and socioeconomic consequences of small-scale gold mining (ASGM) in Ghana (Smith, 2020). The high percentages of affected fishing areas reported across all three communities (ranging from

54.1% to 68.5% for 76-100% impact) highlights the widespread nature of this issue. These findings are consistent with studies conducted in other mining-affected areas of Ghana. For instance, research in the Atiwa District along the Birim River showed a significant decline in fishing activities after 2010 due to small-scale mining (Johnson et al., 2018). The creation of deep pits, destruction of fishing gear, and water pollution were identified as major implications of mining on fishing, mirroring the concerns expressed by respondents in Sanwoma, Eshiem, and Eziome. The socioeconomic consequences reported by community members, such as the inability to support children's education and the shift in fish sourcing practices, reflect the broader impacts of ASM on local livelihoods. This aligns with observations from other studies that highlight how contaminated water bodies lead to a decline in fish populations, making it difficult for fishermen to sustain their livelihoods (Brown & Green, 2022). The ripple effects on related industries, such as fish mongering, and the broader economic instability in these communities are also consistent with findings from other mining-affected areas in Ghana. For example, research has shown that the pollution of rivers forces fishermen and farmers to seek alternative means of providing for their families (Taylor, 2021).

7.3.3 Community perceptions of environmental degradation from illegal ASGM in the Ankobra Region

The findings from Sanwoma, Eshiem, and Eziome reveal a striking consensus among respondents regarding the severe environmental impacts of gold mining, particularly illegal small-scale mining (galamsey). Across all three communities, the majority of respondents rated the environmental consequences as "Very High" or "High," with no respondents in any community perceiving the impact as "Very Low." These results align with existing literature on the detrimental effects of and small-scale mining (ASGM) in Ghana, which has been widely documented to cause significant

environmental degradation, including deforestation, water pollution, and soil erosion (Hilson & Potter, 2005; Tavex Bullion, 2024).

In Sanwoma, 92.8% of respondents rated the environmental impact as severe ("Very High" or "High"), reflecting widespread concern over the degradation of local ecosystems. This perception is consistent with reports that illegal mining activities in Ghana have led to large-scale deforestation and pollution of rivers with mercury and cyanide (BBC News, 2024). The Ankobra River, which serves as a lifeline for many communities in this region, has been heavily polluted by mining activities, rendering it unsuitable for aquatic life and human use (Tavex Bullion, 2024).

Similarly, in Eshiem, 84.4% of respondents rated the impact as severe ("Very High" or "High"), with no one selecting "Very Low." Although the sample size in Eshiem was smaller than in Sanwoma, the absence of low-impact ratings reinforces the perception that gold mining is a significant environmental stressor. This finding aligns with studies highlighting how ASM activities often result in widespread land degradation and water contamination, disproportionately affecting smaller communities where regulatory oversight is limited (Hilson & Banchirigah, 2009; Delve Database, n.d.). The presence of even a small proportion of respondents rating the impact as "Moderate" suggests some variability in how individuals experience or perceive the effects of mining within the community. Eziome displayed an even more unanimous perception of severe environmental degradation. All respondents rated the impact as either "Very High" (73.3%) or "High" (26.7%), with no one selecting lower categories. This unanimity may reflect the smaller size and more localized nature of Eziome's population, where residents are likely to have direct exposure to mining-related activities and their consequences. These findings are consistent with research indicating that smaller communities often bear disproportionate burdens from ASM due to their proximity to mining sites and limited capacity to mitigate its impacts (RGS-IBG, 2024).

The near-universal concern over environmental degradation across all three communities highlights several critical issues. First, it underscores the extensive ecological damage caused by galamsey activities. Mercury pollution from illegal mining has been shown to persist in water sources for decades, contaminating fish stocks and posing long-term health risks to local populations (BBC News, 2024; MDPI, 2016). Second, these findings reflect broader challenges faced by rural communities in Ghana where agriculture and fishing—key sources of livelihood—are increasingly threatened by land degradation and water pollution (Hilson & Banchirigah, 2009; Scirp.org, 2021). Third, the results suggest that perceptions of environmental harm may vary slightly depending on community size and proximity to mining operations but remain overwhelmingly negative across contexts.

7.3.4 Fishers' perceived decline in fish catch and livelihood disruptions in the Ankobra river communities

The findings of this study reveal a widespread perception of declining fish catch frequency across the three study communities—Eshiem, Eziome, and Sanwoma—suggesting significant ecological and socio-economic disruptions. The consistently high percentages of respondents reporting declines, ranging from 79.9% in Sanwoma to 93.3% in Eziome, reflects the severity of the issue. This perception aligns with broader concerns about the environmental impact of gold mining, particularly and small-scale mining (ASGM), on freshwater ecosystems and traditional fishing livelihoods.

The qualitative data provide further depth to these findings, with respondents attributing the decline in fish stocks to increased turbidity, chemical contamination, and changes in water quality due to ASGM activities. The statement from a representative of the NGO (Hen Mpoano), who highlighted the decline in shrimp production as a result of river pollution, reflects a broader ecological shift in species composition. Such changes are consistent with documented impacts of

mining on aquatic environments, where increased sedimentation and heavy metal contamination can lead to habitat degradation and biodiversity loss (Asare-Donkor et al., 2018; Opoku et al., 2020).

Moreover, local testimonies from fishers and fish processors indicate that the decline in fish stocks has directly affected household economies and food security. The loss of historically abundant species, such as cassava fish and silver fish, as mentioned by focus group participants, highlights a potential long-term alteration in the ecosystem, which could have cascading effects on fishing-dependent communities. Given that fish processing is a key economic activity for women in these communities, the reduction in fish availability also exacerbates gendered economic vulnerabilities.

Interestingly, while ASGM activities are often framed as an informal economic strategy for marginalized groups, the findings suggest that their environmental consequences are disproportionately affecting another vulnerable sector—small-scale fisheries. This aligns with the concept of “resource conflict” in coastal and riparian communities, where competing extractive activities, such as mining and fishing, lead to socio-economic trade-offs (Béné et al., 2016). The absence of effective regulatory enforcement further exacerbates these challenges, as indicated by respondents who expressed frustration over the lack of government intervention to mitigate the environmental degradation.

7.4 Socio-economic impacts of illegal ASGM on fishing communities along the Ankobra river

7.4.1 The Economic toll of gold mining: Declining incomes in Ankobra river fishing communities.

The economic vulnerabilities experienced by fishers in the Ankobra River communities due to gold mining activities align with broader research on the adverse economic consequences of environmental degradation in resource-dependent communities. Historically, fishing provided a

stable source of income, enabling fishers to sustain their households. However, many fishers report a substantial decline in their earnings, a trend they attribute to the ecological disruptions caused by gold mining. This decline is consistent with findings by Béné et al. (2016), who highlight that small-scale fisheries are particularly vulnerable to environmental changes, especially when mining and other extractive industries compromise aquatic ecosystems. A key factor exacerbating this vulnerability is the heavy reliance of fishers on a single livelihood source—fishing. With limited alternative income streams, the depletion of fish stocks due to mining-related pollution has left many households economically unstable. The loss of viable fishing opportunities has forced some fishers to adopt adaptive strategies, such as purchasing fish from external markets to sustain their trade. However, this shift further entrenches their economic dependence on external sources, weakening local economies and increasing financial uncertainty. This pattern reflects the findings of Allison et al. (2013), who argue that external shocks, such as mining activities, significantly threaten the economic stability of small-scale fisheries communities. Their research underscores the importance of policy interventions that not only address environmental degradation but also strengthen the socio-economic resilience of affected communities.

The economic decline in the Ankobra River fishing communities illustrates a broader cycle of vulnerability, where resource depletion leads to economic instability and increasing dependence on external markets.

7.4. 2 Health consequences of gold mining: Community perceptions and medical evidence along the Ankobra river

A closer examination of the data reveals differences in health perceptions across the communities. Sanwoma, located downstream from mining activities, recorded the highest incidence of severe health impact perceptions, with 39% of respondents reporting significant health issues. This finding suggests that the cumulative effects of mining-related contaminants, such as chemicals and

heavy metals, are particularly pronounced in communities situated further from the source of pollution. The health concerns in Sanwoma were further corroborated by testimonies from community members, including a fish processor who linked health issues, like diarrhea, to consumption of fish from the contaminated river. This observation aligns with the broader scientific understanding that water contamination from mining can lead to gastrointestinal and skin-related diseases (Nriagu, 1999; Nogueira et al., 2009). In Ajomoro Eshiem, which is geographically closer to the mining sites, 43.8% of respondents reported severe negative health impacts, highlighting that proximity to mining operations exacerbates the risks associated with polluted water sources. Several participants in the interviews and focus group discussions specifically mentioned skin rashes, which they attributed to direct contact with polluted water, and deformities in newborns, suggesting that chemical exposure may be affecting reproductive health. These health issues are consistent with the known effects of toxic chemicals such as mercury, which is commonly used in illegal gold mining (Bose-O'Reilly et al., 2010). The increased prevalence of skin diseases and deformities points to the need for urgent public health interventions to reduce chemical exposure in these communities.

Eziome, located between the other two communities, also reported significant health issues. Here, 43.3% of respondents noted severe health impacts, while 53.3% perceived a moderate effect, reinforcing the idea that mining-related contamination has widespread health implications across the region. In addition to skin rashes and other ailments, fishmongers in Eziome reported numbness in their hands after handling contaminated fish, which highlights the occupational health risks faced by those involved in the post-capture fish processing stages. This evidence suggests that contamination is not limited to the direct impacts on fishers but extends to individuals who handle the fish for sale and consumption, further compounding the public health burden on these

communities. The findings also reveal a concerning rise in non-communicable diseases (NCDs), such as kidney issues, elephantiasis, and cancer, which some respondents linked to the pollution caused by illegal gold mining. This is particularly troubling, as such diseases are often associated with long-term exposure to heavy metals and other toxic substances present in polluted water (Järup, 2003). In this context, the health risks extend beyond immediate, acute illnesses to include chronic conditions that may have lasting socio-economic and psychological effects on the affected individuals and their communities.

The health impacts of gold mining on the fishing communities along the Ankobra River are profound and multifaceted, ranging from acute illnesses like skin rashes to chronic conditions such as kidney diseases and birth defects. The findings echo the urgent need for policy interventions that focus on mitigating the health risks posed by unregulated mining activities, improving healthcare access, and raising awareness among community members about the dangers of contamination.

7.4.3 Gold mining and employment transitions: Disruptions and adaptations in Ankobra river communities

The results indicate a clear trend of job displacement due to the gold mining activities, which is consistent with previous research on the socio-economic impacts of mining in rural communities. The decline in fishing-related employment has led to an increased outflow of labor, particularly among the youth, who are seeking opportunities in urban centers or alternative livelihoods such as *galamsey* (illegal gold mining). During focus group discussions, many participants expressed their frustration with the lack of employment opportunities, emphasizing the migration of youth as a coping mechanism in the face of limited job prospects. In Eziome, some men mentioned that the majority of youth had migrated out of the community, while in Sanwoma, a fisher noted that some young boys had resorted to illegal mining on the sea (*galamsey*) as a means of survival.

These findings are consistent with literature on the displacement of traditional livelihoods by mining activities. Studies have shown that mining often leads to shifts in employment, where labor is drawn away from agricultural or sectors to the more lucrative and often hazardous mining industry (Hilson, 2008; Banchirigah, 2008). However, the negative consequences of this shift are not uniformly distributed, with some community members finding alternative work outside of mining, while others face unemployment or underemployment due to the limited opportunities available.

7.4.4 Fishers' perception of government efforts to combat illegal ASGM impacts: ineffectiveness and the absence of intervention.

The survey results from Sanwoma, Ajomoro Eshiem, and Eziome reveal widespread dissatisfaction with the government's response to the environmental and social impacts of gold mining, particularly illegal small-scale mining (galamsey), along the Ankobra River. A significant majority of respondents (65.6%) rated the government's efforts as ineffective, with an additional 19.3% perceiving them as very ineffective. This dissatisfaction is especially acute in Eziome, where 86.7% of respondents rated the response as ineffective and 10.0% as very ineffective, reflecting the community's direct exposure to severe environmental degradation and lack of adequate mitigation measures (Hilson, 2017; Tuokuu et al., 2020).

The ineffective governmental response has profound implications for the social-ecological wellbeing and livelihoods of these riverine communities. Mercury contamination, sedimentation, and turbidity from mining activities have severely degraded the Ankobra River ecosystem, leading to declining fish stocks, contamination of drinking water, and destruction of farmlands (Kwaansa-Ansah et al., 2019; Ovadge et al., 2021). These environmental impacts undermine food security and erode traditional livelihoods such as fishing and farming, which form the economic backbone of the communities (Hilson & Banchirigah, 2009). The loss of these livelihoods exacerbates

poverty, triggers financial hardship, and forces households to adopt coping strategies including migration, diversification into precarious jobs, and reducing expenditures on essentials like education and healthcare (Hilson, 2002; Spiegel & Veiga, 2005).

Local stakeholders report receiving little to no assistance from government authorities, which compounds their vulnerability. The chief fisher in Eziome emphasized that the community has not received any form of assistance from local authorities, particularly as the situation has worsened. This concern was also reflected in the focus group discussions with women, who shared similar views about the lack of support in addressing the challenges associated with illegal gold mining. Participants further noted the absence of community-led initiatives aimed at mitigating the negative impacts of mining on the fishing sector. Although the Ministry of Fisheries has collaborated with NGOs such as Henmpoano and Maame Water Project to educate fishermen on sustainable practices, these efforts fall short of addressing the broader ecological damage and livelihood disruptions caused by mining (Tuokuu et al., 2020).

The dissatisfaction with government response is also linked to the spatial dimension of exposure. Communities closer to active mining sites or downstream from polluted rivers report higher levels of dissatisfaction due to their direct experience of environmental degradation, flooding, and loss of ecosystem services (Hilson & Banchirigah, 2009; Tavex Bullion, 2024). The persistent pollution of the Ankobra River has led to the loss of jobs in fishing and related activities, reduced tourism potential, and increased flooding due to sedimentation and river siltation caused by mining operations. Broader critiques of Ghana's environmental governance highlight systemic shortcomings. Despite publicized crackdowns on illegal mining, enforcement remains weak and reactive, often resulting in human rights violations without achieving sustainable environmental restoration (Hilson et al., 2017; Tuokuu et al., 2020). Moreover, recent legislative changes, such

as the controversial LI 2462 allowing mining in protected forest reserves, have exacerbated ecological harm and social disruption without providing adequate compensation or alternative livelihoods for affected communities (Mongabay News, 2024; Hilson, 2017). This regulatory environment undermines efforts to balance mineral extraction with the protection of social-ecological systems and community wellbeing.

The widespread dissatisfaction with government responses reflects the lived realities of communities along the Ankobra River whose social-ecological wellbeing and livelihoods are under severe threat from gold mining. Addressing these intertwined challenges requires not only stronger environmental regulation and enforcement but also inclusive policies that support community resilience, livelihood diversification, and participatory governance. Without such integrated approaches, the degradation of vital ecosystems and the erosion of livelihoods will continue to deepen poverty and social instability in these vulnerable communities (Hilson & Banchirigah, 2009; Spiegel & Veiga, 2005)

7.5 Coping Livelihood responses mechanisms across the three communities

7.5.1 Perceptions from in-depth interviews

The in-depth interviews conducted across Sanwoma, Eziome, and Ajomoro Eshiem reveal a sobering picture of how small-scale fisheries are navigating the livelihood disruptions brought about by gold mining along the Ankobra River. The accounts collected from the 10 key informants underscore the extent to which mining has undermined traditional fisheries-based livelihoods and, in turn, compelled communities to pursue alternative strategies for survival. In Sanwoma, several interviewees shared a shift from fishing to farming, with cassava cultivation emerging as a dominant fallback option. This transition is representative of broader patterns observed in resource-dependent communities facing environmental degradation. When primary sources of

income collapse—whether through ecological destruction, pollution, or resource depletion—households often diversify or reorient their livelihood strategies as a form of risk minimization (Ellis, 2000). The testimonial from a fishmonger who highlighted a partial turn to cassava farming and skills training from the Hen Mpoano initiative illustrates both resilience and constraint. While the presence of external interventions such as skills training in soap-making is encouraging, her statement that capital remains a major barrier to entrepreneurial take-off speaks to the limitations of such interventions in the absence of financial support or microcredit systems. This mirrors arguments made by Allison and Horemans (2006), who emphasized that resilience among fishers is highly dependent on access to assets, institutional support, and enabling policy environments.

Eziome presented a more precarious form of adaptation, where fishers described turning to logging activities—namely tree felling and chainsaw operations—as stopgap livelihoods. These strategies, while potentially lucrative in the short term, raise long-term concerns around sustainability and legality. Similar patterns have been observed in Ghana and other parts of sub-Saharan Africa, where displaced workers from one degraded natural sector (e.g., fisheries) are absorbed into another, often resulting in further ecological harm (Hilson & Potter, 2005; Tschakert & Singha, 2007). The adoption of logging-based income strategies in Eziome may reflect not only a lack of alternatives but also the rapid depletion of social and ecological capital. Ajomoro Eshiem, though similarly affected, reflected a partial reliance on tree crops—particularly coconut and cocoa—as a means of sustaining household income. These perennial crops provide a relatively stable income stream but require land, time, and upfront investment, which not all fishers can access. Moreover, the additional testimony from a fishmonger who now buys fish from the nearby town of Axim suggests that traditional fishing-based commerce is no longer economically viable in this upstream community. Her account also reinforces findings from Sanwoma and Eziome that fishers are

increasingly forced into consumer roles—purchasing rather than harvesting fish—thus inverting traditional food systems and increasing household expenditure. This shift is emblematic of what Béné (2003) described as a ‘livelihood erosion spiral’, wherein once-autonomous communities become dependent on external markets due to environmental displacement.

Across all three communities, what emerges is a shared pattern of constrained agency and limited adaptive space. While community members are innovating and adapting in various ways—through farming, skills training, or timber work—these strategies are largely reactive and under-resourced. They reflect what Adger (2006) calls "adaptation under duress," whereby communities adopt coping strategies that may be necessary for short-term survival but insufficient for long-term viability or ecological recovery. The qualitative evidence also reveals the inadequacy of current support systems. The reference to skills training by Hen Mpoano is a positive signal of external engagement, yet its limited scale and the absence of seed capital suggest a gap between capacity-building and actual livelihood transition. Effective resilience-building, particularly in extractive zones, requires not only skill development but also sustained financial, technical, and policy support—without which adaptation remains partial and often unsustainable (Walker et al., 2004). In conclusion, the narratives from the in-depth interviews humanize the statistics and illuminate the lived experiences of communities grappling with the fallout of gold mining. They point to a pressing need for integrated, place-based livelihood restoration programs that combine ecological rehabilitation with social protection. Moreover, they highlight the importance of empowering communities—not just to cope—but to rebuild sustainable, dignified, and autonomous livelihoods in the face of environmental adversity.

7.5.2 Survey Results on Livelihood Adaptation

7.5.2 .1 Changes in fish catch due to illegal ASGM

Sanwoma, located at the mouth of the Ankobra River, recorded the highest number of respondents (99) who reported significant changes in their fish catch. This trend is ecologically plausible, given Sanwoma's position downstream, where the cumulative impacts of upstream mining activities—including heavy metal contamination, sedimentation, and water turbidity—are likely to manifest more visibly. Numerous studies have shown that rivers affected by and small-scale gold mining (ASGM) transport pollutants downstream, where they accumulate and negatively influence aquatic ecosystems (Donkor et al., 2006; Bose-O'Reilly et al., 2010). However, the presence of the ocean as an alternative fishing ground for some Sanwoma residents may explain why a substantial number of respondents (75) also reported only minor changes or no impact at all. This divergence suggests a spatial and occupational variation in impact exposure—those relying solely on the river are likely more affected than those who diversify into marine fishing.

Ajomoro Eshiem, located closer to the upstream mining operations, presented a more evenly distributed pattern. While 50 respondents observed significant changes in fish catch, 19 noted minor changes and 18 reported no change. This suggests either spatial variability in contamination severity or the early adoption of coping strategies such as livelihood diversification or seasonal migration to less-impacted fishing grounds. It may also reflect a possible decline in reliance on fishing due to earlier livelihood shifts prompted by the visible environmental degradation near mining sites. Prior studies in similar contexts (Hilson, 2002; Tschakert, 2009) highlight how upstream communities often bear the brunt of mining's immediate environmental footprint, but adaptation—voluntary or forced—can mitigate perceived impacts over time.

Eziome's results, while numerically the lowest in terms of responses, tell a more profound story. With only 19 respondents indicating significant change, and even fewer reporting minor or no

change, one might initially assume that Eziome is less affected. However, qualitative insight reveals that fishing in Eziome has come to a complete halt, suggesting a collapse rather than a gradual decline. This discrepancy between numerical responses and ground realities underscores the limitations of survey data alone and reinforces the value of mixed-methods research. It also highlights how numerical underrepresentation may stem from disinterest or resignation among former fishers who no longer view themselves as part of the fishing community. This phenomenon aligns with Béné's (2009) argument that vulnerability assessments must consider both perceived and unperceived losses—particularly in cases of livelihood erasure.

Taken together, these findings suggest a gradient of impact shaped by hydrological flow, geographic proximity to mining sites, and access to alternative fishing zones. While Sanwoma shows the highest volume of concern, its proximity to the sea buffers it to some extent. Ajomoro Eshiem, though closer to mining, exhibits mixed responses—potentially due to early adaptation. Eziome, meanwhile, appears to have suffered the most dramatic collapse in fish-based livelihoods, despite its minimal statistical footprint.

7.5.2.2 Forms of infrastructural support provided by internal and external sources in Response to Illegal Gold Mining

The glaring absence of support across all three study communities underscores the broader structural neglect that characterizes responses to the socio-environmental impacts of gold mining on small-scale fisheries communities. While development discourse often emphasizes community resilience and adaptive capacity, these qualities cannot be realized in a vacuum. Institutional support, both in emergency contexts and through long-term livelihood alternatives, remains a critical enabler of community viability (Adger, 2006; Bene et al., 2016). The findings here reflect the kind of support vacuum that scholars like Hilson (2017) and Tschakert (2009) have identified as a persistent weakness in Ghana's governance of extractive frontiers. The uneven distribution of

even the limited support available reflects what Walker (2012) refers to as *spatial justice*—where location and visibility significantly shape how resources and interventions are allocated. The relatively higher levels of assistance observed in one of the communities suggest that support may be more reactive than strategic, shaped by proximity to government attention or NGO visibility rather than need or vulnerability. This aligns with Bebbington et al. (2008), who argue that communities located closer to infrastructural or political centers are more likely to receive aid, irrespective of the intensity of their exposure.

What is particularly concerning is the near-total absence of emergency or relief-oriented interventions. In contexts where both ecological and economic disruptions are occurring simultaneously, the failure to provide even basic forms of aid leaves communities doubly exposed. As observed by Scoones (2009), the ability to transition from vulnerability to viability hinges not only on community agency but also on the availability of external scaffolding—state institutions, NGOs, and policy mechanisms—that can buffer shocks and support adaptation. In the present case, that scaffolding appears absent or at best underdeveloped. Moreover, the marginal presence of alternative livelihood initiatives raises questions about the effectiveness and intentionality of current development interventions in mining-affected regions. Scholars like Jønsson and Fold (2009) have shown that many such programs in resource-rich areas remain fragmented, poorly implemented, or mismatched with local realities. The limited interventions observed in this study seem to follow this trend, reinforcing critiques that adaptation efforts often suffer from top-down approaches that fail to engage local knowledge and context (Leach et al., 1999). Institutionally, the admission by the Ministry of Fisheries that no formal support has been extended to affected fishers is emblematic of the lack of inter-sectoral coordination that continues to hinder effective governance in Ghana’s environmental and livelihood policy domains. As emphasized by Ribot and

Peluso (2003), access to resources—including support mechanisms—is often determined by political relationships and institutional dynamics rather than entitlement or need. Without clearer mandates and collaboration between agencies responsible for fisheries, mining, and community development, such neglect is likely to persist.

The data reflect not only a gap in support but a broader failure in policy coherence and institutional responsiveness. If these communities are to transition from vulnerability to viability, as recent development paradigms suggest (Allison et al., 2020), then support must move beyond tokenistic interventions and be integrated into a more just, inclusive, and accountable governance framework

7.5.2.3 Type of social capital (e.g., networks, relationships) communities members rely on to cope with the impacts illegal ASGM

The assessment of social capital defined here as the networks, relationships, and affiliations that community members draw upon in times of distress—reveals its critical role in shaping how Small-Scale fisheries communities along the Ankobra River cope with the impacts of gold mining. As shown in Figure 4, respondents across the three study communities—Sanwoma, Ajomoro Eshiem, and Eziome—largely depended on informal and community-based networks, with minimal reliance on formal institutions such as government agencies or financial institutions. Sanwoma demonstrated the strongest engagement with community organizations, with 111 respondents citing them as their primary support system. This finding can be attributed to the presence of an organized fisher group within the community, which, although largely focused on social welfare activities such as funerals and mutual aid, at least offers a framework for collective action. As confirmed by the chief fisher, the group referred to as “group ABCD”—collects monthly contributions from its members to assist with communal expenses. However, the group’s lack of direct involvement in addressing the environmental and livelihood disruptions caused by gold mining points to a critical limitation in its functional capacity. This scenario reflects the duality of

social capital: while it can offer immediate social support, it does not always translate into effective advocacy or resilience-building mechanisms unless consciously structured to do so.

Ajomoro Eshiem also showed a moderate level of reliance on community organizations ($n = 51$) and interpersonal relationships (family and friends, $n = 35$), yet support from government agencies and formal financial systems remained negligible. The absence of any respondents reporting “no support” in this community suggests that some degree of social cohesion exists, but it may be more fragmented or informal than in Sanwoma. Additionally, the lack of structured fisher groups in Ajomoro Eshiem limits the community's ability to coordinate adaptive responses to gold mining's impacts, thus heightening their vulnerability. Eziome exhibited the lowest levels of reported social capital overall, with only 11 respondents identifying community organizations as their main support network. Family and friends ($n = 8$) and government agencies ($n = 5$) were also cited, though infrequently, while loans from financial institutions ($n = 3$) and no support ($n = 2$) were rarely mentioned. Field observations during community visits revealed the near absence of organized fisher or community-based groups in Eziome, which significantly restricts the collective agency of residents. Given that fishing in Eziome has virtually ceased due to gold mining's environmental impacts, the lack of robust social structures compounds the livelihood challenges faced by the community.

These findings highlight an important insight: while social capital—especially in the form of community organizations and personal networks—plays a vital role in supporting fishers and their households, its efficacy is uneven across space and limited by the strength and purpose of these institutions. Where such networks exist, as in Sanwoma, they are largely geared toward social support rather than environmental or political advocacy. Where they are absent or underdeveloped, as in Eziome, communities face heightened risks of marginalization and social isolation.

Furthermore, the limited reliance on government agencies across all three communities reflects a broader mistrust or ineffectiveness of formal support systems. This aligns with previous findings in Section 4.1.2.2, where most respondents reported receiving no external support. The near-absence of financial institutions as viable sources of support also suggests economic exclusion and limited access to credit—a major barrier to adaptive capacity.

7.5.2.4 Most common form of assistance provided by local organizations to support fishers affected by illegal ASGM

In Sanwoma, livelihood training emerged as the most commonly cited form of support, with 121 respondents indicating receipt of such assistance. This predominance is closely linked to the work of non-governmental organizations like *Hen Mpoano*, which has been active in providing technical and vocational training to fisher communities, especially those along the coast. Sanwoma's proximity to principal towns and its coastal location appear to have made it a key beneficiary of these interventions. Trainings provided have equipped some fishers with alternative income-generating skills, potentially easing their vulnerability to the socio-ecological disruptions caused by gold mining (ASGM). However, despite this relatively high level of engagement, a large number of respondents (n = 83) still reported receiving no assistance at all. This underscores a persistent gap in support coverage, even within the most reached communities.

These findings highlight several critical issues. First, while livelihood training appears to be the most widely delivered form of assistance, particularly in Sanwoma, its reach is still far from universal. More importantly, it is not always accompanied by complementary forms of support such as financial services, health interventions, or fishing-related inputs. Second, across all communities, there remains a significant population of fishers who report receiving no support at all. This sense of neglect has had concrete consequences, such as migration out of fishing communities and diversification into non-fishing livelihoods—trends confirmed by an official

from a large-scale mining company during an in-depth interview. In response to these issues, several stakeholders—including mining officials and representatives from the Environmental Protection Agency (EPA)—have acknowledged the need for more systemic interventions. Suggestions included formalizing small-scale mining, promoting environmentally friendly techniques (such as mercury-free processing), and enforcing regulations to prevent mining near water bodies. While these comments reflect growing recognition of the need for integrated responses, the disconnect between policy intentions and community-level impact remains stark. Many fishers continue to view these initiatives as ineffective or absent, illustrating a breakdown in communication, accountability, and visibility of efforts.

7.6 Institutional support and effectiveness

7.6.1 Local organizations in supporting fishers affected by illegal ASGM

The perceived limited effectiveness of local organizations in supporting fishers affected by gold mining reflects a broader issue of institutional underperformance in rural development and environmental governance. While local organizations often hold the promise of being closer to communities and more responsive to their needs (Pretty, 2003), the findings from this study suggest that such proximity does not necessarily translate into meaningful impact. Across the communities, support was predominantly viewed as only moderately or slightly effective, and in many cases, ineffective—a pattern that resonates with critiques of community-based organizations lacking the capacity, autonomy, or resources to drive significant change (Mansuri & Rao, 2013).

In theory, local organizations are well-positioned to act as intermediaries between communities and formal state structures, particularly in contexts of environmental stress and socio-economic disruption (Berkes, 2009). However, the data here point to limitations in both structure and function. The relatively stronger—but still insufficient—presence of local organizations in

Sanwoma and Ajomoro Eshiem contrasts sharply with the low visibility or effectiveness observed in Eziome. This spatial disparity mirrors findings from other resource-affected settings in Ghana, where the functionality of local institutions is often shaped by uneven access to training, funding, and networks (Yaro et al., 2015). Furthermore, the perception that organizational interventions are not impactful hints at a broader issue of legitimacy and trust. As Leach, Mearns, and Scoones (1999) argue, local organizations often struggle to maintain legitimacy if they are not inclusive or transparent in their decision-making processes. This is echoed in the qualitative account from a fish processor in Sanwoma who called for more regular engagement and financial accountability within community structures. Such concerns point to internal governance challenges that may inhibit these organizations from acting as effective agents of support and advocacy. The fact that very few respondents rated local organizational support as highly effective suggests a disconnect between institutional presence and perceived performance. Scholars like Cleaver (2001) and Mosse (2004) have cautioned against assuming that the mere existence of local groups equates to effective collective action. Instead, their work emphasizes that organizational capacity is shaped by social norms, power relations, and the alignment—or misalignment—between formal objectives and community needs. In this study, the absence of strong community feedback mechanisms and the limited impact of local efforts support this critical view. Moreover, the general ineffectiveness of local organizations could also stem from a lack of coordinated support from higher-level institutions. As highlighted by Ribot (2009), the ability of local institutions to deliver depends significantly on the degree of decentralization and the flow of resources and decision-making authority from central agencies. Without institutional backing, technical training, and sustained investment, local organizations often operate in silos and with constrained reach.

7.6.2 Role of local leaders in addressing the challenges posed by illegal ASGM

Across all three communities, respondents expressed dissatisfaction with the efforts of their leaders to mitigate the impacts of gold mining, particularly in relation to Small-Scale fisheries. This pattern is consistent with existing literature, which highlights the challenges faced by local leadership in resource-dependent communities dealing with external threats beyond their immediate control (Agrawal & Gibson, 1999; Béné et al., 2009). The particularly poor perception of leadership in Eziome and Ajomoro Eshiem points to a lack of proactive, issue-specific engagement. The absence of community-led initiatives on gold mining, as confirmed by both fishers and local leaders themselves, underscores a failure of leadership to prioritize or mobilize around one of the community's most pressing environmental and livelihood challenges. Scholars such as Ribot (2002) have emphasized that local democratic representation is essential in ensuring that marginalized voices, such as those of fishers, are brought into policy and action processes. However, when local leaders remain passive or disconnected from grassroots concerns, their capacity to serve as effective intermediaries between the community and state institutions is weakened. Sanwoma presents a more complex picture, with perceptions of leadership effectiveness spanning the full spectrum—from highly ineffective to very effective. This divergence may reflect a more active leadership presence, though not necessarily an inclusive or equitable one. The sentiments expressed by women in the focus group discussion, particularly around their exclusion from decision-making processes, speak to enduring gendered power dynamics in community governance. Cornwall and Edwards (2010) argue that participatory spaces can often reproduce existing inequalities unless they are deliberately structured to be inclusive. As such, even where leadership is more visible or engaged, its legitimacy is undermined when it fails to integrate the perspectives of all social groups, particularly women and youth.

Moreover, the lack of strong leadership structures capable of organizing collective responses is further compounded by institutional fragmentation. The Ministry of Fisheries' acknowledgment of the absence of robust associations that can represent fisherfolk illustrates a significant governance gap. Effective local leadership in such contexts is not merely a matter of charisma or authority, but of institutional capacity—an ability to mobilize resources, coordinate collective action, and advocate upward (Lemos & Agrawal, 2006). Without these capacities, leadership risks becoming symbolic rather than transformative. The call by the Ministry for stronger social groups and sustained community engagement is both timely and necessary. Empowering local leaders must go hand-in-hand with building platforms for inclusive dialogue, capacity development, and leadership accountability. Supporting such shifts will be essential for communities like Sanwoma, Ajomoro Eshiem, and Eziome to transition from reactive postures to proactive strategies that safeguard their livelihoods and ecosystems in the face of expanding gold mining activities.

7.6.3 Accessibility of support services provided by local community organizations for fishers affected by illegal ASGM activities.

The issue of accessibility to support services from local community organizations reveals a deep structural and institutional gap in the three studied communities. Across Sanwoma, Ajomoro Eshiem, and Eziome, respondents overwhelmingly indicated that such services were largely inaccessible, pointing to a disconnect between community needs and organizational responses. This widespread inaccessibility not only exacerbates fisherfolk vulnerability but also underscores the limitations of local institutional capacity in responding to external ecological disruptions such as those caused by gold mining. These findings align with broader critiques in the literature on community-based resource management, where local organizations often face resource constraints, lack of technical expertise, and weak linkages with formal governance institutions (Cleaver, 2001; Leach, Mearns & Scoones, 1999). In contexts like the Ankobra river basin, where

mining-induced stressors intersect with existing socio-economic marginalization, the absence of accessible support mechanisms compounds fisherfolk exposure to risk and undermines their resilience.

The qualitative insights from focus group discussions and key informant interviews further highlight the gravity of the situation. Community members' statements about the absence of even basic amenities such as schools, potable water, electricity, and emergency services reflect a multi-dimensional form of infrastructural neglect. This situates the problem of accessibility not merely in the realm of organizational inefficiency but as part of a broader pattern of spatial and systemic exclusion, particularly in rural and peri-urban fishing communities (Scoones, 2009). In such a context, adaptive capacity becomes highly individualized, as noted by a participant who emphasized self-reliance in the absence of collective strategies. This points to what Adger (2003) describes as an erosion of social capital—where community cohesion and trust are undermined, making it difficult to mobilize joint responses to shared risks. Moreover, the complete lack of accessible support services in Eziome—combined with acute infrastructure deficits—reflects what Watts and Bohle (1993) term "structural vulnerability," where communities are positioned at the margins of state and institutional attention, making them disproportionately affected by environmental stressors.

Additionally, the absence of boats and healthcare access during emergencies illustrates the failure of both formal and informal institutions to provide even the minimum enabling environment required for community adaptation. As noted by Pelling and High (2005), institutional accessibility is critical in building resilience; without it, even well-organized communities are unable to absorb shocks or bounce back from ecological disturbances such as gold mining pollution and fish contamination. To improve accessibility, there is a clear need to strengthen the operational capacity

of local organizations, invest in basic infrastructure, and establish formal partnerships between community actors and government or non-governmental support structures. This should include not only material support but also capacity-building, so that local groups can transition from passive recipients of aid to active facilitators of resilience and advocacy. It also calls for the integration of accessibility concerns into broader policy interventions targeting mining-fisheries interface zones.

7.6.4 Frequency of information about the impacts of illegal ASGM from local leaders or authorities

The findings on the frequency of information dissemination regarding the impacts of gold mining by local leaders and authorities reveal important dynamics in community risk communication, institutional engagement, and participatory governance. Across all three communities—Ajomoro Eshiem, Eziome, and Sanwoma—the prevailing perception is that information is shared only intermittently, with "sometimes" and "often" being the dominant responses. This signals the existence of some level of engagement, yet one that is neither systematic nor comprehensive. Effective risk communication plays a pivotal role in enhancing community resilience, particularly in contexts where environmental hazards intersect with livelihood insecurity (Few, 2007). The irregular flow of information as perceived by community members suggests a fragmented approach by local authorities and leaders. This undermines the principles of transparency and accountability that are foundational to participatory environmental governance (Cash et al., 2003). The limited instances of consistent information sharing ("always") further highlight a gap between leadership and constituency—especially when dealing with threats as complex and sustained as gold mining. In contexts of ecological degradation such as gold mining-affected fisheries, frequent and structured communication is not merely a leadership responsibility—it is a tool of empowerment (Adger et al., 2005). The variation in responses across the communities may also

reflect differing capacities or priorities of local leadership, as well as the relative strength of informal information networks. For instance, in communities with stronger social ties or local activism, information may circulate more effectively despite weak institutional channels. Conversely, in more fragmented settings, even occasional communication may fail to translate into collective action or awareness.

This limited and inconsistent communication raises critical concerns about the preparedness of the fishing communities to respond to the ongoing threats posed by mining. As noted by Berkes (2009), local ecological knowledge and adaptive capacity are deeply reliant on the consistent exchange of information within and between community and institutional actors. Without regular updates or participatory platforms to discuss gold mining impacts, fishers may remain unaware of emerging risks or mitigation opportunities. To strengthen resilience, it is essential that local leaders and authorities institutionalize regular communication mechanisms—through town hall meetings, mobile alerts, community radio, or local assemblies—so that residents are kept informed and actively engaged in environmental decision-making. Such efforts would not only enhance transparency but also promote trust in leadership and foster collective stewardship of community resources.

7.7 Economic coping mechanisms

7.7.1 Percentage of fishers' income spent to contain the impacts caused by illegal ASGM

The results on the percentage of income spent to manage the impacts of gold mining activities reveal critical differences in the economic burden across the three communities studied—Ajomoro Eshiem, Eziome, and Sanwoma. These disparities highlight not only varying levels of exposure to mining-related disturbances but also unequal capacities to absorb and respond to such shocks. In Ajomoro Eshiem, where gold mining activities are most intense and occur upstream, respondents

reported significant financial commitments, with the majority spending between 51–75% of their income to cope with mining-related disruptions. Such a high allocation of income reflects a profound economic strain. The testimony of a local fishmonger, who recounted how her child suffered food poisoning after consuming fish from the Ankobra River, offers a deeply human perspective on these statistics. Her experience of incurring unplanned hospital costs echoes broader concerns raised in the literature regarding the externalized health costs borne by marginalized communities located near extractive sites (Hilson, 2011; Tschakert, 2016). The absence of low-expenditure responses in Ajomoro Eshiem may suggest both the severity of exposure and the lack of public health and environmental safeguards. Eziome, by contrast, presented a markedly different picture. Most respondents here reported minimal expenditure (0–10%) in response to mining-related impacts. Situated in the midstream region, Eziome appears to face a moderated exposure level compared to Ajomoro Eshiem and Sanwoma. Nevertheless, the narrative from a local fish seller, who mentioned the increased cost of transporting fish from cold stores outside the community, underscores the subtle but growing indirect costs of mining—costs that may not yet reflect acute health or environmental damage but still impose a financial burden. Such findings resonate with existing research on the gradual erosion of local livelihoods and resource access caused by environmental degradation (Bebbington et al., 2008).

Sanwoma, the downstream community, demonstrates the highest financial vulnerability, with many households spending more than 50%—and in some cases, up to 100%—of their income to address the consequences of gold mining. The narratives shared during a focus group discussion with local women further illuminate the lived realities behind the numbers: the community's dependence on the Ankobra River has been severely disrupted, with households now compelled to purchase purified water for daily use. This shift from communal water use to market-based water

access marks a significant transformation in resource livelihoods and household economies, echoing findings by Maconachie and Binns (2007), who noted similar transitions in West African communities affected by extractive industries. These findings collectively point to a growing precarity in riverine fishing communities impacted by gold mining. The disproportionate financial toll borne by residents of Sanwoma and Ajomoro Eshiem highlights both geographical and systemic vulnerabilities. While proximity to mining activity clearly influences the severity of impacts, the lack of coordinated institutional support or compensation further exacerbates these vulnerabilities. As suggested by Jönsson and Fold (2009), mining can entrench socio-economic marginalization when regulatory and support structures are absent or ineffective. Moreover, the responses illustrate how environmental degradation does not affect households equally. The downstream accumulation of pollutants and sediment, combined with poor infrastructure and limited public health resources, means that communities like Sanwoma shoulder not only the environmental burden but also the economic fallout. This aligns with broader critiques of environmental justice, which argue that low-income and marginalized groups often bear the brunt of ecological harm (Agyeman, Bullard, & Evans, 2002).

7.7.2 Level of resilience by community members to the impact illegal ASGM

The variations in self-reported resilience across Ajomoro Eshiem, Eziome, and Sanwoma reflect the differentiated capacities of small-scale fisheries communities to absorb, adapt, and potentially transform in the face of the gold mining-induced livelihood stress. The predominance of low resilience in all three communities—particularly in Sanwoma and Ajomoro Eshiem—raises concerns about the long-term viability of these communities under continued environmental and economic pressure. Resilience in the context of social-ecological systems is understood as the capacity to absorb disturbances while maintaining core functions and structures (Folke et al., 2002). The high proportion of individuals in Ajomoro Eshiem and Sanwoma reporting low

resilience suggests that gold mining has eroded critical elements of these systems—such as ecological integrity, economic stability, and social cohesion. In particular, livelihood dependence on riverine and near-shore fisheries, which are directly impacted by mining-related pollution and habitat degradation, appears to leave these communities highly vulnerable with limited fallback options.

The limited number of respondents reporting moderate resilience across all communities may reflect a polarization in adaptive capacity—where individuals either feel relatively helpless or believe they can cope, with few occupying a middle ground. This aligns with findings in the broader resilience literature, where capacity is often unevenly distributed based on factors such as access to alternative income, education, leadership support, and social networks (Adger, 2000). For instance, the slightly higher number of individuals reporting high resilience in Sanwoma compared to the other communities could be attributed to relatively better access to community networks or coping mechanisms—even if imperfect. However, the overwhelming dominance of low resilience responses underscores the structural limitations facing fishery-dependent communities. According to Cinner et al. (2009), resilience is deeply linked to social capital, governance, and institutional flexibility—all of which appear to be lacking or underdeveloped in the study areas. As shown in prior discussions, local leaders are seen as largely ineffective, and community support services are often inaccessible. These conditions compound the vulnerability of individuals and groups, making resilience an unlikely outcome unless there are significant external interventions or internal transformations.

The situation in Eziome, though involving a smaller sample size, mirrors the same dynamics: low resilience is the most common outcome, indicating that even relatively less directly impacted communities are not well-prepared to navigate the broader effects of regional environmental

degradation. Moreover, resilience is not just an individual attribute—it is a collective process shaped by shared resources, governance quality, and access to knowledge (Walker et al., 2004). In the absence of these enabling conditions, most community members may experience what Adger (2006) refers to as "resilience deficits," where they are exposed to shocks but lack the means to respond or recover adequately. These findings call for urgent attention to adaptive capacity-building in affected communities. Interventions must go beyond environmental remediation to include strengthening social institutions, supporting diversified livelihoods, and investing in participatory governance structures that empower communities to respond to change proactively. Building resilience in this context requires both bottom-up (community-driven) and top-down (policy-supported) efforts aimed at transforming vulnerability into viability.

7.7.3 Current compensation mechanisms provided by leaders or government for losses incurred due to illegal ASGM to fishers

Compensation, when well-designed, is meant to serve as both a remedy for harm and a means of restoring or enhancing livelihood resilience. However, as observed in this study, compensation efforts appear fragmented, insufficient, and poorly targeted. For instance, although initiatives such as skills training in soap-making and mushroom cultivation were mentioned by local NGOs and community members, these programs were neither widespread nor sustained, and their actual reach or economic viability remains questionable. This aligns with findings by Bebbington et al. (2008), who emphasize that development interventions framed as compensation often lack contextual sensitivity and do not adequately address the root causes of dispossession. Moreover, the perception of compensation as inadequate across all three communities—despite some NGO involvement—suggests a disconnect between aid providers and recipients. The responses highlight what Ferguson (1990) refers to as the "anti-politics machine" of development, where technical solutions like skill training are deployed without addressing the deeper political and structural

injustices communities face—such as land dispossession, environmental degradation, and exclusion from decision-making processes. As one respondent in Sanwoma noted, even these modest interventions occur infrequently or are absent entirely in the face of worsening conditions.

The Environmental Protection Agency’s recommendation of aquaculture and alternative livelihoods as compensation also raises critical questions. While diversification is an essential element of resilience-building (Allison & Ellis, 2001), these approaches must be matched with infrastructure, capital, and market access. In many cases, the burden of adaptation is placed solely on affected individuals, shifting responsibility away from the mining actors and government institutions whose actions or inactions created the vulnerability in the first place. This top-down framing of compensation fails to empower communities and risks reinforcing their marginalization. Sanwoma’s particularly strong dissatisfaction (with 167 individuals expressing dissatisfaction and 14 indicating being very dissatisfied) may stem from the intensity of mining impacts downstream, where cumulative environmental degradation is more visible and acute. This illustrates what Watts (1983) describes as a form of “structural violence,” where ecological and economic systems fail certain groups systematically, and recovery mechanisms are symbolic at best.

7.8 Community Engagement and Participation

7.8.1 Frequency of engagement in the communities related to illegal ASGM and fishing

The analysis of community engagement levels in discussions and forums related to gold mining and fishing across Sanwoma, Ajomoro Eshiem, and Eziome reveals notable disparities in civic participation. Sanwoma emerged as the most active community, with a significant proportion of respondents indicating at least occasional involvement, and a notable number engaging very often. This suggests a relatively vibrant civic environment and a possible tradition of local mobilization,

which is essential for adaptive governance and participatory resource management (Ostrom, 1990; Fabricius et al., 2007). Ajomoro Eshiem's more modest engagement levels reflect a mixed pattern, potentially pointing to variable access to information or differences in social capital. The fact that very few respondents reported frequent participation may signal disillusionment with participatory processes or a lack of meaningful outcomes from previous engagements. This aligns with Cooke and Kothari's (2001) critique of participation as a buzzword that often fails to translate into genuine empowerment or change, especially when forums are symbolic or externally driven. Eziome, the smallest and least engaged community, presents an important contrast. With minimal responses in higher engagement categories and several respondents stating they had "never" participated, this may indicate structural barriers such as isolation, low literacy levels, or exclusion from decision-making arenas. Majority of the responses related the community engagements to other matters but not with gold mining. The lack of basic infrastructure reported in Eziome—such as schools, electricity, or healthcare—may further hinder participation by limiting community cohesion and access to information. As Gaventa (2004) argues, power dynamics play a critical role in shaping who participates and who is left out of governance processes. Eziome's limited engagement could thus reflect a deeper marginalization that needs to be addressed through targeted outreach and capacity building. The findings also bring attention to the importance of inclusive participation in fostering local resilience and co-management of natural resources. Where community voices are absent or muted, adaptive responses to environmental threats like gold mining may be less effective or sustainable (Berkes et al., 2003). Enhancing participation, especially in underrepresented communities like Eziome, is therefore not only a matter of equity but also a strategic imperative for long-term sustainability.

7.8.2 Involvement of women in decision making regarding illegal ASGM impacts of fishery

The findings on women's involvement in decision-making related to gold mining impacts across Ajomoro Eshiem, Eziome, and Sanwoma reveal deeply entrenched gender disparities. Ajomoro Eshiem and Eziome both display limited participation of women, with a majority of respondents indicating women are “not involved at all” or “rarely involved.” This exclusion reflects longstanding patriarchal structures and gender norms that persist in many rural and resource-dependent communities, where men often dominate leadership and decision-making roles (Agarwal, 2001; Cornwall, 2003). In these two communities, the systemic marginalization of women can be seen as both a cause and consequence of their limited access to information, resources, and platforms for collective action. Gendered power imbalances—frequently unacknowledged in local governance—continue to undermine the contributions and rights of women, particularly in sectors like fisheries, where their roles in processing and marketing are often invisible in formal decision-making spaces (FAO, 2017). The exclusion of women from discussions on gold mining is particularly concerning, given that mining activities severely affect fishery-based livelihoods in which many women are directly engaged.

Sanwoma, however, presents a contrasting and more promising picture. While a significant number of respondents still perceived that women were “not involved at all,” the majority acknowledged at least “somewhat” or “high” involvement. This suggests that Sanwoma may be benefiting from either stronger grassroots mobilization, targeted interventions, or community leadership more open to inclusivity. Scholars such as Agarwal (1997) have shown that women's collective agency, when supported by institutional frameworks or civil society, can lead to greater voice and influence even in traditionally male-dominated sectors. The difference in Sanwoma's responses may also point to the influence of local NGOs, donor-funded programs, or education initiatives that empower women and foster a culture of participation. The involvement of organizations like Hen Mpoano

and the mention of training programs, though inconsistent, might be more established in Sanwoma. If so, it underscores the importance of institutional support in enabling women's civic engagement.

Despite these relative differences, the overarching trend across all three communities is clear: women's involvement in decisions that directly affect their livelihoods remains limited and conditional. The responses under the "rarely involved" category across all sites further highlight how participation, where it exists, is often symbolic rather than substantive. This resonates with critiques from feminist scholars who argue that token inclusion without real influence does not challenge underlying structures of power (Kabeer, 1999). The observed disparities call for deliberate, gender-sensitive interventions aimed at transforming the structures and practices that inhibit women's agency. Mechanisms such as gender quotas in local committees, capacity-building workshops, and inclusive participatory frameworks can serve to institutionalize women's roles in local governance. Moreover, promoting gender equity in decision-making is not merely a matter of fairness—it is a strategic imperative. Research shows that when women are meaningfully involved, decisions tend to be more equitable, sustainable, and reflective of broader community needs (Meinzen-Dick et al., 2014).

Chapter 8

Conclusion

8.0 Conclusion on all three objectives

This study has provided a comprehensive examination of the complex relationship between gold mining and small-scale fisheries in the Ankobra region. It has revealed how the nature of gold mining activities and the characteristics of the small-scale fisheries industry intersect to shape the environmental and socio-economic realities of local communities. The findings demonstrate that gold mining, often informal and inadequately regulated, has significantly altered the Ankobra River ecosystem, leading to pollution, habitat degradation, and declining fish populations. These environmental changes have disrupted traditional fishing livelihoods, which remain central to the cultural and economic fabric of the region. The competition for natural resources between mining and fishing activities has intensified vulnerabilities among fishing communities, particularly as they face reduced catches, income instability, and increased health risks.

In response to these challenges, small-scale fisheries have employed various adaptive strategies to sustain their livelihoods. Diversification into farming, petty trading, migration, and engagement in mining-related work reflect the communities' resilience but also highlight the precarious nature of these alternatives. The effectiveness of these adaptations is often constrained by limited access to capital, inadequate institutional support, and exclusion from decision-making processes that directly affect their lives and environment. The study underscores the critical importance of inclusive and participatory governance models that bring together fishers, miners, policymakers, and environmental agencies to collaboratively develop sustainable solutions. Strengthening regulatory frameworks, formalizing mining operations, and integrating community voices into resource management are essential to mitigating environmental harm and fostering socio-

economic resilience. Additionally, targeted support systems-such as skills development, microfinance, and cooperative initiatives-are needed to empower communities and facilitate transitions toward diversified, sustainable livelihoods. Ultimately, the future of the Ankobra region depends on a balanced and just approach that recognizes the intertwined nature of environmental conservation and economic well-being. By fostering collaboration, building social capital, and investing in community-driven development, it is possible to transform vulnerability into viability, ensuring that both the river's ecosystem and the livelihoods it supports are protected for generations to come.

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Appendix

Themes	Descriptions	Number of sources	Number of mentions
Governance and regulations	Government efforts to combat illegal gold mining	14	24
Compensation and collaborations	Efforts to compensate and work together	33	79
Environmental changes	Changes in the natural environment	39	121
Future aspirations and needs	Hopes and requirements for the future	28	59
Gender dynamics	Roles and impacts related to gender	21	44
Gold mining activities	Aspects of gold mining in the community and region at large	11	15
Characteristics of Small-Scale fisheries industry	Features of the fishing industry	9	12
Adaptive responses	How people adapt to challenges		
Health and Wellbeing	Impacts on physical and mental health	35	80
Interaction between gold mining and Small-Scale fisheries	How mining affects fishing	36	98
Knowledge gaps and miscommunication	Areas of missing or misunderstood info	34	63
Livelihood challenges	Difficulties in maintaining livelihoods	37	116
Policy and advocacy	Efforts to influence policy	30	66
Role of community leaders	Influence of local leaders	25	39
Social capital and network	Community relationships and support	29	58
Social inequality and vulnerability	Disparities and at-risk groups	34	62
Tradition and innovative coping mechanisms	Old and new ways of coping	37	103
Youth engagement	Involvement of young people	22	35