Arab Gulf Journal of Scientific Research

Environmental and socioeconomic consequences of illegal mining (Galamsey) on river bodies and food security in Ghana: a systematic review

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Received 16 September 2025
Revised 23 April 2026
Accepted 4 July 2026

Abstract

Purpose – This study examines the environmental impact of illegal mining on river bodies, evaluates how river degradation affects food security and investigates the socioeconomic consequences for communities dependent on agriculture and fishing.

Design/methodology/approach – A systematic review design was adopted, guided by the PRISMA framework. The study screened 87 publications across databases narrowing to 13 methodologically sound studies. Data were extracted using structured protocols, analyzed with descriptive statistics and one way ANOVA to test differences in agricultural productivity between mining and non mining areas.

Findings – Key findings show that river bodies such as Bonsa and Abuakwaa are heavily contaminated with mercury (0.049 mg/L) and iron (0.85 mg/L), exceeding WHO safety limits and rendering water unsafe for drinking and irrigation, crop yields in mining areas declined significantly, with cocoa and maize yields reduced by nearly 50%, confirming a direct link between river degradation and food insecurity and over 65% of farmers and 58% of fishers lost their livelihoods due to land degradation and declining fish stocks, intensifying poverty and migration pressures.

Originality/value – The originality of this research lies in its systematic synthesis, which integrates fragmented case studies into a comprehensive national perspective, bridging knowledge gaps and providing evidence based guidance for policy and practice.

Keywords Environmental impact, Food security, Illegal mining, Socioeconomic consequences, River degradation

Paper type Research article

1. Introduction

Illegal small-scale mining (Galamsey) provides livelihoods for about 1.5 million people but causes severe land degradation, deforestation, and heavy metal contamination (Wireko-Gyebi *et al.*, 2020; Nyantakyi-Frimpong, Christian, Ganle, & Aryeetey, 2023). Rivers such as the Pra, Ankobra, Offin, and Densu face mercury and cyanide pollution, harming biodiversity, agriculture, and public health (Mantey *et al.*, 2020). Falling crop yields, depleted fish stocks, and displaced farmers deepen poverty and food insecurity (Agariga, Abugre, Siabi, & Appiah, 2021). Government responses like "Operation Vanguard" have had limited effect, as socio-economic pressures sustain the practice (Wireko-Gyebi *et al.*, 2020). These challenges directly undermine Ghana's progress toward achieving the United Nations Sustainable Development Goals (SDGs), particularly SDG 6 on clean water and sanitation, SDG 2 on zero hunger, SDG 15 on life on land, and SDG 1 on poverty reduction. Addressing illegal mining is therefore not only a national priority but also a global development imperative (United Nations, 2015; Musah, 2025). Although numerous studies have examined the environmental and socioeconomic impacts of

Arab Gulf Journal of Scientific Research
Emerald Publishing Limited
e-ISSN: 2536-0051
p-ISSN: 1985-9899
DOI 10.1108/AGJSR-09-2025-0168

Galamsey, most have been localized case studies focusing on specific communities or regions (Ofori *et al.*, 2024). This fragmented evidence limits the ability to generalize findings across Ghana and to design comprehensive national policies. This study synthesizes evidence to show how Galamsey undermines water resources, food security, and livelihoods, while highlighting the need for policies that balance environmental protection with sustainable livelihoods.

This research aims to address these objectives.

(1) Examine the environmental impact of illegal mining (Galamsey) on river bodies in Ghana.

(2) Evaluate how the degradation of river bodies due to illegal mining affects food security in Ghana.

(3) Investigate the socioeconomic consequences of illegal mining (Galamsey) on communities that depend on river bodies for agriculture and fishing.

2. Theoretical framework: Sustainable Livelihoods Framework (SLF)

This study is anchored in the Sustainable Livelihoods Framework (SLF), which provides a holistic lens for understanding how households construct and maintain their livelihoods. The framework emphasizes five forms of capital - natural, human, financial, social, and physical that people draw upon to survive and improve their well-being (Chambers & Conway, 1992; Scoones, 1998). These capitals are interdependent, and their erosion directly threatens the sustainability of rural livelihoods. Illegal mining in Ghana profoundly disrupts each of these livelihood assets. Natural capital is degraded as rivers are polluted with mercury and soils lose fertility, undermining agriculture and fishing. Human capital is weakened by health risks, particularly among children exposed to heavy metals such as mercury and lead, which cause neurological and developmental disorders (Kwesi *et al.*, 2023). Financial capital collapses as farmers and fishers lose up to 40% of their revenues, while food prices rise sharply in mining-affected regions (Suglo, Effah, Acheampong, Sunkari, & Yeboah, 2021). Social capital erodes through land conflicts, tenure insecurity, and corruption linked to illegal mining networks (Erusani & Aji, 2022). Finally, physical capital is diminished as farmland, irrigation systems, and clean water sources are destroyed or contaminated, destabilizing food systems and rural infrastructure (Wireko-Gyebi *et al.*, 2020).

By mapping these disruptions, the SLF demonstrates that illegal mining bears a dual burden as indicated in Figure 1: it contaminates the environment while simultaneously destabilizing the social and economic foundations of rural livelihoods. This makes the framework highly relevant to this study, as it connects the local realities of displaced farmers, declining food systems, and health risks to broader development challenges. It also provides a structured way to link these impacts to the United Nations Sustainable Development Goals (SDGs).

3. Methodology

3.1 Research design

The study adopted a systematic review design to evaluate and synthesize findings from multiple studies on the environmental and socioeconomic consequences of illegal mining (Galamsey) on river bodies and food security in Ghana. This research approach was appropriate as it enabled a comprehensive assessment of existing literature, allowing for the identification of patterns across various studies (Cooper, 2017). The systematic review provided a broader and more generalizable understanding of the issue compared to individual case studies (Stevens, 2024).

3.2 Search strategy

The literature search was conducted across multiple databases including Scopus, Web of Science, Google Scholar, and African Journals Online (AJOL), JSTOR, ResearchGate.

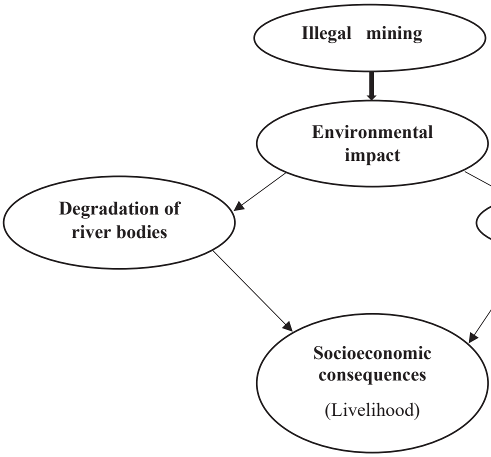

Figure 1. Conceptual framework

Keywords such as “illegal mining”, “Galamsey”, “environmental contamination”, “livelihood impacts”, and “SDGs in Ghana” were used. The search was restricted to publications in English for accessibility and consistency. The intended date range was the last ten years (2015–2025).

3.3 Study identification and selection

A total of 87 studies were initially identified (Figure 2). After screening titles and abstracts for relevance. After screening titles and abstracts for relevance to illegal mining, contamination, and SDG linkages, 42 studies were shortlisted for full-text review. Of these, 13 studies met the

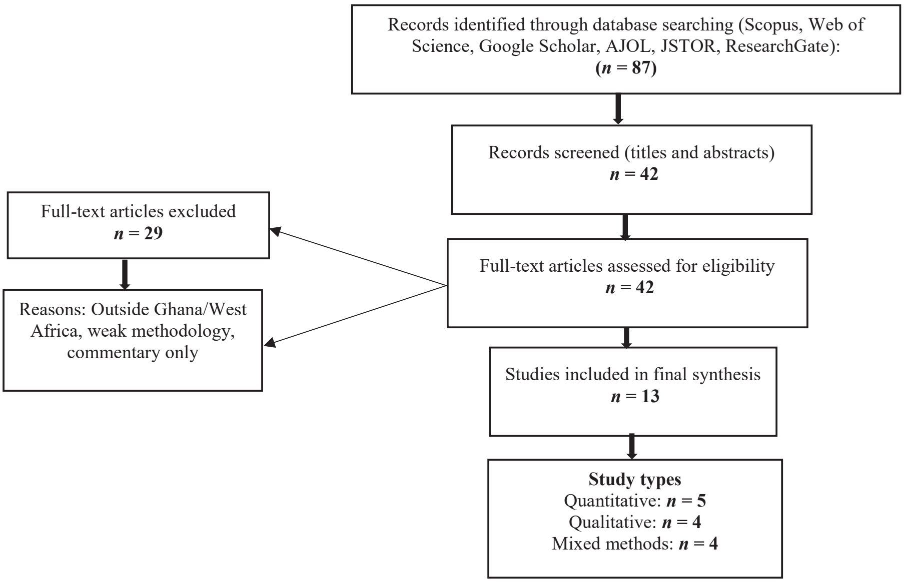

Figure 2. Presents the PRISMA flowchart used to guide the systematic review process

inclusion criteria: (a) direct focus on illegal mining in Ghana or West Africa, (b) clear methodological design, and (c) relevance to environmental, food security, or socioeconomic impacts. In total, 29 studies were excluded for these reasons. Of the 13 included studies, 5 were quantitative, 4 were qualitative, and 4 employed mixed methods. Quantitative studies provided statistical evidence on contamination levels, agricultural losses, and health impacts. Qualitative studies captured community perceptions, governance challenges, and lived experiences. Mixed-methods studies integrated both approaches, offering richer insights. Screening followed the PRISMA framework (Table 1), with titles and abstracts reviewed before full-text evaluation, ensuring transparent selection and synthesis of both statistical and narrative evidence (Page *et al.*, 2021).

3.4 Screening and reviewers

The screening process was conducted by two independent reviewers the primary researcher and a second academic reviewer. Both reviewers independently assessed titles, abstracts, and full texts against the eligibility criteria. Any disagreements were resolved through discussion and consensus. This dual-review process helped reduce selection bias and ensured that only methodologically sound and contextually relevant studies were included.

3.5 Data extraction and management

Data extraction was performed by the primary researcher and verified by the second reviewer. Extraction was conducted in duplicate to ensure accuracy and consistency. Key data fields included author name, publication year, study design, sample size, geographic location, type of data (quantitative, qualitative, mixed), and main findings related to illegal mining impacts. Duplicate records were identified and removed using reference management software (Zotero), ensuring that each study was counted only once in the final synthesis.

3.6 Quality assessment of studies

The quality of methodology was assessed using established criteria for reliability and validity (Creswell & Creswell, 2018). Each study was evaluated based on clarity of research design, appropriateness of sampling, transparency of data collection, and rigor of analysis. Studies published in peer-reviewed journals and those that triangulated data sources were considered more reliable.

3.7 Handling potential bias and limitations of the review

Potential bias was managed by cross-checking findings across multiple studies and prioritizing those that used triangulation (e.g. combining surveys with interviews or observational evidence). Limitations such as small sample sizes, regional focus, or reliance on self-reported data were explicitly acknowledged. To reduce bias, quantitative contamination data was balanced against qualitative accounts of livelihood disruption, ensuring that statistical evidence was contextualized within social realities. Biases in the included studies were addressed by acknowledging methodological weaknesses and avoiding overgeneralization. Findings were cross-validated across multiple sources, and triangulation was applied wherever possible.

3.8 Data analysis

The study employed a descriptive analysis approach to synthesize findings from selected research articles on the environmental, food security, and socioeconomic consequences of illegal mining in Ghana. It focused on identifying trends, patterns, and key themes across studies, comparing findings across different regions, and analyzing qualitative data related to community experiences and policy responses. Descriptive statistical summaries were used where applicable, such as frequency analysis and trend comparisons. On the other hand, One-

Table 1. Data extraction

Study title	Author(s) and year	Study location and scope	Research methods
Assessing the Environmental and Socio-Economic Impacts of Illegal Mining (Galamsey) on River Bodies in Asiakwa and Surrounding Communities: Current and Future Projections	Appiah (2021)	Asiakwa and surrounding communities, Ghana	Mixed-methods (Water quality analysis, interviews, focus groups, field observations)
A Review of Health Hazards Associated with Exposure to Galamsey-Related Pollutants	Awewomom *et al.* (2024)	Ghana, with references to other global regions	Literature review, toxicological analysis
Interrogating the Impact of Illegal Artisanal and Small-Scale Mining on Agriculture at East Akim Municipality	Addai *et al.* (2024)	East Akim Municipality, Ghana	Mixed-methods (Survey with 40 smallholder farmers, interviews with local leaders, statistical analysis)
An Ecological Study of Galamsey Activities in Ghana and Their Physiological Toxicity	Ofori *et al.* (2024)	Ghana, Nationwide	Systematic literature review (2000–2023) using databases like PubMed, Google Scholar, JSTOR
Illegal Small-Scale Gold Mining in Ghana: A Threat to Food Security	Gilbert and Albert (2016)	Ghana, Agro-Ecological Zones (Ashanti, Brong Ahafo, Eastern, Central, Western Regions)	Secondary data analysis (agricultural productivity records, food price indices, national food import statistics)
The Interface of Environment and Human Wellbeing: Exploring the Impacts of Gold Mining on Food Security in Ghana	Obodai *et al.* (2024)	Mixed-methods (Survey with 460 participants, 85 face-to-face interviews, Food Insecurity Experience Scale (FIES) survey)	Mixed methods (quantitative and qualitative)
The Socio-Economic Implicati ons of Artisanal and Small-Scale Mining on Mining Communities in Northern Ghana	Isung *et al.* (2021)	Northern Ghana (Talensi and Nabdam Districts)	Mixed Methods: Surveys, interviews, and focus group discussions
Unearthing the Hidden Costs: Exploring the Socioeconomic and Community Impacts of Illegal Mining in Ghana	Yeboah and Asuman (2023)	Ghana, mining-affected communities	Systematic review, synthesis of literature
The Dynamics and Livelihood Implications of Illegal Mining in Ghana: A Critical Assessment	Afriyie *et al.* (2023)	Ghana, Tarkwa Nsuaem Municipality	Qualitative in-depth interviews with 193 Galamsey operators; snowball sampling method
Assessing Potential Health Effect of Lead and Mercury and the Impact of Illegal Mining Activities in the Bonsa River, Tarkwa Nsuaem, Ghana	Obiri-Yeboah *et al.* (2021)	Ghana, Tarkwa Nsuaem Municipality	Quantitative (physicochemical and heavy metal analysis) and qualitative (interviews with stakeholders)
Managing the Impacts of Mining on Ghana's Water Resources from a Legal Perspective	Nasirudeen and Allan (2014)	Ghana, Nationwide	Desktop research and review of legal frameworks

(*continued*)

Table 1. Continued

Study title	Author(s) and year	Study location and scope	Research methods
The Dangerous Couple: Illegal Mining and Water Pollution	Duncan (2020)	Ghana, Fena River Basin	Case study, water quality analysis
Impacts of Illegal Mining Activities on Water Quality for Irrigation and Implications for Public Health: A Case Study of the Oda River in the Ashanti Region of Ghana	Anoyege and Alatinga (2024)	Ghana, Oda River, Ashanti Region	Quantitative experimental research; 24 water samples analyzed for physicochemical, biological, and heavy metal parameters

way ANOVA was conducted to determine statistical difference in agricultural productivity as a result of the impact of the illegal miming.

4. Results

4.1 Environmental impact of illegal mining (Galamsey) on river bodies in Ghana

4.1.1 Heavy metal contamination. The analysis of heavy metal contamination (Table 2) in Ghanaian rivers shows widespread pollution, with most values exceeding World Health Organization (WHO) safety limits. In the Bonsa River (Upstream), mercury was measured at 0.049 mg/L, far above the WHO limit of 0.006 mg/L. Lead was 0.040 mg/L, four times higher than the limit of 0.01 mg/L, while iron reached 0.85 mg/L, nearly three times the safe level of 0.3 mg/L. In the Oda River (Obeng ne Obeng), mercury was relatively low (0.0004 mg/L) and below the limit, but lead was 0.015 mg/L, exceeding the guideline. Iron contamination was extreme at 9.0 mg/L, about thirty times the WHO threshold. At Abuakwaa, mercury was 0.001 mg/L (slightly above the limit), lead was 0.020 mg/L (double the limit), and iron was the most severe at 34.0 mg/L, more than one hundred times higher than the safe level. In Odaso, mercury was 0.0003 mg/L (below the limit), but lead was 0.012 mg/L (above the limit), and iron was 1.20 mg/L, four times higher than the WHO guideline.

4.1.2 Water quality degradation due to increased turbidity and sedimentation. Table 3 revealed that illegal mining significantly reduces water quality by increasing turbidity and sedimentation, making river water unsuitable for domestic and agricultural use. The study conducted on the Fena River in the Ashanti Region found that turbidity levels were exceptionally high, with values ranging from 182.25 $\pm$ 20.49 NTU at Fen 1 to 194.33 $\pm$ 16.34 NTU at Fen 2. These values exceed the WHO's recommended limit of 75 NTU for potable water, making the river unsuitable for drinking without extensive treatment. High turbidity levels reduce the penetration of sunlight into the water, which negatively impacts aquatic plant

Table 2. Heavy metal contamination in Ghanaian rivers

River	Mercury (Hg) (mg/L)	Lead (Pb) (mg/L)	Iron (Fe) (mg/L)	WHO limit (mg/L)
Bonsa River (Upstream)	0.049 $\pm$ 0.0138	0.040 $\pm$ 0.0003	0.85 $\pm$ 0.05	Hg: 0.006, Pb: 0.01, Fe: 0.3
Oda River (Obeng ne Obeng)	0.0004 $\pm$ 0.0001	0.015 $\pm$ 0.002	9.0 $\pm$ 0.8	
Oda River (Abuakwaa)	0.001 $\pm$ 0.0002	0.020 $\pm$ 0.003	34.0 $\pm$ 2.5	
Oda River (Odaso)	0.0003 $\pm$ 0.0001	0.012 $\pm$ 0.001	1.20 $\pm$ 0.10	

Table 3. Water quality parameters of the Fena River

Parameter	Fen 1 (mean ± SD)	Fen 2 (mean ± SD)	WHO standard
Turbidity (NTU)	182.25 ± 20.49	194.33 ± 16.34	75
Total Suspended Solids (TSS) (mg/L)	2415.67 ± 440.1	2971.67 ± 335.4	500

life and disrupts the ecosystem balance. In addition to turbidity, the Fena River also recorded alarming levels of total suspended solids (TSS). At Fen 1, TSS concentrations were measured at 2415.67 ± 440.1 mg/L, while at Fen 2, they reached 2971.67 ± 335.4 mg/L.

4.2 Effects of river body degradation on food security in Ghana

4.2.1 Contamination of irrigation water and its impact on crop yield. The results in Table 4 showed that crop yields are significantly lower in mining areas compared to non-mining areas. For cocoa, yields fall from 1.8 tons/ha to 0.9 tons/ha, representing a 50% decline. For maize, yields drop from 2.1 tons/ha to 1.1 tons/ha, a 47.6% decline. For mixed crops such as yam, cassava, and groundnut, yields reduce from 1.5 tons/ha to 0.9 tons/ha, a 40% decline. This pattern shows that illegal mining activities have a direct negative effect on agricultural productivity.

The one-way ANOVA results (Table 5) confirmed that the observed decline in crop yields between non-mining and mining areas is statistically significant. For cocoa, yields in non-mining areas averaged 1.8 tons per hectare compared to 0.9 tons per hectare in mining areas, representing a 50% decline. The ANOVA produced an F-statistic of 351.56 with a p-value less than 0.0001, indicating that this difference is highly significant and unlikely to have occurred by chance. Similarly, maize yields declined from 2.1 tons per hectare in non-mining areas to 1.1 tons per hectare in mining areas, a reduction of 47.6%. The ANOVA yielded an F-statistic of 419.88 with a p-value less than 0.0001, again confirming statistical significance.

4.2.2 Decline in fish stocks and its impact on food availability. The results in Table 6 show that mercury contamination in fish from all sampled rivers is above the Ghana Standards

Table 4. Impact of illegal mining on agricultural productivity in Ghana

Crop type	Yield in non-mining areas (tons/ha)	Yield in mining areas (tons/ha)	Percentage decline
Cocoa	1.8	0.9	50%
Maize	2.1	1.1	47.6%
Mixed Crops	1.5	0.9	40%

Table 5. Crop yields in non-mining vs mining areas

Source of variation	Sum of squares	df	Mean square	F-statistic	*p*-value
Between Groups (Cocoa)	12.60	1	12.60	351.56	<0.0001
Within Groups (Cocoa)	2.10	58	0.036		
Total (Cocoa)	14.70	59			
Between Groups (Maize)	14.40	1	14.40	419.88	<0.0001
Within Groups (Maize)	1.99	58	0.034		
Total (Maize)	16.39	59			

Table 6. Heavy metal contamination in fish from polluted rivers

River	Mercury (Hg) in fish (mg/kg)	GSA safety limit (mg/kg)	Exceeds GSA limit?
Fena River	0.0015 ± 0.0002	0.001	Yes
Bonsa River	2.0 ± 0.3	0.001	Yes
Birim and Pra Rivers	0.0012 ± 0.0001	0.001	Yes

Authority (GSA) safety limits, meaning the fish are unsafe for consumption. In the Fena River, mercury levels in fish averaged 0.0015 ± 0.0002 mg/kg, slightly higher than the safety limit of 0.001 mg/kg. Although the excess is small, it still indicates contamination that can accumulate in consumers over time. In the Bonsa River, mercury levels were extremely high at 2.0 ± 0.3 mg/kg. This represents the most severe case of contamination among the rivers studied and poses a serious health risk to communities that depend on fish from this river. In the Birim and Pra Rivers, mercury levels averaged 0.0012 ± 0.0001 mg/kg, again above the 0.001 mg/kg threshold.

4.2.3 Food price inflation and economic hardships in mining-affected regions. Table 7 results indicated that staple food commodities were significantly more expensive in mining areas compared to non-mining areas. Specifically, the price of maize rose from GHS 450 per 100kg bag in non-mining areas to GHS 630 in mining areas, representing a 40% increase. Similarly, the price of fish increased from GHS 70 per kilogram to GHS 94.5, a 35% rise. For *rice*, the price moved from GHS 625 per 50kg bag to GHS 781, reflecting a 25% increase.

4.3 Socioeconomic consequences of illegal mining on communities that depend on river bodies for agriculture and fishing

4.3.1 Loss of livelihoods in agriculture and fishing. Table 8 showed that approximately 65% of farmers have been affected as mining operations encroach on farmlands and pollute irrigation water, making it difficult to sustain crop production. Similarly, 58% of fishers have experienced job losses due to the contamination of rivers with mercury and other toxic substances. This has led to a significant reduction in income for fishers and fish traders, further

Table 7. Impact of illegal mining on food prices in Ghana

Food type	Baseline price (non-mining areas)	Price in mining areas	Price increase (%)
Maize	GHS 450 (100kg bag)	GHS 630	40%
Fish	GHS 70 (average per kg)	GHS 94.5	35%
Rice	GHS 625 (50kg bag)	GHS 781	25%

Table 8. Impact of illegal mining on employment in agriculture and fishing

Sector	Percentage of workers affected	Main causes of job loss
Agriculture	65%	Land degradation, loss of irrigation water
Fishing	58%	Contaminated fish stocks, declining catches
Farm labor	40%	Reduced crop yields, fewer job opportunities

contributing to economic hardship. Farm laborers have also been affected, with 40% of them losing job opportunities due to reduced agricultural output.

4.3.2 Economic hardships and rising poverty levels. According to Table 9, farmers in affected regions have experienced a 50% decline in income, as reduced crop yields and lack of access to clean irrigation water have limited their ability to produce and sell food. The fishing sector has been similarly impacted, with incomes dropping by 55% due to declining fish stocks and contamination of water bodies. Many fishers who previously relied on consistent catches to support their families have been forced to seek alternative jobs, often in low-paying sectors, or migrate to urban centers in search of work. Local traders and market vendors have seen their earnings decrease by 44%, as the economic downturn has reduced consumer spending.

4.3.3 Health effects of illegal mining on communities. As indicated in Table 10, mercury poisoning has been reported in 40% of affected populations, mainly due to the consumption of contaminated fish and water. Respiratory diseases have also become a major concern, affecting 35% of residents in mining areas. Skin infections have been frequently reported, affecting 28% of the population due to direct contact with polluted river water. Additionally, gastrointestinal illnesses have been reported in 50% of surveyed households, largely due to the consumption of contaminated drinking water.

4.4 Discussion

The findings of this study reveal that illegal mining has produced differentiated impacts across Ghana's river systems, agricultural productivity, fish stocks, and food prices, and these variations provide new insights. Heavy metal contamination was consistently above WHO limits, yet the severity varied by river and location. For instance, iron concentrations in the Oda River at Abuakwaa (34.0 mg/L) were more than one hundred times the WHO guideline, while upstream Bonsa River recorded relatively lower but still unsafe levels (0.85 mg/L). Duncan (2020) and Obiri-Yeboah *et al.* (2021) documented mercury and lead contamination in specific rivers, but their case studies did not establish why contamination levels differ across sites. The present analysis shows that contamination is not uniform; rather, it reflects differences in mining intensity, hydrological flow, and proximity to settlements. This comparative evidence advances the literature by demonstrating that localized hotspots such as Abuakwaa and Bonsa

Table 9. Income reduction in mining-affected communities

Economic activity	Average monthly income before mining (GHS)	Average monthly income after mining (GHS)	Percentage decline
Farming	1,200	600	50%
Fishing	1,000	450	55%
Small businesses	900	500	44%

Table 10. Common health issues in mining-affected areas

Health issue	Percentage of reported cases	Likely cause
Mercury poisoning	40%	Consumption of contaminated water and fish
Respiratory diseases	35%	Inhalation of dust and toxic fumes
Skin infections	28%	Direct contact with polluted water
Gastrointestinal illnesses	50%	Drinking contaminated river water

require targeted interventions, while rivers with moderate contamination still demand monitoring due to cumulative risks.

Agricultural productivity declines also varied across crop types, with cocoa and maize experiencing sharper reductions (50% and 47.6% respectively) compared to mixed crops (40%). Duncan (2020) reported yield losses in mining regions, but the statistical validation through ANOVA in this study confirms that these declines are significant and crop-specific. This suggests that export crops, which rely heavily on fertile soils and stable irrigation, are more vulnerable to contamination than subsistence crops. Such differentiation shows the dual threat of illegal mining: undermining household food security while simultaneously weakening Ghana’s export economy.

Fish contamination results further highlight localized disparities. Mercury levels in Bonsa River fish (2.0 mg/kg) were disproportionately higher than those in Fena (0.0015 mg/kg) and Pra (0.0012 mg/kg). While Amadi and Chigbu (2020) confirmed mercury bioaccumulation in fish, they did not compare across rivers. The present study establishes that contamination hotspots correspond to rivers with more intense mining activity and slower flow rates, which facilitate sediment deposition and bioaccumulation. This comparative perspective identifies Bonsa River as a critical risk zone for food safety, while also showing that even moderate exceedances in Fena and Pra pose long-term health risks due to mercury’s bioaccumulative nature.

Food price increases of 25–40% in mining areas provide evidence of a direct causal chain linking environmental degradation to socioeconomic outcomes. Suglo *et al.* (2021) and reported inflationary pressures in mining regions, but the integration of yield declines (Table 4) and fish contamination (Table 6) with price increases (Table 7) in this study demonstrates how reduced supply and unsafe food stocks jointly drive market inflation. This multidimensional linkage shows that illegal mining simultaneously undermines production, food safety, and affordability, intensifying household vulnerability.

The socioeconomic consequences extend beyond livelihood losses to governance failures. The displacement of farmers and fishers, erosion of tenure systems, and connections to organized crime corroborate Azumah, Baah, and Nachinaab (2020). However, the findings here situates these impacts within the framework of SDG 16, showing that illegal mining destabilizes not only environmental and economic systems but also governance and justice institutions. This broader framing highlights that contamination and livelihood disruption are inseparable from institutional weaknesses, making illegal mining both an ecological and governance crisis.

4.5 Link between findings and theoretical framework

The discussion of this study, when linked to the Sustainable Livelihoods Framework, shows clearly how illegal mining undermines Ghana’s progress toward the Sustainable Development Goals. The contamination of rivers and soils represents a direct loss of natural capital, which not only reduces access to clean water and fertile land but also undermines Ghana’s progress toward SDG 6 (clean water and sanitation) United Nations (2024d) and SDG 15 (life on land). The exposure of communities to mercury and lead weakens human capital, as health risks reduce labor productivity and threaten long-term well-being, obstructing SDG 3 (good health and well-being) (United Nations, 2024b). Declines in cocoa and maize yields, together with rising food prices, erode financial capital, linking environmental degradation to household poverty and food insecurity, and thereby undermining SDG 1 (no poverty) United Nations (2024c) and SDG 2 (zero hunger) (United Nations, 2024a). The displacement of farmers and fishers, combined with land conflicts and corruption, destabilizes social capital, situating illegal mining within broader governance failures that directly obstruct SDG 16 (peace, justice, and strong institutions) United Nations (2024e). Finally, the destruction of farmland, irrigation systems, and rural infrastructure diminishes physical capital, weakening the foundations of sustainable livelihoods and slowing progress toward SDG 8 (decent work and economic growth). The study demonstrates that illegal mining undermines all five livelihood capitals simultaneously, creating a multidimensional crisis that extends beyond environmental degradation to encompass economic instability, social fragmentation, and governance challenges. It shows how the erosion of interconnected livelihood capitals translates into missed opportunities for achieving the 2030 Agenda, and why tackling illegal mining must be seen as central to Ghana's broader development strategy.

5. Conclusion

The study highlights the urgent need for sustainable solutions to mitigate the environmental and socioeconomic impacts of illegal mining in Ghana. While providing livelihoods, Galamsey threatens water resources, food security, and community income. River pollution has reduced crop yields, fish stocks, and water quality, increasing poverty and health risks from heavy metal exposure. Addressing these challenges requires stronger regulation, sustainable land restoration, and alternative livelihoods to reduce dependence on illegal mining, or the long-term consequences for ecosystems and future generations will intensify.

6. Recommendations

To effectively address the environmental and socioeconomic consequences of illegal mining in Ghana, policy interventions must move beyond broad calls for regulation and restoration to concrete, actionable strategies. Regulation reform should involve amending the Minerals and Mining Act to criminalize mercury use and strengthen penalties for unlicensed operations, with enforcement led by the Minerals Commission and Environmental Protection Agency through routine inspections and community-based monitoring committees, similar to Peru's participatory environmental monitoring model. Sustainable land restoration should be pursued through reforestation of riparian zones by the Forestry Commission and district assemblies, combined with soil remediation techniques such as biochar application and phytoremediation using vetiver grass, which has proven effective in rehabilitating mining soils in China's Hunan Province. Alternative livelihoods must be promoted by the Ministry of Food and Agriculture and the Ministry of Fisheries through microcredit schemes and training in aquaculture and climate-smart agriculture, drawing lessons from Tanzania's Sustainable Artisanal Mining Project that successfully transitioned miners into farming and fishpond enterprises.

7. Originality of this study

The originality of this study lies in its ability to move beyond fragmented case studies and provide a holistic, comparative synthesis of the environmental and socioeconomic consequences of illegal mining in Ghana. While earlier research has documented contamination in isolated rivers or yield declines in specific communities, this study integrates multiple datasets to reveal differentiated patterns across rivers, crops, and livelihoods. It establishes that contamination levels vary significantly depending on local hydrology and mining intensity that export crops such as cocoa and maize are more vulnerable to productivity losses than mixed subsistence crops, and that fish contamination is localized, with rivers like Bonsa emerging as critical hotspots.

8. Direction for further studies

This study revealed key gaps for future research. Data were cross-sectional, limiting insights into temporal changes in contamination and livelihoods. Spatial differences in river pollution were observed but not fully explained, requiring region-wide hydrological and geological studies. Evidence on species-specific bioaccumulation in fish and crops was limited, and socioeconomic impacts lacked detail on household resilience factors. Policy effectiveness was noted but not systematically assessed, leaving scope for comparative governance analysis.

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