The Ecological Damage of Illegal Mining in Water Bodies and Forest Management in Ghana

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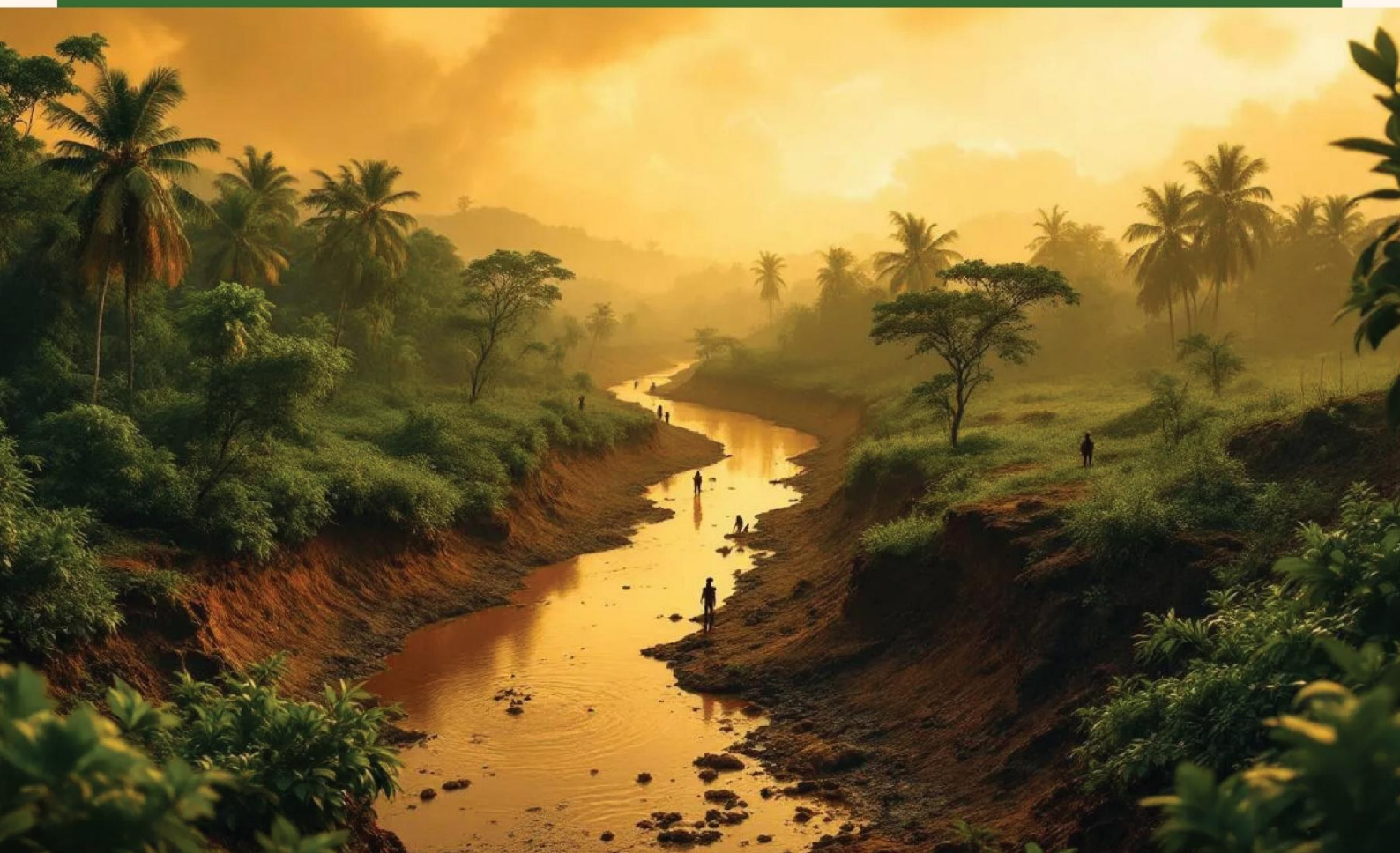

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1. Introduction

Ghana occupies an estimated total land area of 23 884 245 hectares with a 550 km long coastline. The estimated national population is around 35 million, with a growth rate of 2.5% per annum (GSS, 2024). The country is endowed with substantial mineral resources such as gold, diamonds, manganese and bauxite throughout its ecological zones, and is one of the main gold producing countries of the world. Gold mining constitutes a greater portion of the country's Gross National Product (GNP) accounting for over 90% of all mineral revenues annually and paradoxically, it is the bedrock of the country's Economic Recovery Programme. In 2023, Ghana was ranked as Africa's largest gold producer and the 10th largest globally, with gold production rising from 3.7 million ounces in 2022 to 4 million ounces in 2023; and the sector accounted for 8.8% of domestic revenue, 8.6% of total government revenue and about 8.1% of its Gross Domestic Product (GDP), including quarry. The production growth was driven primarily by the expansion in the output of small-scale gold mining (Ghana Chamber of Mines, 2024).

For the past two decades, the Small-Scale Mining (SSM) sector has evolved in terms of scale and significance. There is an upsurge in the number of individuals involved in the sector and an increase in mechanisation within the artisanal small-scale mining (ASM) operations, these, contributing to the output of the sector. Small-scale mining is widely undertaken in the country by both licensed and unlicensed operators, and has been carried out for many years – dating back to over 1000 years, generating employment.

The socio-economic impact of illegal small-scale mining in Ghana is multifaceted. It accounts for about 35% of the country's total gold production and contributes significantly to the total amount of gold reserves (Adranyi et al., 2024). By the end of May 2025, the sector's total gold export reached a new record of 41 tonnes, which translated into $4 billion (EnergyCapital Power, 2025). Illegal small-scale mining is a major source of livelihood for most rural populations across the country. It provides employment to many youth and unskilled labourers; particularly, in rural areas where formal employment opportunities are few (Bansah et al., 2018). For some time now, it has been estimated that illegal mining provides direct employment to about one million people (see McQuilken and Hilson, 2016), with another innumerable figure benefiting indirectly from illegal mining operations. Illegal mining, for example, provides raw materials to local Blacksmiths for making jewelry (Bansah et al., 2018). Considering the upsurge in the scale of operations over the years, this figure is clearly an underestimation. Baddianaah et al. (2022) pointed out that about 70% of locals in gold-endowed areas engage in illegal mining due to poverty and lack of lucrative alternative livelihoods. This has resulted in social impacts such as increased teenage pregnancies and school drop-outs, poor levels of education and child labour. According to Osei et al. (2022), illegal mining plays a pivotal role for miners; thus, a ban on ASM operations has devastating effects such

as job loss and financial hardship for many. A ban on illegal small-scale mining can be a catalyst for worsening poverty levels among miners and communities that depend on galamsey for survival (Dery Tuokuu et al., 2020).

Despite its socio-economic relevance, illegal small-scale mining is a double-edged sword. While it offers significant livelihood opportunities to millions, its unregulated nature generates severe ecological repercussions that derail development. Environmental contamination by exploitation of gold has become a serious problem in Ghana, and presently illegal small-scale mining seems to be better known for its deleterious effects on the environment than for its socio-economic importance. The ecological impact of illegal mining is so dire that it overshadows any potential benefits the sector offers. For the purpose of this undertaking, the focus is an in-depth analysis of the negative ecological implications of illegal mining in Ghana.

Ghana faces an unprecedented environmental crisis due to illegal small-scale mining activities, commonly known as "galamsey". This rampant practice has devastated vast areas of the country's landscape, contaminated water bodies (about 60%) and degraded fertile soils through the indiscriminate use of toxic chemicals like mercury, cyanide, arsenic and lead. These pollutants have rendered many water sources unsafe for drinking (without treatment), irrigation, or aquatic life, bioaccumulating in fish and entering the human food chain. The consequences extend beyond environmental damage to threatening public health, food security, and the livelihoods of millions who depend on these natural resources.

The effects of these heavy metals on humans range from mild eye, nose and skin irritations through severe headache, stomach ache, diarrhea, hematemesis, vomiting, dizziness, to organ dysfunction and deformities. Mercury (Hg) contamination by gold (Au) mining activities is also a great concern in Ghana because Hg is used to effectively extract gold in small-scale mining. Mercury was not utilised in artisanal (small-scale) gold extraction. Its use began only about 45 years ago when it became too difficult for small-scale miners to extract gold from rocks. This has attracted a growing number of people with minimal skill to use mercury to extract gold making the chemical ubiquitous in mining sites. The optimal Hg to Au ratio (Hg:Au) is about 1 (v/v), but gold washers in Ghana commonly add greater quantities (Hg:Au = 4:1) to ensure that all available gold is amalgamated (Babut et al., 2003). Therefore, Hg may be inhaled by the workers and also contaminate soils, tailings, stream sediments and water close to the processing sites. Indeed, Hg pollution of river water, sediments, soil and mine workers in Ghana has been widely documented (Golow and Adzei, 2002; Adimado and Baah, 2002; Golow and Mingle, 2003; Babut et al., 2003) and it is likely that some small-scale miners have died through Hg intoxication. Figure 1 shows the flow sheet of artisanal (small-scale) gold extraction in Ghana.

Figure 1: A typical flow sheet of artisanal (small-scale) gold extraction in Ghana.

When mercury is brought into contact with gold particles in sediments or crushed ore, it forms an "amalgam" - a soft mixture of roughly 50% mercury and 50% gold. To recover gold from the amalgam, it is heated to evaporate the mercury, leaving the gold behind. In the course of their activities and through heating, mercury is released into the atmosphere and ecosystem contaminating water bodies, fish, soil, vegetables and crops as depicted in Figure 2.

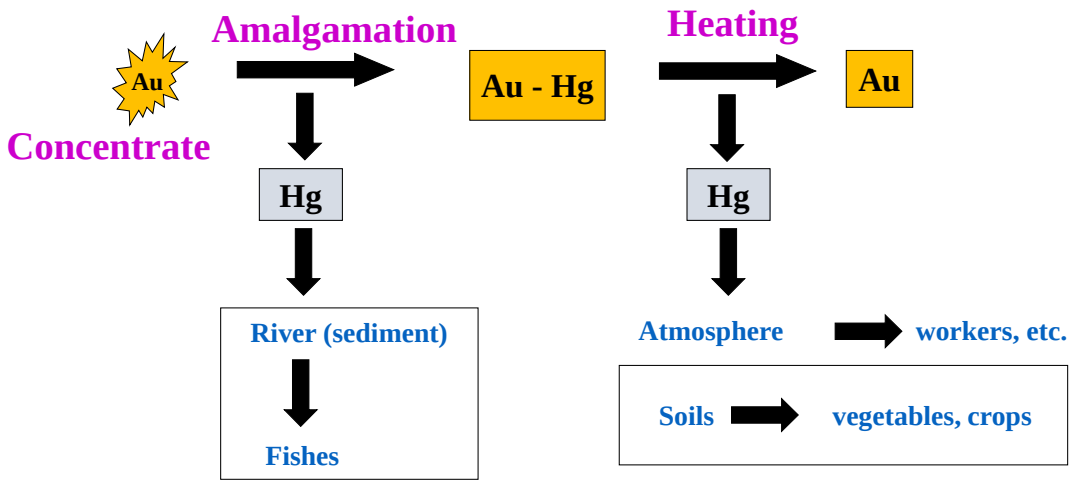


Figure 2: Release of mercury into the ecosystem.

Earlier studies had also reported on arsenic and other trace elements in soil, human urine, and tailing dams from mining communities in Ghana with the attendant environmental impacts (Asante et al., 2007; Antwi-Agyei et al., 2009; Asante et al., 2012; Adjei et al., 2012; Bempah et al., 2013; Kessey and Arko, 2013; Mensah et al., 2015). The government of Ghana, responding to public outcry against the negative

effects of galamsey, acted swiftly and placed a ban on illegal small-scale mining activities in April 2017. This ban stopped both ‘legal’ small-scale and the illegal artisanal miners from carrying out any such activity. However, the ban was short-lived and the activities continued about a year after. Beyond this ban, all other attempts made by the government to curb illegal mining and its devastating effects, have so far proven futile.

2. Review of the State of Ecological Damage of Illegal Mining, Level of Toxicity of Water Bodies, Health Hazards, and Destruction of Forest Reserves

Artisanal and small-scale mining has a long history in Ghana. However, it was in 1989 that the PNDC government recognised its legitimacy through the enactment of Small-scale Mining Act, PNDC Law 218, which was later integrated into the current Mining Act 703 in 2006. The Act provided a blueprint for its formalisation, reserving SSM solely for Ghanaians. The Act legalises small-scale mining by creating the Small-Scale Mining Project, within the Minerals Commission which is mandated to license and regulate operations of artisanal miners. Bureaucratic inefficiency, limited institutional capacity, inadequate monitoring, and corruption have continued to undermine the intended benefits of the formalisation of the sector. This has left many artisanal miners operating informally, vulnerable to exploitation, and in on-going conflict with state authorities. According to Amoyaw-Osei (2025), about 380 active licenses as of November 2024, and about 750 small-scale mining licenses in 2023, represent just about 10% of all SSM activities (i.e. about 90% of all SSM is done illegally).

Regularising the several hundreds of artisanal/galamsey mining (i.e. the 90% illegal mining) could easily overwhelm the regulatory institutions. As the industry is getting increasingly destructive, fears have been expressed that, illegal small-scale

gold mining in Ghana might be a resource curse rather than a blessing. This is because a number of communities have lost their sources of potable drinking water and farmlands, giving away their cocoa farms to the galamseyers in exchange of money.

The problems associated with illegal mining include soil degradation, siltation of river bodies, diversion of river channel, removal of vegetative cover and loss of biodiversity, pollution by heavy metals and other contaminants, destruction of food and cash crops, depletion of forest reserves and degradation of the quality of river bodies, among others.

Speaking on "The Challenge of Galamsey for Sustainable Development– The Social and Economic Challenge" at a public forum organised by the Ghana Academy of Arts and Sciences on 3rd June, 2025, Ing. Dr. Kenneth Ashigbey, the current Chief Executive Officer of the Ghana Chamber of Mines examined the devastating impact of galamsey on Ghana's sustainable development, with a focus on the cocoa industry, forest degradation, loss of taxes and royalties, and livelihood destruction. The analysis revealed the social costs of galamsey, including increased crime, prostitution, drug abuse, and increasing school dropout rates. He urged Ghanaian leadership to act urgently, warning that inaction could lead to the country's extinction. He added that leadership failure and greed have enabled this ecological terrorism, posing an existential threat to Ghana's survival. He called for decisive action to address the menace, recommending policy interventions, enforcement, and accountability, and concluded with a rallying cry for collective action to save Ghana from the destructive consequences of galamsey.

Speaking on Ecological and Environmental Damage, at the same public forum organised by the Ghana Academy of Arts and Sciences, Mr. Erastus Asare Donkor from the Multimedia Group-Ghana reported that a total of 44 forest reserves had been affected by illegal mining. Ashanti Region tops with 14, followed by Western North Region (12), Western Region (11), Upper East Region (4), Eastern Region (2) and Savannah Region (1).

The activities of galamsey have caused widespread environmental degradation, including deforestation, soil degradation and destruction of cocoa farmlands, threatening the long-term sustainability of cocoa production. Many cocoa farmers have been forced to abandon their farms due to the encroachment of illegal mining activities, leading to the loss of income and livelihoods. The impact of illegal mining on the cocoa sector poses a significant threat to Ghana's economy, as cocoa is a major export crop and a significant contributor to the country's GDP.

On climate change implications vis-à-vis deforestation and green gas emissions, Mr. Asare Donkor stated that the rampant deforestation caused by illegal mining activities is not only an environmental catastrophe; but, also a significant contributor to climate change. Furthermore, the mining process itself involves the burning of fossil fuels and release of other greenhouse gases, such as methane, further exacerbating the climate crisis. He continued that the Forestry Commission

estimates that, about 35,000 hectares of forests have been degraded. To wit, vast areas of forests have been cleared, releasing stored carbon into the atmosphere and diminishing nature's ability to absorb greenhouse gases. These emissions trap heat in the atmosphere, leading to rising temperatures, erratic weather patterns, and long-term changes in our climate system.

At the same public forum, speaking on "Galamsey Repair – Health and Ecological Costs", Prof. Ellis Owusu Dabo from the School of Medical Sciences, Kwame Nkrumah University of Science Technology (KNUST) reported high prevalence of malaria in mining areas, increase in prevalence of HIV/AIDS, birth defects/deformities, and mercury and arsenic poisoning. Also, mercury can cause kidney diseases as well as cardiovascular and skin diseases. He added that mercury in drinking water could also result in muscle weakness, vision loss, speech and hearing impairment.

In a documentary POISONED FOR GOLD by Mr. Erasmus Asare Donkor of Joy FM, Prof. Osei Sampene, a Pathologist and Senior Lecturer at KNUST, detailed a deformed baby (preserved in formalin) he examined from the uterus of a dead mother in Bibiani where the dysmorphic baby had 6 fingers, 6 toes, fused eyes, malformed head with no identifiable sex (no genitals) and traced the cause of the deformity to appreciable levels of mercury, cyanide, lead and arsenic in the placenta, through which babies get their feed, oxygen, etc. to survive. He added that he examined three other babies with extreme deformities from the Central, Ashanti and Western Regions. This is a clear case of how heavy metals concentrations can alter the developmental stages of a foetus and concluded that this could be a widespread catastrophe which needs further public health research.

2.1 River Systems and Studies Conducted by CSIR-Water Research Institute

Of the global water budget, only 3% is available as freshwater (Groundwater, Surface water, others) with 97% being seawater, and of the available 3% freshwater, only 13% is accessible with the remaining 87% locked up in glaciers and icecaps. This means that a paltry 0.4% of the global water is accessible to mankind as freshwater (Figure 3). In Ghana, the rivers are classified into three (3) systems. The Volta River System, South-Western River System and the Coastal River System with the contribution of each river system indicated below.

VOLTA RIVERS (70%)

(Black, White, Red, Oti and Main Volta)

(Contribute 64.7% of total runoff in Ghana)

SOUTH-WESTERN RIVERS (22%)

(Bia, Tano, Ankobra, Birim, Offin and Pra)

(Contribute 29.2% of total runoff in Ghana)

COASTAL RIVERS (8%)

(Ochi-Amissah, Ochi-Nakwa, Ayensu, Densu, Tordzie)

(Contribute 6.1% of total runoff in Ghana)

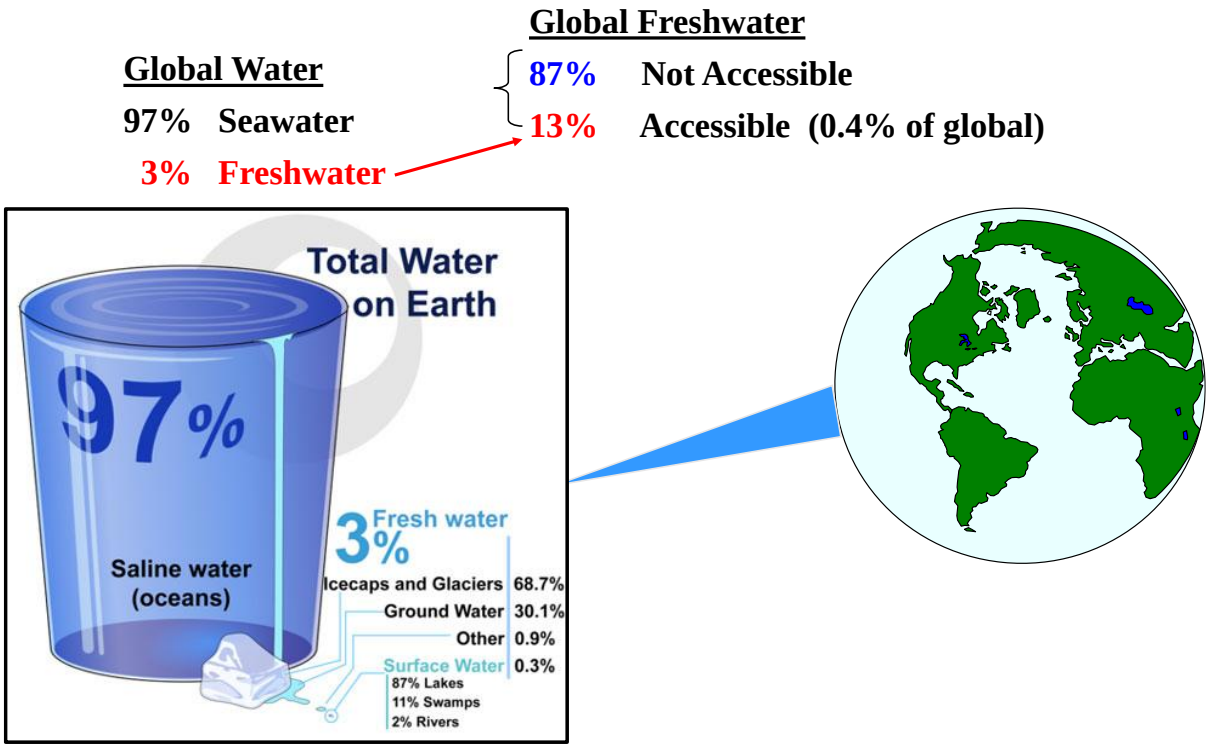


Figure 3: The global water budget

The water quality index (WQI) used to assess the quality of the rivers, is a classification system that uses an index calculated from selected water quality parameters (eg. pH, dissolved oxygen, biochemical oxygen demand, ammonia-nitrogen, nitrate-nitrogen, phosphate-phosphorus, faecal coliform, total suspended solids, temperature and conductivity), by integrating values of key water quality variables into a single number from 0 to 100. The index classifies water quality into one of four categories: Class 1: Good (>80), Class 2: Fairly Good (50 – 80), Class 3: Poor (25 – 50), and Class 4: Grossly Polluted (<25). Most of our water bodies are presently in the Class 3 state. This raises a serious concern as it adds to the cost of water treatment by the Ghana Water Limited (GWL), as amplified by their several calls to halt illegal mining. The current situation has resulted into water

scarcity in some areas in Ghana. As a result, there is the need for Ghanaians, water managers and policy makers to know the magnitude of the problem and the cost involved in restoring the polluted water bodies to the natural state.

Figure 4: The state of South-western rivers in 2018.

Figure 5: The state of South-western rivers in 2024. Arrows indicate GWL intake points.

Currently, all the south-western rivers are polluted and turbidity levels are very high (Figures 4 and 5). This has raised national concern and a call for public action. In order to assess the extent of pollution caused by illegal mining activities, CSIR-Water Research Institute periodically conducts studies on water bodies in the country. Results of such studies generally indicate high levels of total suspended

solids, turbidity and occasionally, other harmful chemicals in the rivers. For instance, in July 2018, a study was carried out to examine the status of water and sediment quality in eight endemic regions of illegal mining to ascertain the outcome of the ban on the water quality of the rivers in 2017. Procedures outlined in the Standard Methods for the Examination of Water and Wastewater (2017) were followed for the laboratory analyses. Results of the study indicated that the rivers were high with total suspended solids (TSS), turbidity and color, suggesting inflow of wastewater from the illegal mining activities and some run-offs. The background levels of turbidity required in surface freshwaters in Ghana is 5 NTU (WRC, 2003a; 2003b), just as in drinking water (WHO, 2017; GSA, 2017). The turbidity levels of the waters were very high in relation to the guideline value. The turbidity in all the waters exceeded the guideline value and ranged from 12 NTU to 4,645 NTU (Darko et al., 2021). The highest value of 4,645 NTU was observed at Ayiem on River Ankobra. The turbidity is contributed by the high TSS present in these waters. Color had a strong correlation with turbidity (r = 0.95) and TSS (r = 0.94), suggesting that the pollution originates from the same sources. Low levels of metals were found in both water and sediment. However, very high concentrations of iron were detected in both water and sediment. Mercury concentrations were low in the water column but relatively higher in the sediment. A comparison of the general water quality status of the water bodies in the Pra Basin in 2013 and 2018 using the Water Quality Index (WQI) showed a marginal improvement in quality in 2018 over 2013 in the Pra Basin. The improvement of water quality in 2018 (Figure 6) was attributable to the ban.

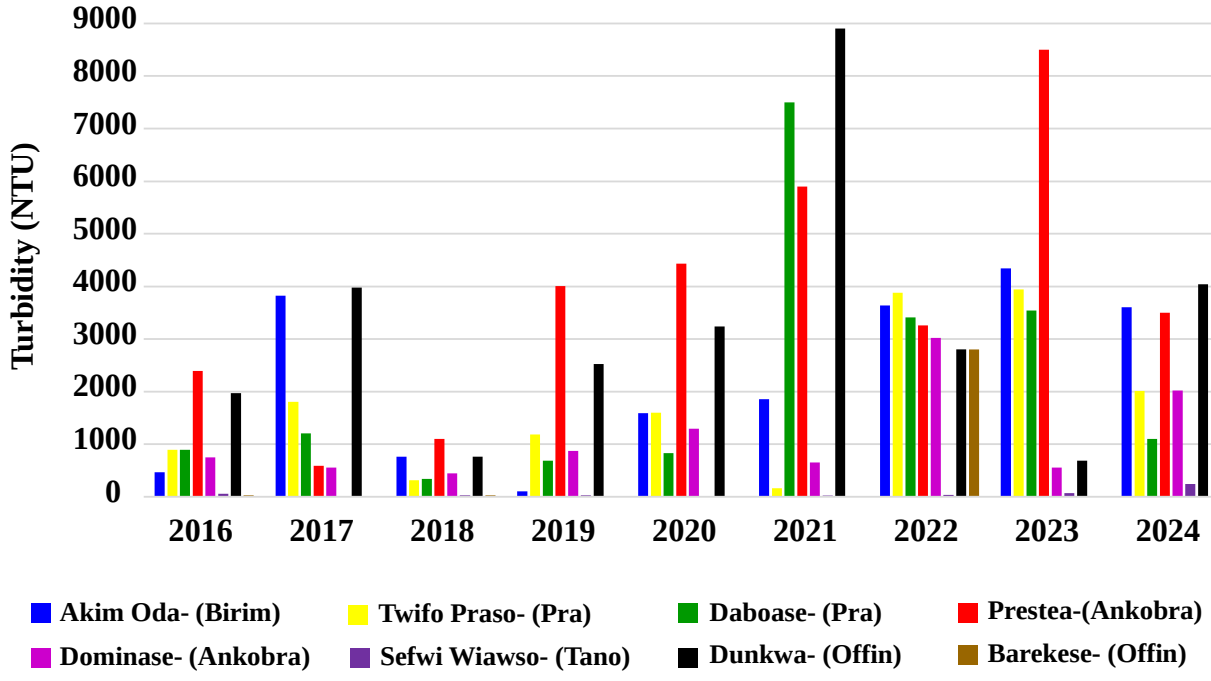


Figure 6: Turbidity measurements from some sites of major basins between 2016 and 2024.

2.2 Land Vegetation and Reclamation Techniques

According to the Encyclopedia Britannica, Ghana has three principal types of vegetation- from the north to the south. These are the Coastal Savanna, Rainforest Zone and Northern Savannah. The Coastal Savanna consists of a mixture of scrub and tall tress (Guinea grass) with giant anthills. The Northern Savanna consists mainly of tall Guinea grass with scattered low trees such as the shea butter tree and species of acacia and baobab. The Rainforest vegetation is predominantly evergreen and tropical semi-deciduous forest. The dense forest zone formerly covered an area of about 30,000 square miles (78,000 km^2) but farming activities and timber exploration have reduced it to less than 8,000 square miles (21,000 km^2) which include about 6,000 square miles (15,500 km^2) of reserved forest (Nimako, 2023).

Albert Kobina Mensah in his book *Soil Pollution and Remediation* (2025), chronicled early reclamation efforts primarily planting fast-growing vegetation to stabilise the soil and reduce erosion. However, these practices were often superficial and did not address the underlying issues such as soil contamination and long-term sustainability of the ecosystem. The late 20th and early 21st centuries saw significant advancements in reclamation techniques which began to incorporate soil amendments, such as organic matter and lime to improve the fertility and pH levels. These amendments helped to create conditions more conducive to plant growth and supported the reestablishment of native vegetation.

Another milestone in the evolution of reclamation is the development of phytoremediation techniques which involve the use of plants (such as ferns, Indian mustard and poplar trees) to remove, stabilise, or neutralise contaminants and absorb heavy metals from the soil. This gained popularity as a cost-effective and environmentally friendly approach. According to A. K. Mensah, in recent years, the concept of "ecosystem reclamation" has gained prominence. This involves the reconstruction of natural habitats and the reintroduction of native species, aimed at creating a self-sustaining environment. This holistic approach recognises the interconnectedness of various ecological components and seeks to restore ecological balance.

2.3 Estimated Cost of Treatment

For unpolluted water, it costs between GHC1 and GHC3 to treat the water for public consumption. However, with the issue of galamsey setting it, it costs between GHC11 and GHC15 to treat the water, increasing the cost of treatment for GWL. The Table below indicates the drainage area, length, width and average annual discharge of some river basins. Based on the information, the estimated volumes of water in each basin can be estimated as indicated in Table 1. Assuming the cost of treating the galamsey-impacted water is even GHC10 per 1 cubic meter, it will cost an estimated GHC48.3 billion to treat the Pra basin, GHC12 billion for the Ankobra basin, GHC45.1 billion for the Tabo basin and GHC80.4 billion for the Black Volta, and all these are direct costs.

Table 1: Estimated volumes of water and treatment cost for some basins in Ghana.

RIVER BAINS	DRAINAGE AREA (KM^2)	DRAINAGE LENGTH (KM)	AVERAGE WIDTH (M)	MINIMUM WIDTH (M)	MAXIMUM WIDTH (M)	AVERAGE ANNUAL DISCHARGE (M^3/S)	ESTIMATED VOLUME (BILLION M^3)
PRA	23,168	325	98	8	196	153	**4.83**
ANKOBRA	8,366	230	65	41	125	38	**1.20**
TANO	16,061	512	48	28	76	143	**4.51**
BLACK VOLTA	142,056 (33,302 in Ghana)	1,363 (688 in Ghana)	52	29	181	255	**8.04**

Source: Authors' calculation; Philip Gyau-Boakye & Kwabena Kankam-Yeboah, 2016.

Identification and Analysis of Key Actors involved in the Menace

As indicated earlier, galamsey is endemic in large sections of the country as an avenue for rural employment and livelihoods, with the economies of some rural communities dependent almost entirely on it. Thirteen (13) out of the 16 regions of Ghana are gold mineralised, and faced with rural poverty and unemployment. People sacrifice their conscience indulging in galamsey as a worthwhile lucrative alternative employment. It is propped up by traditional authorities, unbridled political interests, the youth and women in rural mining communities, among others.

High-handed deployment of the military ended up with accusations of complicity and corruption, and not even ministerial committees on galamsey have escaped the label of corruption (Amoyaw-Osei, 2025). Reports in the media (Television, Newspapers, Electronic) have also identified foreign nationals, particularly Chinese as culprits. The artisanal small-scale sector reserved for Ghanaians is effectively captured by foreigners. Foreign capital inflow and other illicit sources persistently fuel galamsey. Also, foreign gold business interests consolidate their influence through corrupting local authorities, political figures and communities. Leadership of political parties and operatives turn to take interest in and/or urge their followers into galamsey, compromising the fight (Amoyaw-Osei, 2025). In addition, local people not only front perpetrators, but protect and defend them, sometimes against arrests. Also, the continually soaring high price of gold provides impetus for the degrading galamsey, as a tiny amount of gold extracted is a fortune.

Farming land tenancy arrangements are typically informal, favouring ready conversion of arable lands for galamsey with enticing monetary offers to chiefs. Furthermore, labour intensiveness of cocoa cultivation renders it less competitive to galamsey, luring some farmers/landowners to offer their farmlands to galamsey operators for instant earnings. Destructive effects are without limits. Forests are mowed destroying biodiversity and removing the carbon sink for greenhouse gas sequestration, etc., water bodies polluted, and road, rail infrastructure, and utility lines destroyed.

One of the challenges of overcoming this menace is the lack of clarity on exact roles and the relationships among the respective institutions (fragmented oversight) in the small-scale mining sector on social support and regulatory mandate for effective discharge of responsibilities, enforcement, reporting and use of the expected outcomes. Some institutions perceive environmental issues outside their domain, and have nothing to do with Impact Assessment, hence Minerals Commission for instance, during mining licensing process would pause and advise applicants to submit Environmental Permit (from EPA only as evidence), presupposing that the outcome of the Impact Assessment has no input to the mining license decision-making. This above, inadvertently impedes inter-institutional confidence, corporation and sharing of intelligence on sector issues.

3.Methodology for the Assignment

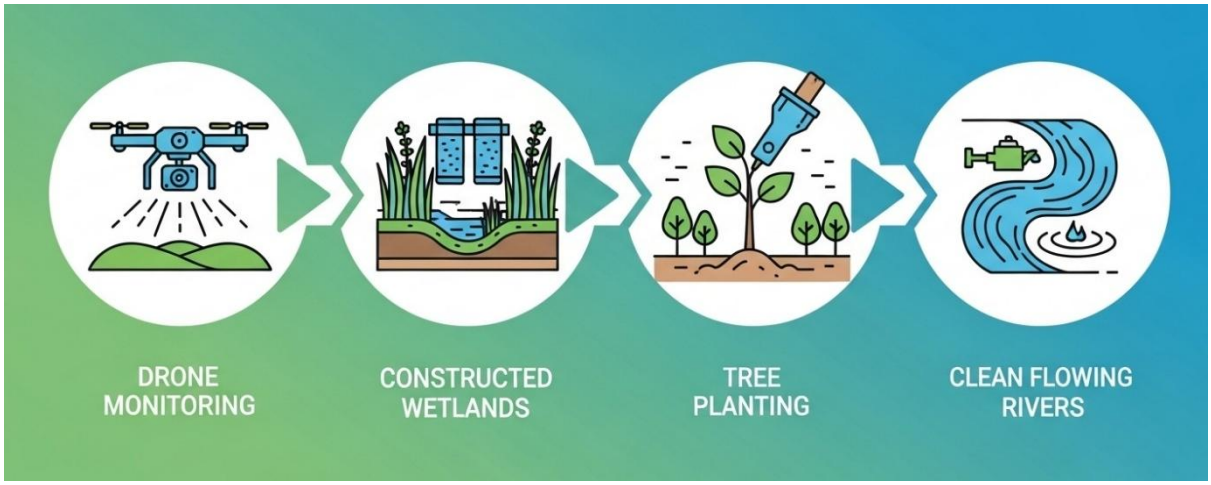
Secondary data comprised of a desk review and research data from the Council for Scientific and Industrial Research- Water Research Institute (CSIR-WRI) were sourced for the completion of this report. Due to the scope of work in this research,

the use of secondary data was an appropriate means of collating current knowledge on the research topic.

The review involved a google scholar search for articles relating to the assignment, in addition to engagements with notable figures who have mounted several platforms to speak against this menace and participation in public fora. Articles retrieved were comprehensively analysed based on their objectives and research findings. This approach provides a summary of what is currently known on galamsey in Ghana, especially pertaining to its ecological blueprints.

Additionally, data from empirical studies conducted by the CSIR-WRI were retrieved and analysed. The CSIR-WRI is a highly reputable institution with expertise in scientific research. The institute has conducted studies on water pollution and related environmental challenges, and thus, has a repository of reliable data. Data from CSIR-WRI was accessed by the consultant who has several years of experience working at the Institute. Through field visits, collection of water and sediment samples from river basins across the country, these were analysed in the laboratories of CSIR-WRI to inform the findings on the extent of water pollution caused by galamsey activities.

4. Analysis of Practical Recommendations for Mitigating the Impact



Restoration Framework for *Galamsey*-Affected Areas

Phase 1: Assessment and Emergency Measures (Months 1-6)

Comprehensive Environmental Mapping

- Conduct detailed soil and water quality testing in all affected regions
- Use satellite imagery and drone technology to map degradation hotspots

- Identify priority areas for immediate intervention

Emergency Declaration

- Designate critically affected water bodies and forests as emergency zones
- Implement immediate bans on all mining activities in these areas

Phase 2: Active Water Quality Restoration (Months 6-36)

Water Restoration Techniques

Phytoremediation: Using aquatic plants like water hyacinth to absorb heavy metals from contaminated rivers

- Bioremediation: Introducing mercury-metabolising bacteria to break down toxic substances
- Constructed Wetlands: Building artificial wetland systems to filter pollutants
- Dredging and Filtration: Removing contaminated sediments from riverbeds

Challenges and Solutions

Major Challenges

- High costs of remediation technologies
- Weak enforcement of mining regulations
- Resistance from communities dependent on galamsey incomes
- Limited technical expertise locally

Proposed Solutions

- Political will to enforce regulations and allocate adequate resources
- Temporary Mining Moratorium: Proposed 3-5 year suspension to facilitate reclamation
- Community education and sustainable alternative livelihood programmes
- Community participation in ensuring local ownership of restoration efforts
- Multi-stakeholder collaboration (government, NGOs, private sector)

Proposed costs of interventions for the restoration of water bodies are presented in Table 2.

Table 2: Cost estimates for proposed key interventions.

Intervention Type	Unit Cost Estimate (USD)	5-Year Projection (USD)	Source
Enforcement (task force, drones, patrol)	$8M/year	$40M over 5 years	Ministry of Lands & Natural Resources 2021 budget for anti-galamsey taskforce
Enrichment Planting (Native species)	$3,000 per hectare	$15M for 5,000 ha	Based on Forestry Commission (2020), average cost for seedling procurement, planting, maintenance over 5 years
Phytoremediation	$150K per site	$3M for 20 sites	Adapted from studies on phytoremediation in West Africa (Asamoah et al., 2019; UNEP project pilots in Nigeria and Ghana)
Riverbank Stabilisation	$50 per meter	$5M for 100 km	FAO & IUCN, confirmed by local riverbank bioengineering pilot in Pra Basin (WRC Ghana, 2018)
Education & Training	$500,000 per year	$2.5M over 5 years	UNDP Ghana and CSIR-led community capacity building cost in riverine districts (2020–2022 reports)
Sediment Dredging	$1M per major site	$10M for 10 rivers	EPA Ghana + Ghana Water Company Limited dredging estimates (2021)

5. Conclusion

The proliferation of galamsey undermines investor confidence and tarnishes Ghana's international reputation as a responsible mining jurisdiction, threatening long-term foreign direct investment in the extractive sector. The Ghana Chamber of Mines has consistently highlighted how illegal mining reduces government revenues through tax evasion, loss of royalties, and smuggling of gold outside official export channels. Galamsey also creates unfair competition for licensed small-scale and large-scale miners, who face higher operational costs due to compliance with environmental and labour regulations. A durable solution to illegal mining must confront the root cause: lack of viable economic alternatives. Galamsey thrives not only because of gold's allure; but, also due to the collapse of rural economies, widespread youth unemployment, and the absence of state investment in job creation. Attempts to eliminate galamsey without addressing these structural gaps risk entrenching poverty and social unrest. The continuous degradation of the country's water bodies will compound the cost of water treatment by GWL and contaminate fish and food crops with the potential to cause severe food insecurity if not halted. Appreciable levels of mercury, cyanide, lead and arsenic in examined placenta, led to babies with extreme deformities. This is a clear case of a dire public health challenge that requires further research.

6. Recommendations

a. Make farming lands in mining communities more productive through special extension support to turn subsistence agriculture into intensive cultivation and farm produce packaging with commercialisation and market-driven growth in mind, for the sector to become competitive and lucrative.

b. Increase awareness of chiefs and other traditional leaders on land documentation process to end the era of informal land transaction for the protection of tenant farmers.

c. Pay competitive compensations to farmers to render farming equally lucrative. Especially for cocoa farmers, government efforts should be geared towards improved production and incomes from cocoa production which contributes significantly to Ghana's GDP.

d. Provide extension support services for food crop cultivation in the rehabilitation of cocoa farms.

e. Prepare compensation (resettlement) Action Plan for each affected farmer, and farmers made to sign a legal documentation binding them not to divest their cocoa farms to galamsey.

f. The penalty for galamsey offences in forest reserves should be reviewed and the Forests Protection Act (1974) accordingly amended to align with the "polluter-pays-principle".

g. Declare water bodies/riparian areas "no-go areas" for ASM with strong deterrent environmental sanctions and property forfeiture.

h. Convert galamsey into formal artisanal small-scale mining (ASM) cooperatives for mass employment opportunities. And there should be transparent and coordinated institutional system for ASM governance.

i. Politicians and political office holders should be barred from engaging in small-scale mining.

j. Increase education/awareness on the devastating impacts of galamsey in mining communities to effect behavioural change among participants in the sector and with this improved awareness that can form the basis for a revolt against illegal mining operations.

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