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FARMLAND LOSS AND LIVELIHOOD EFFECTS: DIAMOND AND GOLD MINING IMPLICATIONS ON FARMERS' SUSTAINABILITY IN SIERRA LEONE

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ABSTRACT

Mining businesses are problematic in developing countries because they intrude on farming ecologies, rendering arable lands almost unavailable to farmers and making them unproductive. This paper expounds on the impact of agricultural land loss on mining activities in Kenema, as farming is the primary source of income for the locals; nevertheless, small-farm holdings are a definitive characteristic of this district. Using perceptions-based data gathered from 358 respondents, the software STATA 14 was employed to analyse the ordinal logit model. The results suggest that though mining operations gave the community quick income and short-term jobs, the negative impacts on farmers' livelihood and outcomes surpass the benefits. The challenges farmers face from mining activities are Water pollution, displacement from their lands, and agricultural land degradation, and most get into illegal mining due to these constraints. This is mirrored in the average cultivation area of about 4 acres, with a relatively small harvest and an average monthly farm income of less than USD 40. Moreover, the results disclosed that the mines had increased land concession with less or no land reclamation or restoration. Therefore, it is recommended that all parties involved use a standardized method of communication that will prevent mining-related farmland encroachment. Moreover, it is good that authorities empower environmental law-enforcing bodies to monitor mining operations closely to ensure total compliance with the laws of the land management system.

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INTRODUCTION

Several investors have purchased an estimated 56 million hectares of land worldwide as of 2010. Of this amount, 29 million hectares are located in countries in sub-Saharan Africa (ElHadary and Obeng-Odoom, 2012). The increased awareness of the rights of marginalized communities and their power to assert ownership over their indigenous land and natural resources makes the worldwide land-grab phenomenon a significant worry for them. Because of land pressure, it is now widely accepted that agricultural productivity is inversely proportional to the size of farms. This is especially true in Africa (Larson et al., 2014). This means that land constraints will force new developments. However, several caveats call into question the reliability of this premise, including the presence of flaws in the land, labour, and capital markets (Chen et al., 2011).

Since mining expansion reduces the lands accessible for agricultural production and raises land use competition in minerals-endowed countries, sustainable land management is a critical concern in agricultural and mining zones (Moomen, 2017). The land surrounding mine sites is crucial to the survival of the indigenous people that live there, but industrial mining necessitates a disproportionate amount of space for its activities (Hilson, 2002). Additionally, mining-related soil contamination may impact extensive regions, lowering cultivable land (Aragon and Rud, 2016). Thus, increasing agricultural production and mining expansion are essentially incompatible activities; as mining potential is further developed, it will place a more significant burden on farmland and reduce agricultural production and productivity (Moomen and Dewan, 2015).

Mineral exploitations put pressure on people's ability to access and utilize land and natural resources in rural communal areas. Several ecological and social factors govern the ability of people to access and derive livelihood benefits from agriculture and natural resources in communal land ecosystems (Chimhowu and Woodhouse, 2006). Conventionally, the availability of land and other natural resources is crucial to the economic stability of rural areas. Millions of people rely on agriculture and ecological products and services provided by communal lands (De Sherbinin et al., 2008). Mining development threatens agricultural production since it could reduce available farmland. The simultaneous expansion of large-scale mining operations, a government's priority under reform, has also induced landlessness and further expansion of illegal and small-scale mining (Akabzaa and Darimani, 2001). Since not all services can be maximized simultaneously, every land use decision involves trade-offs, often resulting in competing interests and substantial conflicts about the desired use of land among stakeholders (Turner et al., 2007). Economic land use theory suggests that markets resolve such conflicts via differences in land rents that will lead to the most profitable land use allocation (Walker, 2004). Large-scale expropriation of farmlands by multinational corporations, governments, and individual entrepreneurs has profoundly affected the global agriculture industry (Cotula et al., 2014). Likewise, the African Centre for Economic Transformation (ACET) documented the increasing peril facing farmland and, by extension, food, and cash crop production. Land degradation is rising, and efforts to promote commercial agriculture are in jeopardy because of the failure to reclaim mined-out places (ACET, 2017). There has been a dramatic shift in how farmland is used in recent decades. The implications of this expropriation on subsistence farmers have prompted substantial discussion over the appropriateness of converting agricultural land to other uses (Borras et al., 2012). Disposing of farmers and denying them access to land through land expropriation has devastating long-term effects on their ability to make a living (Cotula et al., 2014). Most mining concessions are located near human settlements and agriculture in developing countries, increasing competition for land use and threatening farmers' livelihoods (Tetteh, 2010). It is possible for the external appearance of a mining site to grow as a result of land change brought about by corporate mining activities (LaJeunesse et al., 2016). Large swaths of land are under the exclusive control of the mining companies, and farming is prohibited in the concession zones. It is seen that large and small-scale mining operations coexist alongside agricultural practices. The mining sector takes up much real estate, and its environmental effects are more profound than any other type of earth disturbance (Danielson and Logos, 2001). It is interesting to note that environmental repercussions occur throughout mining development (Farrell and Kratzing, 1996).

Botchway (2018) posits that surface mining accounts for the disturbance in the agricultural land base does away with plants and soils, disrupts the flow of ecosystem services, and also leads to the permanent loss of farmland as well as the degradation of agricultural lands beyond short-term reclamation for intensive post-mining agricultural purposes. The degradation of agricultural lands drives farmers from sustainable livelihoods to alternative income-generating businesses (Botchway, 2018). Also, mining affects farmers' access to land as fertile expanses of agricultural lands are devastated and rendered uncultivable for years, thereby denying farmers access to scarce lands. This situation is aggravated by miners' almost coercive takeover of farmlands, leading to a reduction in the size of farmlands (Poku, 2016). The conversion of farmland to mining territory is primarily attributable to surface mining operations (Ouoba, 2018). According to Hilson (2002), the Ok Tedi Mine in Papua New Guinea has the potential to impact approximately 15,000 hectares of land. It is unavoidable and frequently permanent that farmland will be lost as a result of surface mining as it eliminates vegetation and soils, disrupts flows of ecosystem services, and destroys habitats. Consequently, disputes between locals and miners over land ownership are a major source of instability in many West African countries (Maconachie and Binns 2007). Integrating local populations' socioeconomic and ecological values into mine design, planning, and extraction in a way consistent with the desired end usage objectives is essential for achieving sustainable land reclamation sites (Elliott et al., 1996).

In addition to environmental damage, the loss of farmland for mining has led to food and cash crop shortages. Mines accelerate the taking of land from farmers to the vantage of wealthy groups at the expense of the farmers (Owusu-Koranteng, 2005). Mining causes the local people to lose their homes, agricultural lands, and forest-based livelihoods (Obeng et al., 2019). The nature of the relationship between agriculture and mining is dynamic depending on the location; nevertheless, regardless of its location, it is competitive and very confrontational (Brown and Kimani, 2021). Land degradation occurs due to the process of generating pits and dumps (Aborah, 2016). Despite mining's advantages, many groups and communities worry that it comes at too great a cost to the natural world, specifically in terms of access to clean water, biodiversity loss, soil fertility, agricultural land, community fragmentation, and economic losses (Bermúdez-Lugo, 2013). In the Tarkwa area in Ghana, it is estimated that over 70% of the land previously used for farming is under mine concessions (Akabzaa and Darimani, 2001).

Agriculture and mining have complex, dynamic, adversarial, and cooperative interactions. They are dynamic because they are affected by other external factors, such as commodity prices, and complicated because they share and compete for the same factor inputs, namely land, water, labour, and capital (ACET, 2017). Subsequent research has demonstrated that these two vital economic sectors support rural livelihoods (Reardon et al., 2001) and most rural residents in developing countries by providing jobs and reliable sources of income (Teschner, 2014). Furthermore, academics have presented broader perspectives regarding the significance of transformation in the agricultural sector, whereby mining is seen as a vital aspect (Hilson, 2016). Notwithstanding its numerous socio-economic advantages, mining has a negative impact on the environment due to its rivalry with agriculture for resources. It can be concerning that unlawful mining has a Janus face. According to research conducted in this area, the symbiosis between most mining activities and agriculture has only sometimes been seamless in obtaining and applying factor inputs (Musemwa, 2009). The fierce competition between these two drivers of rural development for land access has primarily resulted in resource-use conflicts.

In contrast, competition for resources and space has occasionally led to cohabitation and interface across forms of land use (Pijpers, 2014). Mining, being an extractive industry, has the potential to harm agriculture in several ways. Land deterioration is one important mechanism. Less land may be available for agricultural production due to the detrimental legacy of mining, which includes mine pits and excavated soils, which can make formerly fertile fields unfit for crop production (Ncube-Phiri et al., 2015). Mining operations have been shown to lower crop yields by causing farm invasions and destroying farmed crops near agriculturally productive areas (Arthur et al., 2016).

Furthermore, the national government's budget may bear a significant financial burden from land reclamation projects in mining hotspots that seek to return degraded mining lands to nearly their original state so that they can be used for a range of other vital industrial uses, such as agricultural production (Mantey et al., 2016). Environmental restoration of small-scale damaged lands in Ghana's Western Region alone was $198 million, according to Mantey et al. (2016). According to Obiris et al. (2016), mining gold can harm rural livelihoods by polluting water. One way this plays out is when mining activities mess with river systems, which means less water flowing through them and less water available for farmers to grow more crops (Ncube-Phiri et al., 2015).

Over the years, countries like Ghana, the Democratic Republic of the Congo, Nigeria, Guinea, and Sierra Leone have relied excessively on revenue from mineral exports like gold, diamonds, oil, and other commodities. However, the negative impacts of mining operations on natural resources, including land and water, outweigh the benefits, particularly in the rural communities where these operations are carried out (Gasparatos et al., 2016). In Ghana, large tracts of agricultural lands are currently under mining concession, which could cover land areas from 50 km2 to 4,000 km2, and these concessions are agricultural lands that form the economic base of many mining communities (Owusu-Koranteng, 2008). The mining industry in Ghana has contributed to pollution, which has negatively impacted agricultural output (Aragon and Rud, 2016). Most local economies suffer from mining due to its devastating impacts on the environment and society; as a result, some farmers have diversified their livelihood by engaging in illegal mining because the extensive mining operations have taken over the use of sizeable arable land that had been used for agricultural production (Kumah, 2006). The mining industry rarely has a noticeable effect on local economies. Numerous studies have shown that the government and other major players in the mining industry reap the vast majority of the benefits while the local community takes the hit (Dontala et al., 2015). Graham (1996) stated that the loss of a significant amount of land is one reason why surface or open-pit gold mining is not the best or should be opposed by those living near mining regions. In addition to violating the human rights of indigenous people, as asserted by Ocansey (2013), surface mining causes several issues with land usage related to livelihoods in the mining areas.

In Sierra Leone, agriculture and mining Sectors are the country's economy's mainstays; hence, it is one of the countries in West Africa endowed with a wealth of natural resources. These resources include iron ore, rutile, gold, bauxite, platinum, and diamonds. Sierra Leone was, in 2010, the world's 10th largest producer of diamonds (Akiwumi and D'Angelo, 2018). Loss of farmland due to mines is an underexplored issue in an agriculturally important region of Sierra Leone. With agriculture accounting for 46% of the country's GDP and 25% of export earnings, it is essential to Sierra Leone's economy. More than two thirds of the population make their living from the agriculture industry. Even though Sierra Leone's national government prioritises agricultural development, food insecurity remains a significant problem in rural communities (GoSL, 2021). As agricultural development faces challenges like overexploitation of resources, overuse of inputs, and groundwater over-extraction, sustainable development becomes increasingly difficult (Razzaq et al., 2022). Studies on the effects of mining in Sierra Leone have focused more on the environmental effects of mining on people's welfare (Fayiah, 2020). Wilson (2015) has also cross-examined the community development challenges and corporate social responsibility in Sierra Leone's diamond and rutile mining regions in the northern part of Sierra Leone. Few studies have been done on how mining affects farming, and those focused on pollution (Margao, 2021). The rapid loss of arable land in mineral-rich regions highlights the urgent need to address the environmental crisis caused by mining, especially in the agricultural sector (Nunez, 2019). Studies focusing extensively on the effect of mining operations' loss of arable land on farmers' production and productivity in Sierra Leone need to be probed. Therefore, this research explored the effects of farmland loss by mines on the livelihood of farmers in the eastern part of Sierra Leone, Kenema district.

METHODOLOGY

Study Area

Kenema district (Figure 1), home to both small- and large-scale mining operations, is one of the country's most diamond and gold-bearing regions. With an average elevation of 1,067 meters above sea level, this study area is situated in Sierra Leone's interior plateau region (Gwynne-Jones et al., 1978). The area is located in an equatorial region with alternating dry and rainy seasons. Even while industrial mining is taking place, communities that mine for diamonds and gold also participate in illicit mining as well as other forms of commerce. Tree crop production, small-scale trading, and farming of cereal crops are further significant sources of income. Despite the indiscriminate mineral exploitation in this region, farming is the primary source of livelihood for the majority of the residents in the Kenema district; mining activities are hindering vast farmland at the expense of farmers (Mabey et al., 2020). Local governance is in two folds: representatives of the city or town council and traditional leaders. The hierarchy of traditional leaders consists of the paramount chief, who oversees the chiefdom; section chiefs, who are in charge of the chiefdom's sections; village/town chiefs; and female leaders. The mayor serves the city, and the district chairperson is in charge of the district with their respective council members.

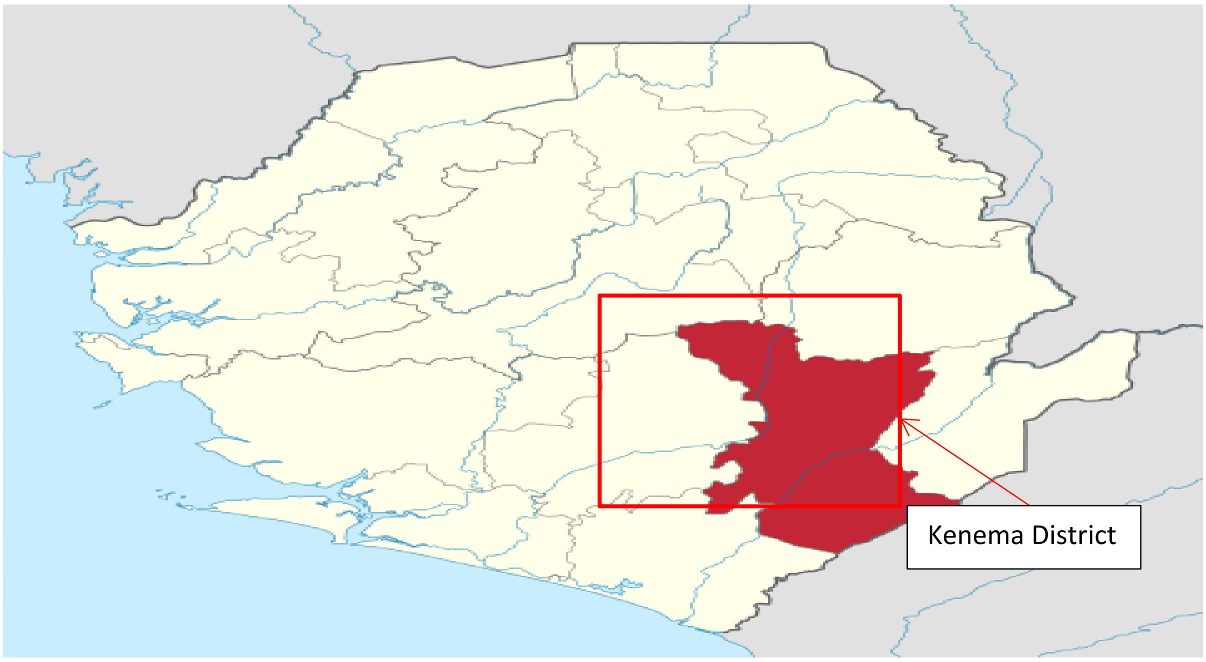

Figure 1. Map of Sierra Leone indicating Kenema District; Source: http://www.statistics.sl.

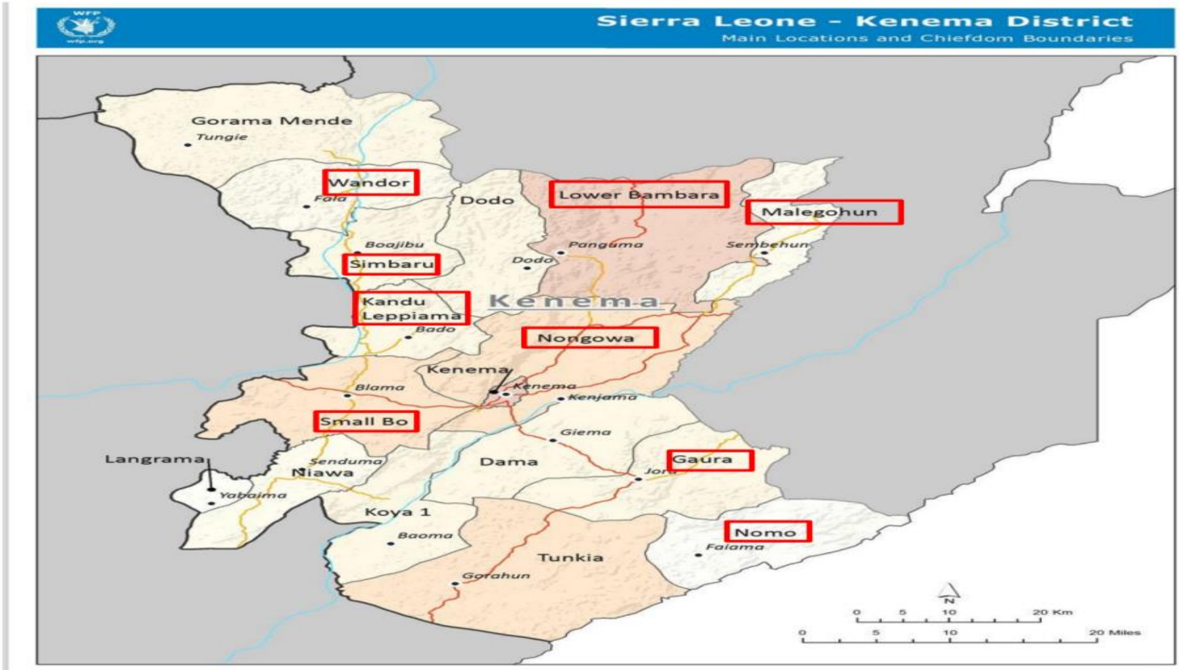

Figure 2. Map of study area; Source: http://www.statistics.sl.

Data Acquisition and Processing

A household survey was conducted from July to September 2023, serving as this study's primary data source. A multistage random sampling technique was used to collect the primary data. Nine chiefdoms (Nomo, Gaura, Small-bo, Simbaru, Kandu-leppiama, Malegohun, Lower-Bambara, Nongowa, and Wandor) that are still active in mining activities were purposely selected (Figure 2). There were 85,692 rice-farming households in Kenema district, which is 10.3 percent of the rice-farming households in Sierra Leone (Leone, 2015). Three hundred and fifty-eight (358) were randomly selected as a sample population using the Yamane (1967) method, and questionnaires were administered to them for relevant and credible cross-sectional data. Since most respondents were illiterate, a face-to-face interview was conducted by completing the questionnaires. Data was analysed by descriptive statistics and inferential statistics using STATA 14 version: mean scores, range, and ordinal logistic regression model estimated based on the perceptions of rice farmers' households' heads responses.

Obtaining sample size (Yamane formula):

$$n = {}^{N}\!/_{(1 + Ne^2)} \tag{1}$$

Where: n = required sample size; N = target population; e = level of precision (0.05).

The ordinal regression model for getting the estimates of the predictor variables is given below:

$$Agri\_lanL = \phi_0 + \beta_i Land\_con + \beta_i Land\_exp + \beta_i Land\_solF + \beta_i Land_{opp} + \beta_i Land\_rec + \beta_i Land_{\_minF} + \varepsilon \tag{2}$$

Whereas: Agri_lanL = Agricultural land loss in area/acre (dependent variable).

ϕ and β are parameters; ϕ is constant and β_i is coefficient of the independent variables and ε is error term.

i= 1, 2 & 3: β_1 = disagree; β_2 = agree and β_3 = strongly agree.

Land_con = land concession; Land_exp = land expropriation; Land_solF = Farmers' indulged in sales of their agricultural land to illegal miners; Land_opp = abandoned open pits by the mines industry; Land_rec = lack of land reclamation; Land_minF = Farmers' engaged in mining their farmland.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Rice Farming Households

As shown in Table 1, the average age of the rice farmers' household heads was 46 years, which suggests that the average age of rice farmers in the district is slightly above the average age of youth. Similar studies indicated the average age of agricultural family heads in Sierra Leone was 40 years old (Leone, 2015). As is usually evidenced, male farmers' household heads accounted for the majority of the respondents, with a mean of 1.5. Also, the marital status of the respondents indicated that a large proportion of them, with a mean value of 2.3 (83%), were married. This result aligns with the research done by Baddianaah et al. (2022) in Ghana, who found that farmers' household heads were mostly married. The range of household sizes was one person to 38 people, with seven people being the average per household head. This is similar to ICI's (2017) findings that the typical number of farmers' households in West Africa is eight. The household head and their immediate family comprised most of the household's population. The results likewise showed that a significant level of illiteracy exists among the farmers in the district, which is about 75% of the mean value (1.8). Most literate respondents had a primary school, with the average length of their formal education being close to three years (2.9 years).

Moreover, the research results disclosed that the average farm size of the respondents was 3.7 acres, a minimum of 1.0 acres, and a maximum of 15 acres. This result collaborates with the findings by Conteh (2017), which stated that most rice farmers in West Africa cannot cultivate rice on average beyond two hectares. In addition, the results revealed that the average acreage of arable land lost during mineral exploitations for the past five years was 1.6 acres, with a minimum of 0.0 acres and a maximum of 15 acres. Being that most of the rice farmers are subsistence, mining encroachment on their fertile arable lands is exacerbating both the farm size and fertility nature of the land, which is correspondently documented in scholarly literature that at least 2 acres of agricultural land area on average is falling in the hands of mining industries in mining regions (Maconachie and Binns, 2007).

Table 1. Socio-demographic characteristics of rice farmers.

Variables	Mean	Std. Error	Min.	Max.
Age	46.0	0.668	20	80
Gender/male	1.5	0.023	1	2
Marital status/married	2.3	0.042	1	5
Household size	7.3	0.218	1	38
Literacy status/illiterate	1.8	0.023	1	2
Years of formal education	2.9	0.290	0	21
Average farm size cultivated	3.7/acre	0.106	1	15
Average yield of paddy rice (Kg) harvest before mining	1,745	57.016	225	8,000
Average yield of paddy rice (Kg) harvest after mined	180	46.298	5,500	1,381
Average monthly farm income	38.3/USD	3.390	5	1,100

Source: Authors' computation, 2023.

In addition, results explained that the average rice paddy yield before the mine invasion was 1,745kg, with a minimum of 225kg and a maximum paddy yield of 8,000 kilograms per rice farmer; after the mine invasion, the average result of paddy rice was 1,381kg, with a minimum yield of 180kg and a maximum of 5,500kg paddy rice per farmer in the research communities. This is a clear manifestation that mining activities have hindered the productivity of agricultural lands in the research communities.

Similarly, results were manifested in a published article by Shubita et al. (2023) that mining tailings like mercury, cyanide, inorganic oil, etc., are heavily deposited into soils, leading to low agricultural land productivity in the mining regions of Ghana. Furthermore, the results disclosed that the rice farmers earned a mean income of Le.843.04 (USD 38.32) a month from selling their produce, with revenue ranging from a minimum sum of Le.100 (USD 5.0) to a maximum of Le. 24,200 (USD 1,100).

Farmers Perceptions on Mines-related Factors of Agricultural Land Loss

According to the marginal effects estimates of the ordinal logistic regression model of Table 2, the results revealed that if the land concession increases by one unit, there will be 8% less likely to disagree that agricultural land loss is due to mines-related land concession in the research communities. In addition, the results disclosed that a one-unit increase in mines-related land concession would lead to 0.4% and 8% more likely to agree and strongly agree that mining land concession had caused severe agricultural land loss in the mining area. This implies that there is indeed a significant ($p<0.05$) agricultural land loss in the mining communities as a result of mining land concession. Similar research has indicated that concessions are usually given to mining firms as standard practices in affluent mineral areas (Isahak et al., 2013). These mined land concessions pay little attention to the advantages of biodiversity in the impacted environments, resulting in more detrimental effects on the locals, of which even the compensations they receive will be minimal (Luning and Pijpers, 2017).

The results also indicated that for any one-unit increase in land expropriation, there would be 9% less likely to disagree with agricultural land loss caused by mines-related land expropriation in the research area. The effect of land expropriation on agricultural land to mines is significant ($p<0.05$), and it might be due to mining operations on the agricultural land areas in most of the study communities. Moreover, the results disclosed that for any one-unit increase in the mined land expropriation, there would be 8% more likely to strongly agree that mining land expropriation is inflicting agricultural land loss in the mining communities. The reason for this is that most farmers are unable to afford even needed commodities, normally sold at exorbitant prices due to competitive miners' profits, because of the mines' claim of lands from the farmers with inadequate, sometimes no compensations offered (Taabazuing et al., 2012).

Similarly, the results showed that for any one-unit increase in agricultural land sales to illegal miners by farmers, there would be 11% less likely to disagree with the loss of agricultural land due to the farmers' agricultural land sales. On the other hand, if there is any one-unit increase in agricultural land sales, there will be 0.5% and 10% more likely to agree and strongly agree, respectively, that the loss of agricultural land is due to farmers selling their lands to illegal miners. In other words, respondents' perceptions were very high to accept land loss due to sales by farmers rather than reject the cause of farmers selling their farmland to illegal miners. In most cases in West African countries, grossly poor farmers are influenced by money that should be involved in such acts. So, the effect of rice farmers losing their farmland through sales to illegal miners is significant ($p<0.05$) in the research area. Related studies have shown that land attainment in mining rights can be acquired by leases, allocations, or outright purchases by private entities, businesses, and governments, which involve displacing hundreds of families and individuals from their farmlands (Martinez-Alier et al., 2014). Other studies likewise documented that landowners do not have the absolute right to engage in the large-scale selling of their lands. Still, they primarily sell secret land, particularly to illegal miners (Bury, 2004).

Furthermore, the results revealed that for any one-unit increase in abandoned mined open pits, there would be 1% less likely to disagree that the substantial loss of agricultural land was associated with abandoned mined pits in the study area. Likewise, the results explained that for any one-unit increase in abandoned mined open pits, there would be 0.06% and 1% more likely to agree and strongly agree, respectively, that abandoned mined open pits caused significant ($p<0.050$) effects on agricultural land loss in the research communities. This implied that mining industries should have covered the excavations created in the fields during their operations, causing a decrease in arable lands for farming. A similar study by Maus et al. (2020) built a dataset using Google Earth software indicating mining surface elements, such as open pits, tailing dams, and infrastructure, were visually identified across the globe in the year 2020 across an area of 21,060 polygons mined pits totalling 57,277 km square which is substantial agricultural land areas that might be. Related documents have also shown that industrial mining excavated ponds and lakes in Sierra Leone over twenty-six years still need to be in better shape, rendering the agricultural land useless for agricultural production (Akiwumi and Butler, 2008).

Table 2. Farmers' perceptions on mines-related factors of agricultural land loss.

Variable	Estimate	Percent (%)	Std.Err	P-value (* 5%)
Land_con (1)	-0.0832*	8	0.0267	0.002
(2)	0.0038*	0.4	0.0043	0.017
(3)	0.0794*	8	0.0252	0.002
Land_exp (1)	-0.0880*	9	0.0259	0.001
(2)	0.0041*	0.4	0.0043	0.040
(3)	0.0839*	8	0.0253	0.001
Land_solF (1)	-0.1058*	11	0.0239	0.000
(2)	0.0049*	0.5	0.0052	0.046
(3)	0.1009*	10	0.0235	0.000
Land_opp (1)	-0.0125*	1	0.0264	0.037
(2)	0.0006	0.06	0.0014	0.679
(3)	0.0119*	1	0.0251	0.012
Land_rec (1)	-0.0157*	2	0.0261	0.048
(2)	0.0007	0.07	0.0014	0.610
(3)	0.0150*	2	0.0249	0.028
Land_minF (1)	-0.1450*	15	0.2322	0.000
(2)	0.0067	0.7	0.0071	0.345
(3)	0.1383*	14	0.0230	0.000

Source: Authors' computation, 2023. P* significant at 5%.

Additionally, the results disclosed that for any one-unit increase in the lack of land reclamation by mined industries, either small or large, 2% of the respondents' perceptions to less likely disagree that the cause of agricultural land loss was in association with mining industries failure in reclaiming the mined fields. Also, the results revealed that if the lack of land reclamation by mining industries increases by one unit, there will be 0.07% and 2% more likely to agree and strongly agree, respectively, that agricultural land loss is due to the lack of mines industries in reclaiming the mined fields in the mining community. This result implied that mining industries were just busy removing the minerals without paying attention to bringing the lands to productive agricultural land. Policies are sometimes in place, but due to corruption, most of these things are being compromised by stakeholders to ensure the mined land is reclaimed. Related studies revealed that due to the incapability of farmers to reclaim mined abandoned fields, particularly in areas with abundant mineral resources, there is a decrease in food output due to the conversion of the agricultural fields and the migration of a productive labour force into the mining activities, forgetting about the agricultural production (Hoedoafia et al., 2014).

Furthermore, the results indicated that for any one-unit increase in the farmers' involvement in mining their farmland, there would be 15% less likely to disagree with the effect of agricultural land loss in connection to the farmers' involvement in mining their farmland in the mining areas. Besides, the results indicated that for any one-unit increase in the farmers' involvement in mining their farmland, there would be 14% more likely to strongly agree the effect of agricultural land loss in connection to the farmers' involvement in mining their farmland in the mining communities. This result reflects the issue of farmers' access to quick income, which may warrant them to be involved in mining on their farmlands, leading to unsuitable and horrible land conversion in the mines area. This study's results corroborated the study by Hilson and Garforth (2013), which stated that food items could become scarce in mine zones as much as the vast majority of those poor farmers venture into small-scale illegal mining, worsening the arable land availability and farming practices in their community.

CONCLUSIONS

Mines in many developing countries are located in rural areas, where agriculture is an important economic activity and the primary source of livelihood for a large proportion of the population. Most importantly, mines exploit land to extract minerals and, in the process, generate significant hostile spillovers to farmers, such as pollution, competition for land, and labour. Agriculture is the main economic activity of the people in the Kenema district of Sierra Leone; however, farmers in this district are mainly characterized by small-farm holdings due to shrinking agricultural land and increasing mining activities in the district. However, the study illustrates the agricultural land loss effects of mining activities in Sierra Leone, especially Kenema district. The study indicated that much mining occurs on agricultural land, mainly based on mined land concessions, which implies a substantial agricultural land loss. Likewise, the results disclosed a lot of mined pits with minimal or no land restorations done on the mined fields, which had been pre-occupied by agricultural activities. Moreover, the average yields before and after five years of mining in the communities were compared, and the results explained an adverse link between mining expansion and cereal production. This may be associated with farmers abandoning cereal (rice) farming in favour of illegal mining. These findings indicate that because there is a growing shortage of land for the production of cereals, mining expansion may pose a threat to the food supply.

Thus, the government and stakeholders should ensure effective community participation in environmental decision-making, addressing the weaknesses in the mining environmental policies and enforcement, establishing environmental oversight groups, and awareness campaigns in mining communities with more emphasis on mining industries to reclaim and restore the mined fields.

New evidence from our study supports developing agricultural land in Sierra Leone sustainably. Nevertheless, there are still certain limitations to the article. We solely assessed farmers' perceptions of mining's effects on the sustainability of agricultural land for farmers' livelihoods, taking into account issues related to land loss. Further studies need to be conducted to determine the extent of the effects of decreasing agricultural land due to diamond and gold mining on agricultural land in the mining communities at a national level. This will offer helpful information supporting the cost-benefit analysis of how mining affects communities and other economic sectors. Realizing the advantages and disadvantages of mining for communities and other industries will be important information for future mining policy development. Also, empirical research can be done on the implication of diamond and gold mining operations on farmers' productivity, and the results help contribute to a sound policy formulation for a sustainable increase in agricultural productivity in the mining regions.

REFERENCES

Danielson, L., Lagos, G., 2001. The role of the minerals sector in the transition to sustainable development. Int. Min. Miner. 4, 20–21.

Aborah, E.O., 2016. Effects of small-scale mining on food production in the Amansie West District of the Ashanti Region Ghana (Doctoral dissertation). Kwame Nkrumah University of Science and Technology in Ghana. https://ir.knust.edu.gh/server/api/core/bitstreams/8c4dcfaa-1528-4afe-8f50-d7c43076a7a6/content.

ACET, 2017. The impact of expanding artisanal and small-scale mining on small-scale holder agriculture in West Africa: A case study of Burkina Faso, Ghana and Sierra Leone. African Center for Economic Transformation. Synthesis Report October, 2017. Retrieved online from: http://www.acetforafrica.org.

Akabzaa, T., Darimani, A., 2001. Impact of mining sector investment in Ghana: A study of the Tarkwa mining region. Third World Netw. 11, 47–61.

Akiwumi, F.A., Butler, D.R., 2008. Mining and environmental change in Sierra Leone, West Africa: a remote sensing and hydrogeomorphological study. Environ. Monit. Assess. 142, 309–318.

Akiwumi, F.A., D'Angelo, L., 2018. The Sierra Leone rare earth minerals landscape: An old or new frontier? Extr. Ind. Soc. 5, 36–43.

Aragón, F.M., Rud, J.P., 2016. Polluting industries and agricultural productivity: Evidence from mining in Ghana. Econ. J. 126, 1980–2011.

Arthur, F., Agyemang-Duah, W., Gyasi, R.M., Yeboah, J.Y., Otieku, E., 2016. Nexus between artisanal and small-scale gold mining and livelihood in Prestea mining region, Ghana. Geogr. J. 2016, 1–18.

Baddianaah, I., Baatuuwie, B.N., Adongo, R., 2022. Socio-demographic factors affecting artisanal and small-scale mining (galamsey) operations in Ghana. Heliyon, 8(3), e09039.

Bermúdez-Lugo, O., 2013. The mineral industry of Ghana. 2011 Minerals Yearbook. Volume 3: Pp. 36.1–36.

Borras Jr, S.M., Franco, J.C., 2012. Global land grabbing and trajectories of agrarian change: A preliminary analysis. J. Agrar. Chang. 12, 34–59.

Botchway, S.K., 2018. Assessing the effects of small-scale mining on agricultural production in the Atiwa District. Department of Geography and Resource Development. Doctoral Dissertation, University of Ghana, Legon. https://www.ug.edu.gh/pad/sites/pad/files/u6/docs/SCHOOL%20OF%20GRADUATE%20STUDIES-compressed.pdf.

Brown, B.E.K.A., Kimani, E., 2021. Artisanal and Small-Scale Mining: The Paradox of Extraction, pp. 1–5. https://www.iied.org/sites/default/files/pdfs/migrate/G00905.pdf.

Bury, J., 2004. Livelihoods in transition: transnational gold mining operations and local change in Cajamarca, Peru. Geogr. J. 170, 78–91.

Chen, Z., Huffman, W.E., Rozelle, S., 2011. Inverse relationship between productivity and farm size: the case of China. Contemp. Econ. Policy 29, 580–592.

Chimhowu, A., Woodhouse, P., 2006. Customary vs private property rights? Dynamics and trajectories of vernacular land markets in Sub-Saharan Africa. J. Agrar. Chang. 6, 346–371.

Conteh, F.M., 2017. Politics, development and the instrumentalisation of (de) centralisation in Sierra Leone. Rev. Afr. Polit. Econ. 44, 30–46.

Cotula, L., Oya, C., Codjoe, E.A., Eid, A., Kakraba-Ampeh, M., Keeley, J., Kidewa, A.L., Makwarimba, M., Seide, W.M., Nasha, W.O., 2014. Testing claims about large land deals in Africa: Findings from a multi-country study. J. Dev. Stud. 50, 903–925.

De Sherbinin, A., VanWey, L.K., McSweeney, K., Aggarwal, R., Barbieri, A., Henry, S., Hunter, L.M., Twine, W., Walker, R., 2008. Rural household demographics, livelihoods and the environment. Glob. Environ. Chang. 18, 38–53.

Dontala, S.P., Reddy, T.B., Vadde, R., 2015. Environmental aspects and impacts its mitigation measures of corporate coal mining. Procedia Earth Planet. Sci. 11, 2–7.

ElHadary, Y.A.E., Obeng-Odoom, F., 2012. Conventions, changes, and contradictions in land governance in Africa: The story of land grabbing in North Sudan and Ghana. Afr. Today 59, 59–78.

Elliott, P., Gardner, J., Allen, D., Butcher, G., 1996. Completion criteria for Alcoa of Australia Limited's bauxite mine rehabilitation. In Third International and the 21st Annual Minerals Council of Australia Environmental Workshop, Newcastle, Australia, October (pp. 14-18). https://onlinelibrary.wiley.com/doi/10.1111/j.1442-8903.2004.00172.x.

Farrell, T.P., Kratzing, D.C., 1996. Environment effects. In: Environmental management in the Australian minerals and energy industries – principles and practices (Ed. Mulligan, D.), UNSW press in association with Australian Mineral and Energy Environmental Foundation, Sydney: 77-98. https://www.library.uq.edu.au/.

Fayiah, M., 2020. Mining and environmental degradation: A gift brings grief scenario for mining communities in Sierra Leone. J. Min. Environ. 11, 347–361.

Gasparatos, A., Takeuchi, K., Elmqvist, T., Fukushi, K., Nagao, M., Swanepoel, F., von Blottnitz, H., 2016. Sustainability science for meeting Africa's challenges. 371-372.

GoSL, 2021. 2021 VNR Report on SDGs in Sierra Leone. Government of Sierra Leone: Freetown. https://sustainabledevelopment.un.org/content/documents/279542021_VNR_Report_Sierra_Leone.pdf.

Graham, Y., 1996. The Ghanaian Mineral Industry: Implication for the Future. Africa Agenda, No. 15 Accra: Asempa Publication. Pp.6-7. https://urn.fi/URN:NBN:fi:amk-201301231641.

Gwynne-Jones, D.R.G., Mitchell, P.K., E-Harvey, M., Swindell, K., 1978. A New Geography of Sierra Leone. Longman, London. https://books.google.com.pk/books/about/A_New_Geography_of_Sierra_Leone.html?id.

Hilson, G., 2002. An overview of land use conflicts in mining communities. Land use policy 19, 65–73.

Hilson, G., 2016. Artisanal and small-scale mining and agriculture. Exploring their limits in rural sub-Saharan Africa. Sustainable Market, Issue paper IIED, London. https://www.iied.org/sites/default/files/pdfs/migrate/16617IIED.pdf.

Hilson, G., Garforth, C., 2013. 'Everyone now is concentrating on the mining': drivers and implications of rural economic transition in the eastern region of Ghana. J. Dev. Stud. 49, 348–364.

Hoedoafia, M.A., Cheabu, B.S.N., Korang, V., 2014. The effects of small scale gold mining on living conditions: A case study of the west gonja district of Ghana. Int. J. Soc. Sci. Res. 2, 151–164.

ICI, 2017. Cocoa farmers in Ghana experience poverty and economic vulnerability. International Cocoa Initiative. Available online at: https://cocoainitiative.org/news-media-post/cocoa-farmers-in-Ghanaexperience-poverty-andeconomic-vulnerability/.

Isahak, A., Surif, S., Sahani, M., Gill, A., Phang, J., 2013. Environmental stewardship for gold mining in tropical regions. J. Degrad. Min. Lands Manag. 1, 37–42.

Kumah, A., 2006. Sustainability and gold mining in the developing world. J. Clean. Prod. 14, 315–323.

LaJeunesse Connette, K.J., Connette, G., Bernd, A., Phyo, P., Aung, K.H., Tun, Y.L., Thein, Z.M., Horning, N., Leimgruber, P., Songer, M., 2016. Assessment of mining extent and expansion in Myanmar based on freely-available satellite imagery. Remote Sens. 8, 912.

Larson, D.F., Otsuka, K., Matsumoto, T., Kilic, T., 2014. Should African rural development strategies depend on smallholder farms? An exploration of the inverse-productivity hypothesis. Agric. Econ. 45, 355–367.

Leone, S.S., 2015. Population and Housing Census-Summary of Final Results. Freetown, Sierra Leone: Statistics Sierra Leone. https://www.statistics.sl/images/StatisticsSL/Documents/final-results_-2015_population_and_housing_census.pdf.

Luning, S., Pijpers, R.J., 2017. Governing access to gold in Ghana: in-depth geopolitics on mining concessions. Africa (Lond). 87, 758–779.

Mabey, P.T., Li, W., Sundufu, A.J., Lashari, A.H., 2020. Environmental impacts: Local perspectives of selected mining edge communities in Sierra Leone. Sustainability 12, 5525.

Maconachie, R., Binns, T., 2007. 'Farming miners' or 'mining farmers'?: Diamond mining and rural development in post-conflict Sierra Leone. J. Rural Stud. 23, 367–380.

Mantey, J., Nyarko, K., Owusu-Nimo, F., 2016. Costed reclamation and decommissioning strategy for galamsey operations in 11 selected MDAs of. International Growth Centre. https://www.theigc.org/sites/default/files/2017/01/Mantey-et-al-2016-Final-report.pdf.

Margao, P.J., 2021. Assessing the challenges of diamond mining and its impact on Sierra Leone's economy. Master thesis, International Institute of Social Studies-Netherlands. file:///C:/Users/dell/Downloads/Margao-Paul-Jason_MA_2020_21_ECD%20(7).pdf.

Martinez-Alier, J., Temper, L., Munguti, S., Matiku, P., Ferreira, H., Soares, W., Singh, S., 2014. The many faces of land grabbing: cases from Africa and Latin America. EJOLT Rep., 10, 93.

Maus, V., Giljum, S., Gutschlhofer, J., da Silva, D.M., Probst, M., Gass, S.L.B., Luckeneder, S., Lieber, M., McCallum, I., 2020. A global-scale data set of mining areas. Sci. Data 7, 289.

Moomen, A., 2017. Strategies for managing large-scale mining sector land use conflicts in the global south. Resour. Policy 51, 85–93.

Moomen, A.W., Dewan, A., 2015. Mining, agricultural space and land use conflicts: The role of local government. Fourth International Conference on Agro-Geoinformatics (Agro-geoinformatics) (pp. 228-233). IEEE. https://www.researchgate.net/publication/282700301_Mining_agricultural_space_and_land_use_conflicts_the_role_of_the_local_government.

Musemwa, M., 2009. Contestation over resources: the farmer-miner dispute in colonial Zimbabwe, 1903-1939. Environ. Hist. Camb. 15, 79–107.

Ncube-Phiri, S., Mucherera, B., Ncube, A., 2015. Artisanal small-scale mining: Potential ecological disaster in Mzingwane District, Zimbabwe. Jàmbá J. Disaster Risk Stud. 7, 1–11.

Nunez, C., 2019. Deforestation Explained. National Geographic. Retrieved online from: https://www.nationalgeographic.com/environment/global-warming/deforestation/.

Obeng, E.A., Oduro, K.A., Obiri, B.D., Abukari, H., Guuroh, R.T., Djagbletey, G.D., Appiah-Korang, J., Appiah, M., 2019. Impact of illegal mining activities on forest ecosystem services: local communities' attitudes and willingness to participate in restoration activities in Ghana. Heliyon 5, e02617–e02617.

Obiri, S., Mattah, P.A.D., Mattah, M.M., Armah, F.A., Osae, S., Adu-Kumi, S., Yeboah, P.O., 2016. Assessing the environmental and socio-economic impacts of artisanal gold mining on the livelihoods of communities in the Tarkwa Nsuaem municipality in Ghana. Int. J. Environ. Res. Public Health 13, 160.

Ocansey, I., 2013. Mining impacts on agricultural lands and food security: Case study of towns in and around Kyebi in the Eastern Region of Ghana. Turku University of Applied Sciences Thesis. https://urn.fi/URN:NBN:fi:amk-201301231641.

Ouoba, Y., 2018. Industrial mining land use and poverty in regions of Burkina Faso. Agric. Econ. 49, 511–520.

Owusu-Koranteng, H., 2005. The impact corporate social responsibility has on community development and conflict prevention: A study of Newmont mining company in the Asutifi North District, Ghana. https://erepo.uef.fi/bitstream/handle/123456789/30424/urn_nbn_fi_uef-20231067.pdf?sequence=1&isAllowed=y.

Owusu-Koranteng, D., 2008. Mining investment & community struggles. Rev. Afr. Polit. Econ. 35, 467–473.

Pijpers, R., 2014. Crops and carats: Exploring the interconnectedness of mining and agriculture in Sub-Saharan Africa. Futures 62, 32–39.

Poku, N.O., 2016. Effects of illegal small scale mining on crop production in Amansei Central, Ghana. Doctoral Thesis, Menel University in Brno. 91pp. https://doi.org/10.55058/adrrijafs.v4i5(4)

Razzaq, A., Sharif, A., Ozturk, I., Skare, M., 2022. Inclusive infrastructure development, green innovation, and sustainable resource management: evidence from China's trade-adjusted material footprints. Resour. Policy 79, 103076.

Reardon, T., Berdegué, J., Escobar, G., 2001. Rural nonfarm employment and incomes in Latin America: overview and policy implications. World Dev. 29, 395–409.

Shubita, M., Ahmed, S., Essel-Paintsil, M., 2023. The economic impact of corporate social responsibility on the development of indigenous communities: evidence from Ghana's mining sector. Int. J. Organ. Anal. 31, 196–214.

Taabazuing, J., Luginaah, I., Djietror, G., Otiso, K.M., 2012. Mining, conflicts and livelihood struggles in a dysfunctional policy environment: the case of Wassa West District, Ghana. African Geogr. Rev. 31, 33–49.

Teschner, B.A., 2014. "Orpaillage pays for everything": How artisanal mining supported rural institutions following Mali's coup d'état. Futures 62, 140–150.

Tetteh, E.N., 2010. Evaluation of land reclamation practices at Anglogold Ashanti, Iduapriem Mine Ltd, Tarkwa. Doctoral dissertation. Retrieved online from: https://ir.knust.edu.gh/handle/123456789/2086.

Turner, B.L., Lambin, E.F., Reenberg, A., 2007. The emergence of land change science for global environmental change and sustainability. Proc. Natl. Acad. Sci. 104, 20666–20671.

Walker, R., 2004. Theorizing land-cover and land-use change: the case of tropical deforestation. Int. Reg. Sci. Rev. 27, 247–270.

Wilson, S.A., 2015. Corporate social responsibility and power relations: Impediments to community development in post-war Sierra Leone diamond and rutile mining areas. Extr. Ind. Soc. 2, 704–713.

Yamane, T., 1967. Statistics, an introductory analysis. NewYork: Harper and Row. https://www.tarleton.edu/academicassessment/wp-content/uploads/sites/119/2022/05/Samplesize.pdf.