IAA Journal of Scientific Research 11(2):21-32, 2024. www.iaajournals.org
©IAAJOURNALS ISSN:2636-7319
https://doi.org/10.59298/IAAJSR/2024/112.2132 IAAJSR:112.2132

Assessment of the Environmental and Socio-economic Impacts of Iron Ore Exploration Activities in Uganda. A Case Study of Iron Ore Mines in Muko Sub-County in Rubanda District

Shabahurira Deus and Omuna Daniel

School of Natural and Applied Sciences, Kampala International University, Uganda.

ABSTRACT

This study assessed the environmental and socio-economic impacts of iron ore exploration activities in Uganda, specifically focusing on iron ore mines in Muko Sub-County, Rubanda District. The research has three specific objectives. First, it seeks to identify the various iron ore exploration activities being carried out in the study area. Second, it aims to uncover the challenges faced by the local communities living around the iron ore site. Lastly, the study aims to examine the interventions that have been implemented to address these challenges. Various data collection tools like interviewing, observation, focus group discussion, and questionnaires were applied to gather the required data for this study. By conducting a comprehensive analysis of the environmental and socio-economic impacts, this research hopes to contribute to a better understanding of the potential consequences of iron ore exploration activities. It also seeks to provide valuable insights into the strategies that can be employed to mitigate these challenges and foster sustainable development in the region. The findings of this study indicated that various exploration and exploitative iron ore activities have been carried out within the study area such as; open-pit mining, site preparation, hauling and transportation, survey, and mapping among others. The study also revealed that; conflicts, displacements of residents from their lands, degradation of the environment, and employment opportunities among other effects have arisen. On the issue of measures to mitigate the effects, EIAs, and restorations of the degraded environment were identified. This study concluded that; the results of this study show that the study region has been significantly impacted by iron ore exploration and extraction activities. Environmental degradation brought on by these practices includes soil erosion, water contamination, and deforestation. In addition, socioeconomic developments such as eviction, loss of livelihoods, and growing inequality have affected the nearby villages. In conclusion, both the environment and the nearby communities have suffered as a result of iron ore exploration and exploitation activities in the study region. To lessen these negative effects and encourage sustainable practices in the sector, immediate action must be taken. It was also recommended that strict laws and enforcement by government agencies and community engagement should be put at the fingers point to ensure the most sustainable iron ore mining not only in the study area but also in the country-Uganda as a whole.

Keyword: Environmental impacts; Socio-economic impacts; Iron ore exploration; Uganda; Muko Sub-County

INTRODUCTION

Iron ore exploration activities have been recognized as one of the significant contributors to environmental degradation and socio-economic impacts in several regions globally [1, 2]. The exploration of iron ore involves various activities that have the potential to cause severe environmental and socio-economic impacts, including land degradation, soil erosion, water pollution, deforestation, displacement of communities, and loss of biodiversity. These impacts can have far-reaching consequences on the local and global environment and can also affect the well-being and livelihoods of the communities residing in and around the mining sites. As such, there is a need to investigate the environmental and socio-economic impacts of iron ore exploration activities comprehensively to develop effective mitigation measures and sustainable mining practices that can minimize negative impacts while maximizing the benefits to local communities and the environment [3]. Mining plays a prominent role in the economy worldwide since human efforts have been more concentrated on extraction than recycling of natural resources. Ores composed of various minerals vary according to geological evolution [4]. The mining industry triggers

intense environmental impacts. Human exposure to multiple small particles from mining effluent, such as dust, uranium, iron, lead, zinc, silicon, titanium, sulfur, nitrogen, platinum, chromium, vanadium, manganese, and mercury, is a health risk. Such elements can have several pathological effects, such as respiratory and cardiovascular, multiple chronic inflammation, and neurodegenerative diseases. Additionally, mining results in severe soil, water (surface and aquifer), and air contamination, reaching large areas far away from the source [5]. Negligence of mining companies, with the recovery of ancient mined areas during the early development of environmental laws and regulations, compromises environmental integrity for more extended periods, increasing coverage of the affected areas. The iron ore mining (Exploration and exploitative) activity results in considerable waste production and impacts on surrounding ecosystems. Natural recovery of impacted areas is absent or occurs slowly, especially when associated with prolonged dry seasons in tropical regions[6]. Mining and associated smelting and metal processing activities have led to perturbations in the cycling of metals in the surface environment. In this context, iron-ore mines act as important sources of major metals, mainly Fe and Mn, but also associated trace metals into the environment. In India, the Joda-Barbil region of the Keonjhar District, Odisha, has played a key role on India's mineral map as a result of its extensive natural resources, particularly its high-grade iron and manganese ore reserves. The extraction of a nation's mineral resources is a crucial commercial activity for its economic growth. Opencast iron ore mining and other associated operations affect the local ecosystem and environment. Massive, irrational opencast mining operations that adversely affect other natural resources like land, water, soil, air, flora, and fauna are causing a wide range of environmental issues. Ambient air is significantly harmed by the addition of fugitive dust and other pollutants at every stage of mining activities, from exploration to exploitation [7].

Barium sulphate, sometimes known as barite, is a non-metallic mineral that is primarily utilized by the oil and gas sector as a weighing ingredient in drilling mud during drilling operations in Nigeria. Barite must have a specific gravity between 4.1 and 4.6 in order to be used as an addition in drilling mud [8]. The barite from Nigeria is of moderate to excellent quality. It frequently coexists with minerals including calcite, fluorite, quartz, and dolomite. Iron oxide (goethite), quartz, and carbonates of magnesium, iron, and calcium are the mineral's main impurities. Poor infrastructure development, safety and security, a lack of geophysical and geoscience data, and imprecise mining methods are only a few of the difficulties associated with mining the material. During surface mining operations, overburden is usually removed to expose the primary ore deposit. When the mined goods are taken from the mine site and transported to another place [9]. Uganda aspires to exploit its abundant iron ore resources to supply the required raw material for developing its iron and steel industry across all the phases of the value chain. The country imports USD 369 million worth of iron and steel products annually, 60% of which are raw materials for the steel processing plants [10]. The National Planning Authority, a government planning organization, carried out a study to see if the nation's iron ore resources might be utilised as a source of supply for the production of iron and steel. Accessible geological literature was acquired from a number of sources and studied for the study in order to better understand the process of iron ore mineralization in Uganda, particularly that in the South West [11]. A field trip to the deposits was planned in order to confirm the information discovered through literature research, conduct a thorough reconnaissance study to benchmark the most likely scenarios required for the development of the iron and steel value chain, and establish the most likely mining and processing needs of the deposits [12, 13]. The reconnaissance research confirmed the existence of hematite deposits that visually display high-quality iron ore characteristics (55%–68% Fe) suitable for the production of iron [14]. Surface scans reveal that the deposits are predominantly composed of thin beds of mineralization. The two kinds of hematite that can be mined and used as direct feed for ore processing plants are massive hematite and speculate hematite (a metamorphic platy variant), both of which normally require mineral processing [10]. According to the information that is currently available, the majority of the iron ore reserves were found in the Kanungu district, Bukimbiri in the Kisoro district, Muko, Nyamiringa, and Nyamweru sub-counties in the Rubanda district, and Buhara Sub County in the Kabale district. The iron content of the ore found in the Kigezi region is 60%. The important industry of iron ore mining contributes significantly to the growth of the world economy. Iron ore exploration activities are one of the major causes of socioeconomic consequences and environmental deterioration in many parts of the world. The search for iron ore necessitates a number of actions that have the potential to have detrimental effects on the environment and society, including deforestation, soil erosion, water pollution, community uprooting, and biodiversity loss. The ecosystem both locally and globally may be significantly impacted by these effects, which may also have an impact on the communities living near mining sites and on their quality of life. In order to establish efficient mitigation strategies and sustainable mining techniques that can limit adverse effects while maximizing the benefits to the environment and society, it was necessary to thoroughly analyse the environmental and socioeconomic implications of iron ore exploration

activities. And it was upon this back ground that, the study was conducted on the 'assessment of the environmental and socio-economic impacts of iron ore exploration activities in Rubanda district, Uganda".

METHODOLOGY

Research Design

This study involved a cross-sectional survey where the researcher visited the study site and obtained both primary and secondary data from the target study population. This study was also mixed research in nature, where both narrative and systematic approaches were used to collect both qualitative and quantitative data.

Background Information of the Study area

Muko Sub- County is located in Rubanda District in the western region of Uganda. Muko Sub-County is a local government administrative unit in Rubanda District, located in the southwestern part of Uganda. The area was originally inhabited by the Bafumbira, a Bantu ethnic group, who were primarily farmers and herders. The sub-county was established as part of the Ugandan government's efforts to decentralize power and improve local governance in the country. Throughout the year, temperatures in Muko typically range from 20 to 30 degrees Celsius, making for a tropical climate. The dry season normally lasts from December to February and from June to August, while the rainy season typically lasts from March to May and from September to November. Regarding the vegetation, Muko is located in a region renowned for its luxuriant and varied plant life. The sub-county is primarily mountainous, with valleys covered in a variety of trees, bushes, and grasses. Many of the nearby slopes are covered in tea plantations, which have made the sub-county particularly well-known. Eucalyptus trees, banana plants, and many kinds of fruit trees are among the other common flora in the region

Data Collection Tools

This study used tools such as surveys, interviews, focus groups, and observations to collect data.

Surveys

Using this method, the researcher created a survey questionnaire and distributed it to key stakeholders and local inhabitants in order for him to be able to acquire the information. The questionnaire was semi-structured with both open-ended and close-ended questions such that respondents were given room to express their views/thoughts and perceptions about the problem of study.

Interviewing Method

An in-depth interview was conducted by the researcher with the concerned authorities in the study area such as the local council, environment departments, and the hydrologists who could give technical information needed by the researcher. This method also involved a face-to-face interaction between the researcher and the officials in the study area.

Observation

This method involved the use of necked eyes for the research to be able to observe some of the study parameters and through this method, the researcher would always keep an eye on the exploration locations and gather information on their effects on the ecosystem and other physical parameters in the study area.

Focus Group Discussion

Using this method, a researcher holds meetings with a group of key stakeholders in the community to discuss the study problem. Each group consisted of 12 to 15 respondents and about five groups were formed each with a specific schedule for meeting.

Study Population

The population for this study was derived from the total population of the entire Muko sub-county in the district. According to the Uganda Bureau of Statistics, Muko sub-county has a total population of 37900 inhabitants as per the population census of 2014.

Target Population and Sample Size

Target Population

This study majorly targeted participants from various sectors like the district environment and natural resource officials, geologists, sub-county chiefs, councilors, farmers, business people, and some students, particularly from higher levels of learning in the study area.

Sample Size

The sample of participants for this study was derived from the total population of the entire district and this sample size of the target population chosen represented the ideals and perceptions of the entire population in the study area and the sampling techniques to be used when choosing samples included; simple random sampling that was applied on the local community members and then purposive sampling which was also applied on the technical expertise that could give technical and expert information needed by the researcher to achieve the study objectives.

To obtain the appropriate sample size for this study, the researcher adopted Slovene's formula of 2004 which states that;

$$n = \frac{N}{1 + Ne^2}$$

Where; n = sample size,
N = Population size of the entire area (37,900)
e = Margin of error (0.05 at C.I = 95%).

$$n = \frac{37900}{1 + 37900(0.05)^2} = 397.59 \approx 398 \text{ people}$$

Therefore, the sample size for this study was 398 respondents from the target population

Distribution of Respondents

The participants in this study were distributed according to their gender and the study engaged people of all sex. Participants in this study were therefore; chosen using both purposive and simple random sampling techniques as indicated in Table 1 below;

Table 1: Participants' distribution:

Target participant(s)			Technique to be used
	Males	**Females**	
Local residents	90	109	Simple random sampling
Miners/workers	75	25	Simple random sampling
Technical people	30	21	Purposive sampling
CBOs & NGOs	25	23	Simple random sampling
Total	**220**	**178**	

Source: Field researcher, 2023.

Data Analysis Methods

Data collected from the respondents was edited to correct any missing information on the questionnaire as this ensured accurate and reliable information/ results. Later, the data was coded with the use of Microsoft (MS) Excel. Descriptive statistics were also utilized such as; the use of frequency distribution tables, pi-charts, line graphs, and bar graphs to analyse the data collected to summarise the research findings through which the researcher made appropriate conclusions and recommendations for policy and decision-making.

Ethical Considerations

During the preliminary stages of the research, a researcher obtained an introductory letter from the school that was presented to the concerned authorities in the study area to confirm that his study is legally done. A consent form was also issued to the selected participants and the purpose of them participating in this research was disclosed to them. The identity of the participants to this study was kept confidential where the engaged respondents were asked to use serial numbers instead of using their names and the findings of the research was used for academic purposes only. It was also an ethical consideration that, this work was voluntarily done by participants and therefore, the researcher was able to disclose to the participants that, there must be no material gain expected by any participant and therefore, participants were given the right to withdraw from participating in this study at any time they would want.

RESULTS

Respondents' Demographic Features.

Gender of the Respondents.

A total of 398 (N = 398) participants were recruited and according to the distribution of participants who consented by gender, 220 (55.3%) were males and 178 (44.7%) were females which translated a male: female ratio of 5.53:4.47 ∞ 6:4 (Fig 1).

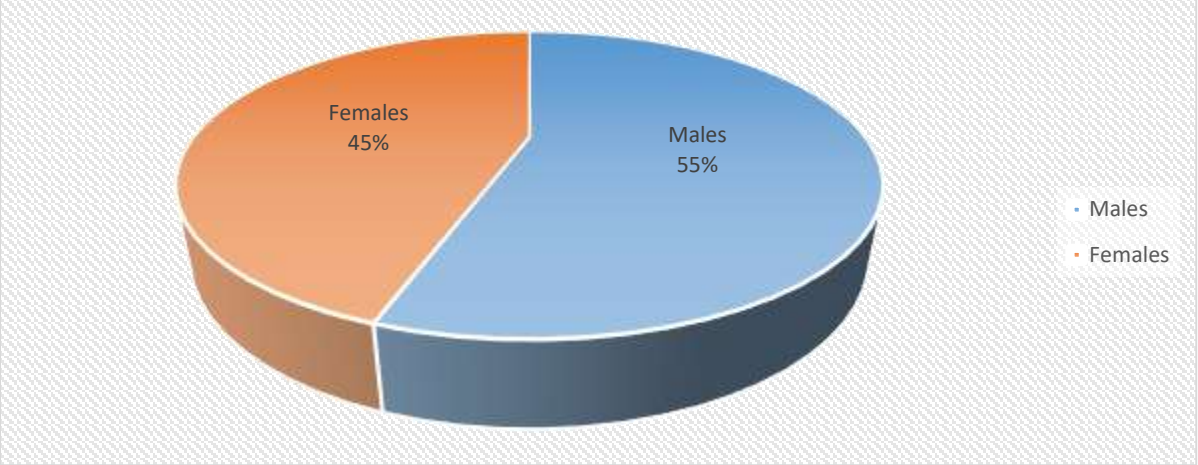

Figure 1: Distribution of respondents by gender.
Source: Field researcher, 2023.

This study engaged all categories of gender in order to ensure that data concerning the study problem is gotten from all dimensions of gender. Gender sensitive is very vital in gathering information since all kinds of people got challenged with any negative impact arise from iron ore mining activities and since females are the most vulnerable group, the researcher gave much attention to their views. Therefore, this study was gender sensitive and balanced as indicated in the fig1 above.

Respondents' Age Group

Out of the total number of respondents that were engaged in this study (N = 398), majority of the respondents lied in the age group of 36-45 years; 120 (30.2%). These were followed by those between 26-35 years; 99 (24.9%) and 15-25 years were 95 (23.8%). The least number of respondents were found in the age group between 46 and above; 84 (21.1%) as in (**Table 1**) below;

Table 2: Participation of Respondents by Age group

Variables		Frequency (N)	Percentage (%)
Age group (Years)	15 – 25	95	23.8
	26 – 35	99	24.9
	36 – 45	120	30.2
	≥46	84	21.1
Total		**398**	**100**

Source: Field researcher, 2023.

It is critical to consider the age group of research participants in any study. Physical, cognitive, and emotional development phases differ according to age group. The researcher was able to capture the whole spectrum of developmental changes and learn how factors such as genetics, environment, or interventions affect individuals at different phases of life by enrolling participants from diverse age groups. Age-related health issues and vulnerabilities vary by age group. The researcher was able to thoroughly analyze the prevalence, causes, and consequences of many health concerns by studying a varied range of ages. It also aided in the development of particular therapies and healthcare strategies for age-related illnesses. Individuals' social roles, obligations, and cultural settings are influenced by their age. The age groupings of the participants were taken into account by the researcher in order to throw more light on how societal norms, cultural traditions, and intergenerational dynamics influence people's experiences, attitudes, and behaviors. This knowledge could be used to help establish policies, programs, and interventions that are responsive to age-related social and cultural characteristics, among other things.

Distribution of Respondents by years of residence within the study area

Out of the total (N = 398) respondents, majority have been staying in the area for more than 16 years; 170 (42.7%). These were followed by those that have been in the area between 11-15 years and 6-10 years; 120 (30.2%) and 83 (20.8%) respectively. Only very few participants had not stayed in the area for so long i.e, they had stayed in the area for a period between 0-5 year; 25 (6.3) as in ***fig 2*** below;

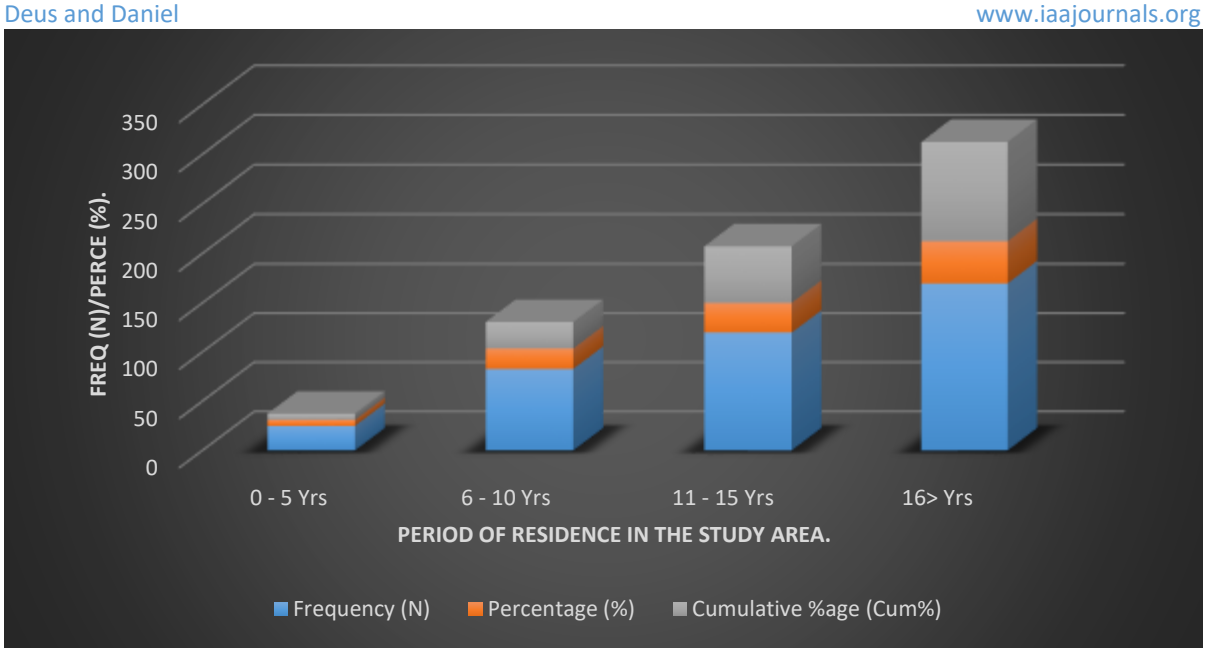

Figure 2: Distribution of Respondents by years of residence within the study area
Source: Field researcher, 2023.

Taking into account the duration of residence of research participants in the study region is crucial for various reasons, including the researcher's understanding of the context and dynamics of the community. Individuals' knowledge, experiences, and attitudes can be influenced by the amount of time they have lived in a place, which were important considerations examined by the researcher when performing his study. It also allowed him to examine the effect of participants' prolonged exposure to the research location. Researchers gain insights into the potential long-term consequences of environmental, social, or economic factors on people's lives by determining how long they have lived in a specific location. Furthermore, the length of stay assists researchers in identifying any potential biases or limits in the study. People who have recently moved to a new neighbourhood may have different viewpoints and experiences than long-term residents. The researcher ensured that their sample represented a varied variety of backgrounds and opinions by taking residence time into account. In conclusion, taking into account the length of residence of research participants increased the study's depth and accuracy by capturing the distinctive characteristics and effects of the study location, generating useful insights, and eliminating potential biases.

Participants' Level of Education and their Occupation.

Out of the total number of respondents engaged in this study (N = 398), the highest percentage of participants had attained formal education, about 300 (75.4%). Only a few respondents, about 98 (24.6%) had non-formal education. Of those who had obtained formal education, the majority had attained secondary education, about 150 (37.7%). These were followed by those that had attained tertiary education; about 100 (25.1%). Of the total number of participants that had attained formal education, only very few had primary level education; about 50 (12.6%) as in (***Table 2***) below;

Table 3: Respondents' Occupation in Relation to their Level of Education

Variables		**Occupation of respondents**					**Total**
		Peasant/Farmers	Professionals	Civil servant	Business	Others	
Education level of respondents	Informal	98	0	0	0	0	98
	Primary	50	0	0	0	0	50
	Secondary	60	0	0	90	0	150
	Tertiary	0	20	60	5	15	100
Total		**208**	**20**	**60**	**95**	**15**	**398**

(Source: Field researcher, 2023.)

Most of the respondents who had low levels of education, like informal and primary levels, were highly engaged in farming activities, particularly subsistence farming. Those with secondary education engage in both farming and business. Those who had attained tertiary education were mostly engaged in a wide range of professions like professionals, civil service, business, and others like teaching. This illustrates that education level opens great opportunities for people and for any community to develop, and education must be put at the center of this.

Iron ore Exploration and Exploitative Activities.

The Different Iron Ore Exploration and Exploitative Activities in the Study Area.

Respondents' views or perceptions concerning the different iron ore mining activities as per study objective (i) were sought. And majority of the participants identified activities like survey and mapping, site preparation, open-pit mining, hauling and transportation, processing, and beneficiations among others. Among these activities that were identified, open-pit mining was the most identified activity by a great percentage of participants; about 45% (179). This was followed by site preparation; about 25% (99), hauling and transportation, and survey and mapping; about 15% (60) and 12% (48) respectively. Only three percent (3%) (12) of respondents identified others as in Table 3 and Fig 3 below;

Table 4: Respondents' response on the different exploration and exploitative iron ore activities.

Iron ore mining activities	Frequency (N)	Percentage (%)
Open-pit mining	179	45
Site preparation	99	25
Hauling and transportation	60	15
Survey and mapping	48	12
Others	12	3
Total	**398**	**100**

Source: Field researcher, 2023.

The researcher learned from the aforementioned data that geologists and scientists conducted site surveys and site mapping throughout the exploration phase. The quantity and quality of the iron ore deposits have been determined by surveying and mapping the iron ore mining sites in the different regions of the district, according to an expert from the district working in the department of natural and mineral resources. Regarding the study region, it was discovered that it is one of the major iron ore sites with significant iron resources. I.e. Surveyors gather information and produce precise maps of the mining region using specialist equipment. With the aid of this knowledge, promising ore deposits may be found, ideal sites for mining operations can be chosen, and the layout of the mining site can be planned. Another participant mentioned that site preparation happens once the quantities of the iron deposits are determined by mapping and surveying. Site preparations start when the survey is finished. To prepare the land for mining operations entails clearing the site, eliminating any vegetation, and leveling the ground. During this phase, infrastructure like access roads, drainage systems, and storage facilities are also installed. The main technique for removing iron ore is open-pit mining. Using powerful equipment like excavators and haul trucks, it entails creating a sizable, open pit or excavation in the ground. To make the iron ore deposits more visible, these machines clear away the overburden (topsoil and rock layers). The ore is extracted using drilling and blasting methods after it has been made visible. The ore is split up into smaller pieces using explosives, which are then loaded onto trucks and driven to the processing facility. Concerning processing, top district administrators, further reveal that a mega iron ore processing plant is soon constructed and experts together with investors have been conducting meetings on how to start up the new processing plant.

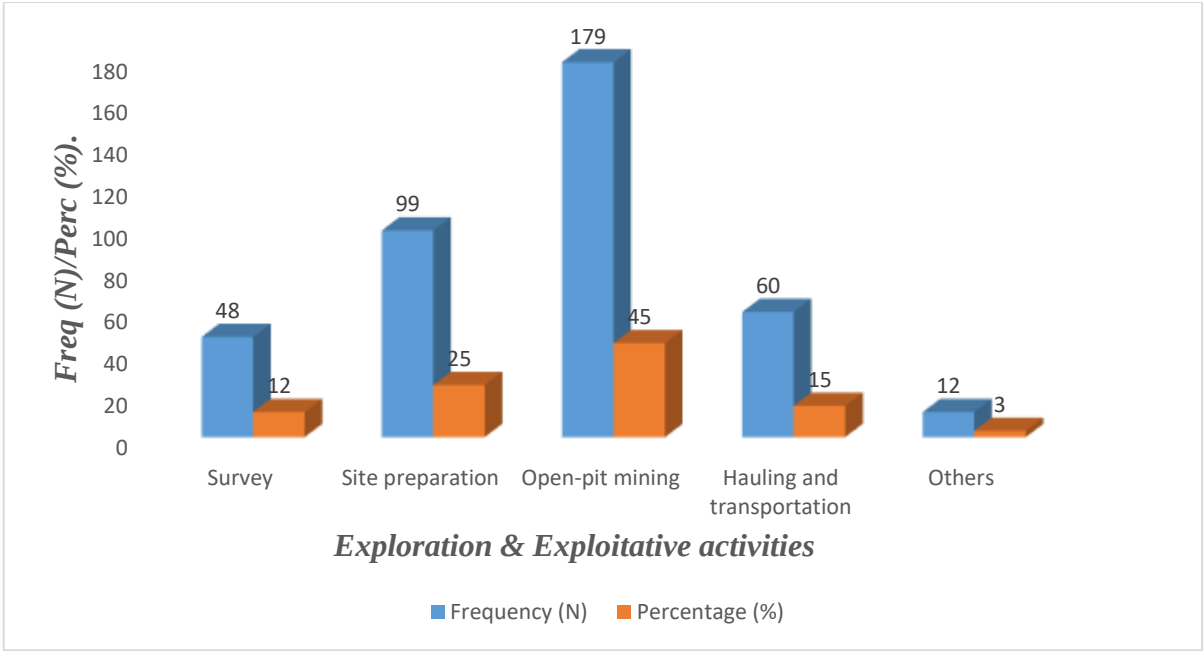

Figure 3: Distribution of respondents' responses on the various exploration and exploitative iron ore activities.

Source: Field researcher, 2023.

The Effects of Iron ore Exploration and Exploitative Activities in the Study Area.

Participants' responses on the effects or consequences of the iron ore mining activities as per study objective (ii) were also sought of. Out of the total number of participants (N = 398) that were engaged in this study, a great number of socio-economic impacts, about 75.1% (299) while the smallest percentage about 24.9% (99) acknowledged the environmental impacts (*Fig4*).

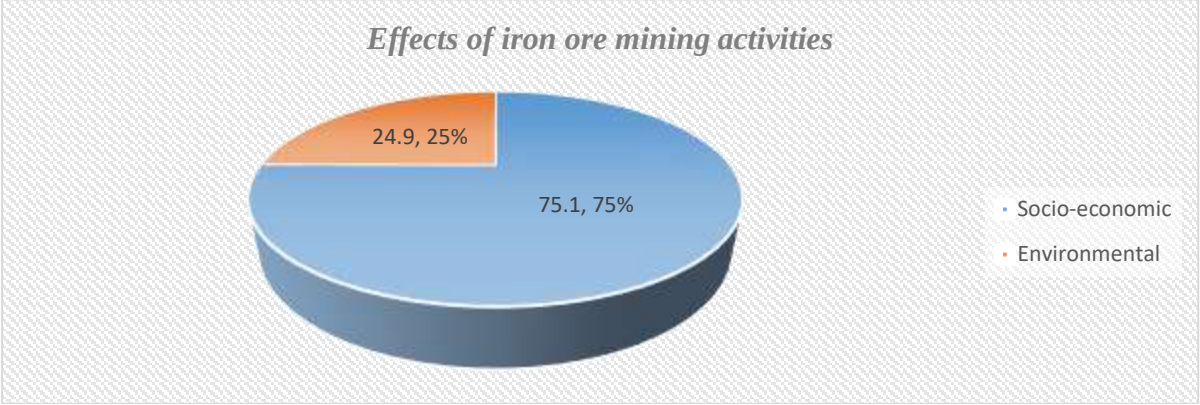

Figure 4: Effects of iron ore exploration and exploitative activities.
Source: Field researcher, 2023.

Of the total number of participants, (N = 398) that were asked about the effects of the above iron ore explorative and exploitative activities, it was revealed by the majority that the existence of this site has contributed to socio-economic development in the area through job creations to the local miners, infrastructural development like road construction that has promoted and improved connectivity and trade. Also, it was revealed that, the existence of the mines has contributed to revenue generation through tax pay and allowance pay and some loyalties by the local artisanal miners to the government. These were observed as some of the positive effects of the sites. However, the study also revealed that, due to the existence of such iron ore sites in the study area, a lot of issues like local community member displacements from the lands have occurred. The displacement of local residents from their lands by some investors without or with little compensation for their land has contributed to the emergency of conflicts in the area. Conflicts over the ownership of the iron ore mines in the district have been a great challenge which has contributed to severe loss of human life, property loss, and other people have been arrested and imprisoned. Disputes over the ownership of the iron ore mines in Rubanda district have been between some political leaders and the local artisanal miners.

Most residents in the study area who were engaged in this study through a focus group discussion expressed their feelings and dissatisfaction by being frustrated by most of their elected political leaders and some government officials who have failed to fully and completely work on their compensation dues. Other participants added that their families' development and the schooling of their children have been affected by the severe ongoing disputes. Accidents and injuries caused by falling off iron ore stones have been claimed endangering the lives of people and animals within the study area. Also, too much dust from the iron ore operations affects the health status of people from the study area according to the health officials in the area. Severe illness. From the environmental/ecological point of view, the study also revealed that there has been degradation of the environment like deforestation, habitat loss, soil erosion, and water pollution through the release of harmful chemicals into the environment that end up affecting the ecosystem and biodiversity.

An environmentalist who was engaged in this study argued that land pollution due to iron ore deposits that are left on the available land has also affected agricultural production hence contributing to food insecurity in the study area. However, it was also revealed to the researcher that, the existence of the iron ore mining activities in the study has had not only negative effects but also positive effects that have contributed to the socio-economic development of the area. Among these positive socio-economic effects included;

- Employment; it was stressed that both the local residents and foreigners from different parts of the world have been given jobs in the iron ore sites to work as miners, engineers, security guards, maintenance and operations managers, etc., and due to this, people that have been employed have been earning a living through the salary pay.
- Revenue generation due to the tax pay and licenses by the miners to both local and central government has aided easy provision and extension of public services like health care and education services in the area.
- Provision of markets for the locally produced foods was also identified by some participants. It was stressed that people who work in the iron ore sites have no time to engage in agricultural practices but instead, they buy food staff from some farmers to support their families.

Mitigation Measures of the Effects of Iron ore Exploration and Exploitative Activities.

As per study objective (iii), the measures to mitigate or control the effects of iron ore activities in the study area were sought and various methods like focus group discussion and interviewing of participants were conducted in order to gather information. Concerning the control of the effects of iron ore exploration and exploitative activities, several measures that have been put in place to protect the environment and minimize negative impacts were identified and explained by the study respondents as indicated below;

Environmental Impact Assessment (EIA), Community Engagement, reclamation and rehabilitation, strict regulatory frame wok, sustainable mining practices, water management and biodiversity conservation.

Of the above measures, community engagement was identified by majority of the participants; about 53% (211). This was followed by EIA; about 30% (119) participants, reclamation and rehabilitation; 7% (28), regulatory frame works and sustainable mining practices 4% (16) and 3% (12) respectively. The least measures acknowledged by respondents were water management and biodiversity conservation; about 2% (8) and 1% (2) respectively *(**Table 4**)*.

Table 5: Distribution of respondents' response on the mitigation measures to the effects of iron ore exploration and exploitative activities in the study area.

Variables		Frequency (N)	Percentage (%)
Mitigation measures	Community engagement	211	53
	Environmental Impact Assessment (EIA).	119	30
	Reclamation & rehabilitation	28	7
	Regulatory frame works	16	4
	Sustainable mining practices	12	3
	Water management	8	2
	Biodiversity conservation	4	1
Total		**398**	**100**

Source: Field researcher, 2023.

The above results were further analysed and presented statistically using a statistical graph as indicated in ***fig 5*** below;

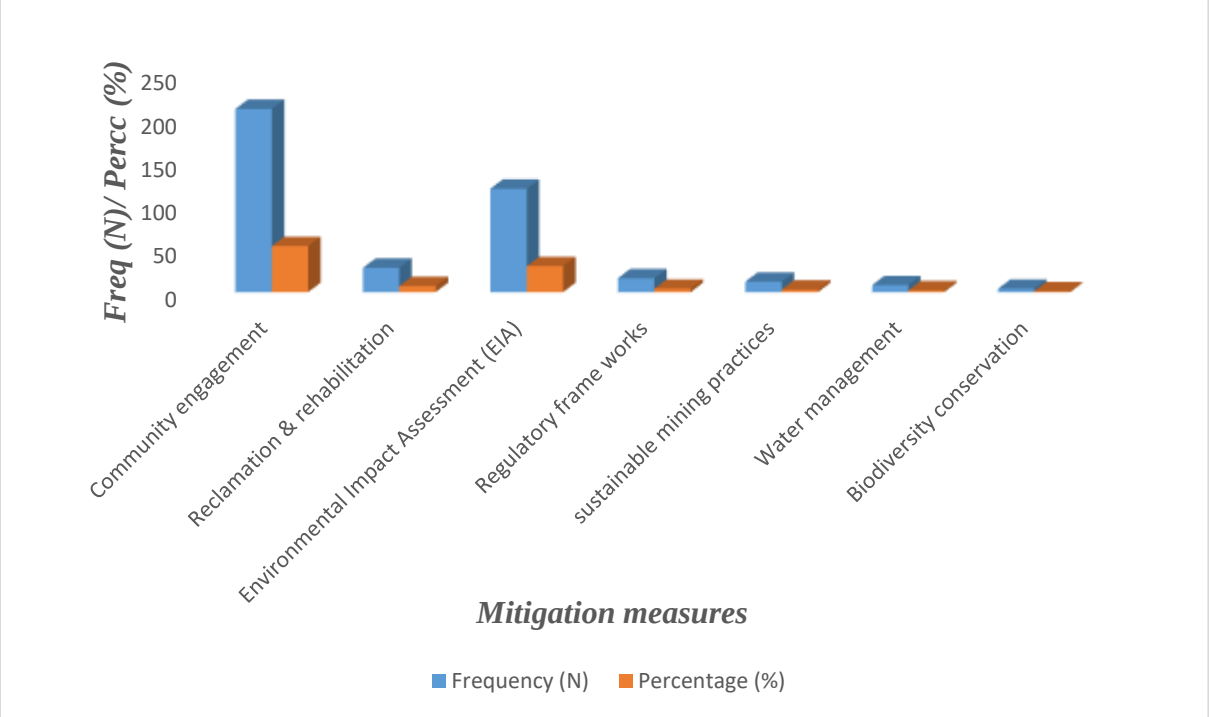

Figure 5: Measures being taken to control the effects of iron ore mining activities in the area of study Source: Field researcher, 2023.

DISCUSSION

The researcher learned that detailed EIAs had been conducted to evaluate potential ecological and social concerns prior to the start of any mining or exploratory activity. Still dealing with the same issue, some participants emphasized the significance of doing an EIA to detect prospective problems, such as health-related dangers to the activities, and establish mitigation plans before they arise. Regarding the subject of sustainable mining practices, it was emphasized that businesses had been urged to adopt these methods, which included reducing the use of potentially dangerous chemicals, using effective waste management strategies, and encouraging reclamation and rehabilitation of mined areas[15, 16]. It was also emphasized from an ecological standpoint that practices like biodiversity conservation have been used to ensure the protection and conservation of a wild variety of both flora and fauna in the area by establishing protected zones, creating wildlife

corridors, and putting policies in place to reduce habitat destruction and fragmentation[17]. Water management was also emphasized to the researcher, who was informed that measures have been taken to ensure proper management of water resources, including monitoring and regulating the discharge of effluents into water bodies, implementing water recycling and conservation practices, and reducing the impact on local water supplies. Through comprehensive community development programs, initiatives to create jobs and build capacity, and strict regulatory frameworks like the enforcement of strict regulations and standards for iron ore exploration and mining activities, local communities can be engaged in decision-making processes and guaranteed participation in the benefits of mining activities[18, 19]. Compliance with environmental and safety regulations might be helped by routine inspections and audits. Reclamation and Rehabilitation: Following the cessation of mining operations, mining corporations are expected to rehabilitate and restore the land[20]. This entails replanting vegetation, fostering soil health, and developing sustainable land uses after mining.

CONCLUSION

The following conclusion can be reached based on the evaluation of the impacts of iron ore exploration and exploitation activities in the study area: The results of this study show that the study region has been significantly impacted by iron ore exploration and extraction activities. Environmental degradation brought on by these practices includes soil erosion, water contamination, and deforestation. In addition, socioeconomic developments such as eviction, loss of livelihoods, and growing inequality have affected the nearby villages. In conclusion, both the environment and the nearby communities have suffered as a result of iron ore exploration and exploitation activities in the study region. To lessen these negative effects and encourage sustainable practices in the sector, immediate action must be taken.

REFERENCES

1. Leone, S., Thullah, A., Sesay, M.T.: Environmental and Socio-Economic Impact of Mining on Operational Communities in Tonkolili District Northern *Corresponding author. Journal of Civil Engineering Research. (2022). https://doi.org/10.47363/JCERT/2022(4)126
2. Baeten, J., Langston, N., Lafreniere, D.: A spatial evaluation of historic iron mining impacts on current impaired waters in Lake Superior's Mesabi Range. Ambio. 47, 231–244 (2018). https://doi.org/10.1007/s13280-017-0948-0
3. Emmanuel, A.Y., Jerry, C.S., Dzigbodi, D.A.: Review of Environmental and Health Impacts of Mining in Ghana. J Health Pollut. 8, 43–52 (2018). https://doi.org/10.5696/2156-9614-8.17.43
4. Beland Lindahl, K., Suopajärvi, L., Tulilehto, M., Poelzer, G., Eerola, T.: Factors affecting local attitudes to mineral exploration: What's within the company's control? Resources Policy. 84, 103715 (2023). https://doi.org/10.1016/j.resourpol.2023.103715
5. da Silva-Rêgo, L.L., de Almeida, L.A., Gasparotto, J.: Toxicological effects of mining hazard elements, (2022)
6. Rios, C.O., Siqueira-Silva, A.I., Pereira, E.G.: Revegetation of mining-impacted sites with a tropical native grass: Constraints of climate seasonality and trace-element accumulation. Journal of Environmental Management. 326, (2023). https://doi.org/10.1016/j.jenvman.2022.116655
7. Wilson, S.A., Wilson, C.O., Moise, I.K.: Livelihood impacts of iron ore mining-induced land change in Sierra Leone: A time series analysis. Applied Geography. 144, (2022). https://doi.org/10.1016/j.apgeog.2022.102713
8. Ebunu, A.I., Olanrewaju, Y.A., Ogolo, O., Adetunji, A.R., Onwualu, A.P.: Barite as an industrial mineral in Nigeria: occurrence, utilization, challenges and future prospects, (2021)
9. Gomo, S., Rapetsoa, M.K., Manzi, M.S.D., Onyebueke, E., Dildar, J., Sihoyiya, M., Mutshafa, N., Harrison, W., Bourdeau, J.E., Brovko, O., James, I., Cooper, G.R.J., Scheiber, S., Durrheim, R.J.: Integrated geophysical methods for boulder delineation to improve mining. Geophysical Prospecting. (2023). https://doi.org/10.1111/1365-2478.13322
10. Abraham, M.J.B., Gift, R., Hennery, S., Asuman, G., Rita, A., Dexter, D., Joseph, M.: The Prospects of Uganda's Iron Ore Deposits in Developing the Iron and Steel Industry. Journal of Minerals and Materials Characterization and Engineering. 08, (2020). https://doi.org/10.4236/jmmce.2020.84019
11. Mawejje, J.: The oil discovery in Uganda's Albertine region: Local expectations, involvement, and impacts. Extractive Industries and Society. 6, (2019). https://doi.org/10.1016/j.exis.2018.09.007
12. Muwanguzi, A., Olowo, P., Hennery, S., Guloba, A., Mezulic, D., Bonci, P., Muvawala, J.: Modelling the Growth Trend of the Iron and Steel Industry: Case for Uganda. American Journal of Industrial and Business Management. 2020, 1640–1654 (2020). https://doi.org/10.4236/ajibm.2020.109104

13. Agboola, O., Babatunde, D.E., Isaac Fayomi, O.S., Sadiku, E.R., Popoola, P., Moropeng, L., Yahaya, A., Mamudu, O.A.: A review on the impact of mining operation: Monitoring, assessment and management. Results in Engineering. 8, 100181 (2020). https://doi.org/10.1016/j.rineng.2020.100181
14. Newman, H.R.: The mineral industry of Uganda. In: 2011 Minerals Yearbook (2013)
15. Makgae, M.: Key Areas in Waste Management: A South African Perspective. In: Integrated Waste Management - Volume II. IntechOpen (2011)
16. Makhathini, T.P., Bwapwa, J.K., Mtsweni, S.: Various Options for Mining and Metallurgical Waste in the Circular Economy: A Review. Sustainability. 15, 2518 (2023). https://doi.org/10.3390/su15032518
17. Kumar, A., Thakur, A.K., Gaurav, G.K., Klemeš, J.J., Sandhwar, V.K., Pant, K.K., Kumar, R.: A critical review on sustainable hazardous waste management strategies: a step towards a circular economy. Environ Sci Pollut Res Int. 30, 105030–105055 (2023). https://doi.org/10.1007/s11356-023-29511-8
18. Carvalho, F.P.: Mining industry and sustainable development: time for change. Food and Energy Security. 6, 61–77 (2017). https://doi.org/10.1002/fes3.109
19. Wambwa, D., Mundike, J., Chirambo, B.: Enhancing sustainable mining with effective design of financial assurance programs: A viewpoint on the various legal and regulatory frameworks of Zambia, South Africa and Chile. Social Sciences & Humanities Open. 8, 100638 (2023). https://doi.org/10.1016/j.ssaho.2023.100638
20. Yu, H., Zahidi, I., Fai, C.M., Liang, D., Madsen, D.Ø.: Elevating community well-being in mining areas: the proposal of the mining area sustainability index (MASI). Environmental Sciences Europe. 36, 71 (2024). https://doi.org/10.1186/s12302-024-00895-9

CITE AS: Shabahurira Deus and Omuna Daniel (2024). Assessment of the Environmental and Socio-economic Impacts of Iron Ore Exploration Activities in Uganda. A Case Study of Iron Ore Mines in Muko Sub-County in Rubanda District. IAA Journal of Scientific Research 11(2):21-32. https://doi.org/10.59298/IAAJSR/2024/112.2132