



Original Research

Impacts of Stone Quarrying on Environment and Socio Economy of the Local Community: The Case of Aira District West Wollega Zone

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Abstract

Despite being a profitable industry, quarrying is an extractive and exploitative one that eventually depletes natural resources. The research area is at significant risk for environmental degradation and human socio-economic activities due to the damaging nature of quarrying and inadequate management of quarry sites. In order to gather the necessary data, questionnaires, interviews, observations, and soil samples obtained at a depth of 0–20 cm from 0–5 years, 6–10 years, and above 10 years of the quarry site were used in conjunction with an experimental research design and descriptive survey. A basic random sampling technique was used to pick 101 respondents, 43 of whom were quarry workers and 58 of whom were residents of residential areas. A statistical tool for social science was used to analyse the gathered data, producing statistical graphs and cross-tabulation as well as frequencies for the data's interpretation. The main social effects were related to health, including stress, coughing, and human death, and property damage and air pollution. Deforestation, land use change, land degradation, and landscape modification have all resulted from biodiversity loss. Of the responders in total, 65.3% claimed that an activity had a distracting effect on the surrounding area.

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INTRODUCTION

The quarry business is significant because it contributes to the nation's economic growth by providing jobs, particularly for the rural people, construction materials, and tax and royalty revenue for the government (Divya et al., 2012). According to Sati (2015), stone quarrying regardless of size causes environmental disruption because it generates vast amounts of waste that can have harmful effects for decades. It also deteriorates the environment primarily because of inefficient and wasteful working methods and rehabilitation techniques. The

ecology is typically significantly impacted by quarrying (Belay et al., 2020). The lives of those who work in quarries and the communities that surround them are impacted by these activities (Nartey et al., 2012). These activities impact the biological and physical environments. In most situations, the impact on the environment is detrimental, meaning that the environment is harmed. The goal of the study was to determine how local residents' socioeconomic standing and the surrounding environment are impacted by quarrying operations in the study area. Because

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it concentrated on the advancement of technology in stone quarrying within the research area as well as future environmental conservation in the region, the study was significant. In addition, it would deal with the drawbacks of stone quarrying and offer prompt development control methods. Because stone quarrying and environmental degradation were pressing issues in the area that required immediate response from the government and stakeholders, the study was significant.

Statement of the Problem

According to Lad and Samant (2013), mining activity frequently has long-term effects on the environment, the economy, and society. One of the main issues is that local communities suffer from various socioeconomic and environmental negative effects of these operations, while the mining firms, reap the most share of the advantages from quarrying. As a result, there have been ongoing disputes between the villagers who live close to the quarry sites and the mine owners. Self-determination and resource management, land usage, sociocultural survival, pollution, and land degradation are common causes of conflict (Enatfenta, 2007).

As a result, the research region is among the most promising quarry sites that might produce a lot of jobs and supply building materials, primarily stone. Farm land is found to be impacted by a number of environmental and social issues, including soil erosion, land deterioration, and the abandonment of the excavation site, leaving it as wasteland. Furthermore, it has had a negative impact on the employees' health. The stakeholders must thus pay attention to the scope of such issues as well as how they affect society and the environment. The goal of the study is to determine whether the issues encountered in other regions where

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quarrying occurs also affect the study area. Investigating the effects of stone quarrying on the environment and socioeconomic standing of the local people in the research region is, thus, the main goal of the project.

Research Questions

The research endeavours to address the subsequent inquiries:

- i. Which physical habitats within the study region are notably impacted by stone quarrying operations?*
- ii. How much do the nearby populations think stone quarrying affects their socioeconomic endeavors?*

Effects of Quarrying in Different Parts of the World

A large portion of the materials required to make ceramic tiles, including granite, limestone, marble, sandstone, slate, and even merely clay, come from quarrying activities. But quarrying also has a big environmental impact, much like other man-made activities do (Okafor, 2006).

Quarry mining will have an impact on noise levels due to the use of earthmoving machinery, power producing sets, machinery, and automobile traffic. It is well recognised that noise reduces productivity, frightens off wildlife, and disturbs bird habitat. To uncover the mineral, it will typically be necessary to remove overburden and dirt. For direct usage or additional processing, the mineral must first be extracted from the quarry and transported. Power-driven equipment is needed for these tasks in order to move materials about the site and perform excavation. Crushing and grading plants are common on-site processing plant applications. The rock-blasting process will also produce noise. There may be vibrations, noise,

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dust, and fumes produced during the blasting process. Houses may sustain damage from rock blast vibrations. (2012) Nartey et al.

By preserving the fact that stone quarrying, in any size, produces massive amounts of waste that can have detrimental effects on the environment for decades, and that the main causes of the environmental degradation brought on by stone quarrying are inefficient and wasteful working methods as well as inadequate rehabilitation measures (Sati, 2015), There are concerns about whether stone quarrying in Ghana should continue due to the extent of land degradation it causes (Nartey et al., 2012). Furthermore, it has been estimated that 4 million individuals in underdeveloped countries pass away each year due to severe respiratory conditions, most of which are made worse by environmental (Asante et al., 2014).

Friis (2015) lists the primary health issues that these workers face, including silicosis and tuberculosis, physical injuries, and accidental deaths. According to Gale and Groat (2001), engineering work done during aggregate extraction and operations directly contributes to the numerous environmental disruptions produced by quarrying. According to Asante et al. (2014), stone quarrying can boost the local economy. They also mentioned that the majority of the population in Buoho, Ashanti Region, makes their living from stone quarrying.

Effect of Quarrying in Ethiopia

Ethiopia is rich in various construction minerals, including red clay, ignimbrite for masonry work and cobblestone production. The city is home to numerous quarry sites (Setegn, 2013). However, there was a dearth of study and social and environmental effect analyses carried out in relation to the beginning of the stone quarrying business. Nonetheless, certain data indicates that

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certain locations, like Augusta Quarry, were operational before to 1960 and continue to be so now (Enatfenta, 2007). The need for building materials has grown in recent years as a result of increased infrastructure development activities, and this has led to an alarming growth in quarrying operations.

There are 400 quarry projects in the city, according to the Addis Ababa Environmental Protection Authority. The majority of these projects, which are mostly those that produce cobble stone, were opened in areas that are appropriate for agricultural use (Setegn, 2013). Urban poor people in particular have benefited from employment opportunities made possible by their involvement in this non-formal sector, which has helped to reduce poverty in urban areas. Consequently, the business generates employment chances for around 489,000 jobless individuals. In addition to generating a great deal of employment opportunities and meeting the city's growing demand for building materials, quarry operations may result in the loss of vegetation cover, harm to already-existing natural landforms, soil erosion, loss of scenic quality, unpleasant setting creation, instability issues with the land, and subsequent land degradation (Enatfenta, 2007). Furthermore, it was implemented since the necessary financial, technical, and law enforcement tools were available for the regulation of quarry restoration and closure. On the other hand, most quarry projects continue to operate without any interventions to mitigate their detrimental effects on the environment. As a result, a number of issues have arisen and have turned into a set of environmental concerns that must be taken into account (Setegn B., 2013).

Quarrying and Environment

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The global practice of rock quarrying and stone crushing has raised concerns in both developed and developing nations (Nartey et al., 2012). The importance of quarrying activities may be seen in the abundance of construction materials used in the production of ceramic tiles, including clay, marble, sandstone, and slate. Thus, much as with other anthropogenic causes, assessing the environmental impact of mining and quarrying operations is a significant roadblock to attaining sustainable development and resource management (Essalhi et al., 2016). Inadequate mitigation efforts by all relevant parties, including quarry operators, exacerbate environmental problems. These affect ecological sustainability, which poses a risk to the long-term viability of the economy as a whole. There are insufficient efforts being made in monitoring, rehabilitation, restoration, or post-mining programmes to lessen the negative environmental effects of quarrying, with respect to the main environmental legislation and its application. In a similar vein, Darwish et al. (2010) found that in the majority of developing nations, the majority of quarry sites remain unrehabilitated at the time of area closure.

Impacts of Stone Quarrying on Soil

Lead, zinc, nitrate, cadmium, and other metals were discovered in the soil as a result of quarrying activity in the area, according to Nwaugo et al.'s 2007 study on the post-operational effects of quarry mining on soil quality in Ishiagu. Metal concentrations are high because of soil pollution caused by quarrying operations. A surface quarry that intersected a canal that was hydraulically connected to a nearby river recorded a flow of 2525 litres per second, according to Lucca (2009), who conducted study on the effects of quarrying on groundwater flow. He proposed pumping the

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quarry's water, which lowers hydraulic head and thus lowers the water levels in the rock that drains into the quarry (Fellmann et al., 2005; Wang et al., 2010)

Socio-Economic Impacts of Stone Quarrying

While agriculture continues to be the primary approach for reducing rural poverty, small-scale mineral extraction is also contributing significantly to the development of rural livelihoods by generating new employment possibilities and supplemental income (Fellmann et al., 2005). More than 500 million people live in developing nations, according to Wang et al. (2010).

MATERIALS AND METHODS

Description of the Study Area

One of the districts in the west Wollega zone is Aira district, which is 504 kilometers from Addis Ababa, the nation's capital. Gulliso to the north, Yubdo to the southeast, and Kelem Wollega Zone to the south and west define its borders. The administrative hub is Aira town. The district is situated between latitudes 6°12' and 10°03' N and longitudes 28°07' and 34°10' E. There are 2 urban and 15 rural kebeles in the district.

Research Design

The study was both a cross-sectional survey research design and an experimental type of research design that investigated and analysed the realities and facts of what was happening on the ground or in the study area.

Key Informant Interview

A key informant interview was conducted with kebele leaders' community representatives and

quarry workers representatives on the basis of purposive sampling to get the affluence

information that supports the objective idea of the study.

Table 1

Key Informants Working Office and Expertise Composition

Organization	No of key informants	Expertise Knowledge
Aira district EPA	2	Geographer, environmental science
District's administration head	1	MBA
Quarry employee enterprise leaders	2	12 th complete
Kebele leader	2	Animal Science

Source: *Compiled By Researcher (2020)*

Method of Data Analysis

The researcher employed a combination of quantitative and qualitative research methods to address the study's research topics. Numerical data from closed-ended questions are utilised to quantify study-related data using a quantitative manner. The information gathered from firsthand observation regarding the effects of stone quarrying on the environment and society is examined using qualitative methodologies. Excel and SPSS version 23 were the statistical instruments used in the analysis. On the other hand, socio-demographic features are described using descriptive analysis (mostly using pie and bar charts for visual representation).

RESULTS AND DISCUSSION

Age Distribution of Respondents

In vital statistics, censuses, and surveys, age is a key demographic variable and the main

foundation of demography (URT, 2005). All working age groups were involved in stone quarrying, just like in any other informal sector activity (Table 2). The majority of those employed in stone quarrying are young individuals because of the nature of the profession, which demands active workers. Based on the data analysis, 44.1% and 32.5% of the workers belonged to the 26–33 and 19–25 age groups, respectively, while the ages of less than 18, 34–41, and 42–49 age groups accounted for only 9.3%, 11.6%, and 2.3% of the workers, respectively. This suggests that the majority of quarry workers were young people. The age groups of less than 18, 19 to 25, 26 to 33, and above 50 comprised just 1.7%, 13.7%, 18.9%, and 3.4% of the respondents, respectively, whereas the age groups of 34 to 41 and 42 to 49 comprised 29.3% and 32.7% of local residents, respectively.

Table 2
Age Distribution of Respondents

Age category of workers	Frequency	Percent	Age category of residents	Frequency	Percent
less than18	4	9.3	less than18	1	1.7
19-25	14	32.5	19-25	8	13.7
26-33	19	44.1	26-33	11	18.9
34-41	5	11.6	34-41	19	32.7
42-49	1	2.3	42-49	17	29.3
Above 50	-	-	above 50	2	3.4
Total	43	100.0	Total	58	100.0

Source: *Field Survey (2020)*

Sex Distributions of Respondents

Table 3 shows the sex distribution of respondents. The majority of the quarry employees and local residents, which are

74.4% and 60.3%, respectively, were males, and the remaining 25.5% and 39.6% were females for both quarry employees and local residents, respectively.

Table 3
Sex of Respondents

Sex of Quarry workers	Frequency	Percent	Sex of local residents	Frequency	Percent
Male	32	74.4	Male	35	60.3
Female	11	25.5	Female	23	39.6
Total	43	100.0	Total	58	100.0

Source: *Field Survey (2020)*

Educational Level of Respondents

The study found that 11.6% and 41.8% of quarry workers respondents had attained college, university, or secondary school, respectively. On the other hand, respondents possess a minimum of primary school, read and write, and are illiterate, with a majority of 27.9%, 13.9%, and 4.6%, respectively. This shows that the majority of the respondents were not certified. The stone quarriers have

little knowledge, skills, and awareness of the dangers associated with stone quarrying. This is an environmental disaster in the area. Also, for local residents, 27.5% and 39.6% had attained college, university, or secondary school, respectively. Also, 17.2%, 8.6%, and 6.8% attained primary school, read, wrote, and were illiterate, respectively. This shows that the local residents were more educated than quarry workers (Table 4).

Table 4*Academic level of Respondents*

Educational level of quarry workers			Educational level of local residents		
	Frequency	Percent		Frequency	Percent
Illiterate	2	4.6	Illiterate	4	6.8
Read and write	6	13.9	Read and write	5	8.6
Primary school	12	27.9	Primary school	10	17.2
Secondary school	18	41.8	Secondary school	23	39.6
College and university	5	11.6	College and university	16	27.5
Total	43	100.0	Total	58	100.0

Source: *Field Survey (2020)*

Number of Years Lived and Worked in the Area

The majority of those surveyed had been at their current address for over ten years. A few of them had grown up in the

neighborhood since they were born. 65.5% of the population had been there for more than ten years, followed by 24.1% for five to ten years, 8.6% for two to five years, and 1.7% for one to two years (Table 5).

Table 5*For how long local residents lived in the area*

Years	Frequency	Percent
1-2 yrs	1	1.7
2-5yrs	5	8.6
5-10yrs	14	24.1
more than 10 yrs	38	65.5
Total	58	100.0

Source: *Field Survey (2020)*

The labourers have spent several years working in that quarry. Consequently, 20.9% had worked for 1-2 years, 7% had worked for 5–10 years, and 72.1% had been at their current workstation for 2–5 years. Because of the unbalanced work load, the little revenue from the activity, and the negative health impacts of quarrying, the quarry workers were unable to stay at their jobs for very long.

According to a similar study by Eshiwani (2007) on the environmental effects of quarrying activities in Nairobi County, a case study of the Embakasi district, the working conditions and health effects of the quarrying activity were causing the quarry workers to leave their place of employment before long (Table 6).

Table 6*For How Long the Quarry Workers Engage In Stone Quarrying*

Years	Frequency	Percent
1-2 yr	9	20.9
2-5yrs	31	72.1
5-10yrs	3	7.0
Total	43	100.0

Impacts of Quarry Activity on the Income of Workers

In addition, the researcher wanted to compare the earnings of non-quarry workers and find out how stone quarrying had influenced the general quarrying community. The data presented in the table below indicates that the bulk of respondents quarry workers (37.2%) said their monthly income is less than \$25, 41.2% said it is between \$25 and 77, and just 20.9% said it is more than 77.

In contrast, 44.8% of respondents who do not work as quarry workers earn more than 77 USD, 39.7% earn between 25 and 77 USD, and

15.5% earn less than 25 USD. The bulk of community members and quarry workers do not profit monetarily from the quarries to a significant extent.

Furthermore, the majority of household income in communities with and without quarrying is less than \$25 USD and more than \$77 USD monthly, respectively. Thus, it is possible to draw the conclusion that there is a substantial income gap in the research area between those engaged in quarrying and those who are not, i.e., non-quarry workers make more money than quarry workers (Table 7).

Table 7

Income of Quarry workers and Non quarry workers per month

Income of quarry workers	Frequency	Percent	Income of quarry residents	Frequency	Percent
Less than 25 USD	16	37.2	Less than 25 USD	9	15.5
25-77 USD	18	41.2	25-77 USD	23	39.7
More than 77 USD	9	20.9	More than 77 USD	26	44.8
Total	43	100	Total	58	100.0

Source: Field Survey (2020)

Stone Quarrying and Economy of Respondents

Reasons Why People Engage in Stone Quarrying

From the data analysis, it revealed that the majority of the quarry workers respondents, 81.3% of the respondents, strongly agreed to engage in this sector due to poverty; 76.7% of respondents strongly agreed that they engaged in this sector for job opportunities; 20.9% of respondents and 2.3% strongly agreed that they engaged in this sector for additional income and saving purposes, respectively.

Based on this information, the researcher came to the conclusion that most respondents

who work in this industry—quarry workers—considered it their principal means of subsistence, while some only utilised it sometimes. As a result, they claimed that the main causal factors were livelihood strategies and poverty.

Interviews with locals reveal that the establishment of a stone quarry in the Aira district is also due to rural-urban migration. In a similar vein, young people from the district's rural areas frequently move to the town in quest of unfilled positions, exacerbating the already serious unemployment issue. Given the aforementioned issue, a number of people who are dealing with deteriorating political and

economic conditions take use of the area's exploitable natural resources (forests, agricultural lands, etc.). As a result of these circumstances, stone quarrying began to develop in the research region (Table 8).

Table 8

Quarry workers perception against factors of engagement in stone quarrying

Responses	Rank			
	Strongly agree	Agree	Disagree	Strongly disagree
Poverty	81.3%	13.9%	4.6%	0%
Job Opportunity	76.7%	16.2%	6.9%	%0
Additional Income	2.3%	4.6%	58.1%	34.85
Saving	20.9%	25.5%	30.2%	23.2%

Source: *Field Survey (2020)*

Quarrying Activity Changes the Economic Status of Employees

The government organised, supported, and took over the initiative of the quarry sector for the workers with the intention of creating job opportunities, enhancing the workers' saving culture, and empowering them to transition into other economically productive industries like manufacturing, construction, textiles, and others. According to the literature, quarrying is a labor-intensive industry that generates a lot of jobs across several nations. In a same vein, the Ethiopian government recognised it as one of the livelihood strategies that makes it easier to provide those who wish to work in the industry with resources like land, credit, tools, training, and information.

The respondents stated that the government's livelihood policy, which enabled the on-site service, was one of the factors that compelled people to work in quarries. Because of this, a large number of persons in the study region were employed in quarrying and similar industries in order to

meet their basic necessities. According to the data analysis, 25.5% of the respondents who worked in quarries stated that their economic status had changed. However, the majority of them—74.4% of the sample population of quarry workers—thought that their economic status had not changed as a result of their work (Table 9). Furthermore, when asked why they participated in stone quarrying activities, they stated that poverty is a key contributing factor and that most of them choose to do so in order to make a daily living. In contrast to the findings of this study area, where quarry employees depend on the informal sector for their daily needs, Zelalem's 2007 study on the effects of stone quarrying on the environment and livelihood of local communities in Addis Ababa peri-urban areas, for the Hana Mariam cobble stone quarry site, suggests that the sector's employees may have been able to save more than 1 billion birr over the course of the previous five years, with the study area contributing 33.45 percent of the total savings.

Table 9*Whether or Not Stone Quarrying Changed Their Economic Status*

Answer	Frequency	Percent
Yes	11	25.5
No	32	74.4
Total	43	100.0

Survey (2020)

Stone Quarrying and Environmental Impact**Severity of Impacts on the Physical Environment**

When asked how seriously they felt that stone quarrying affected the surrounding environment, respondents indicated that the study area's quarrying activities had a significant negative influence on the physical environment. Additionally, as Table 10 below demonstrates, 35.6% of respondents stated that it has a very distracting effect on the physical environment, followed by 29.7% who said it has a distracting effect on the physical environment, 20.8% who said it has

a little impact on the physical environment, and 13.9% who said it has no effect at all.

Based on the observations made in the research region, it is evident that the physical environment is significantly impacted by the quarrying activities in the area. Furthermore, as indicated in Table 10 below, the primary physical environmental repercussions of quarrying, according to the respondents, are the loss of agricultural land, land degradation, and depletion of water supplies. Likewise, according to the study conducted by Sati (2015), quarrying either on a micro or bulky scale is integrally unsound to the environment.

Table 10*The severity of impact affects the physical environment*

Response	Frequency	Percent
Doesn't have any impact	14	13.9
Little impact	21	20.8
Distractive	30	29.7
Very distractive	36	35.6
Total	101	100.0

Source: Field Survey (2020)

Loss of biodiversity, habitat, and deforestation

The pie chart below shows that 68 (69.3%) of the respondents felt that the stone quarry had a significant negative influence on habitat and biodiversity and was a big contributor to deforestation. Certain plant and animal species that were present in the research site were considered threatened, based on information gathered from key informant

interviews with local elders and firsthand observations made during the intense extraction and excavation of the quarry (Figure 1).

Several animal species, including Ape, Bosonu, Gogori, and Bezer, and some endangered plant species, including Warka, Badesa, Mukarba, and Bakanisa, are found in areas where animals inhabit and where forests have been lost or disturbed for quarrying purposes. Similar findings were

made by Darwish et al. (2011), who discovered that quarrying was responsible for the loss of a significant portion of productive forestland and the species richness of extant animals and plants in the quarry zone. According to Munthali et al. (2019), nature has given biodiversity and wildlife a variety of habitats, but it is not as able to adapt to its environment as humans are. As a result, human overexploitation of resources for economic and other reasons, coupled with population increase, damages indigenous resources and, if left unchecked, may

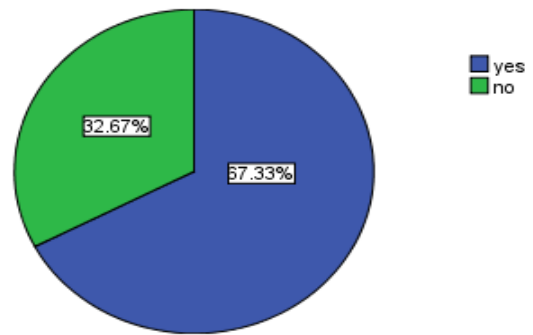


Figure 2 *Losses of Biodiversity, Habitat and Deforestation*
Source: Field Survey, 2020

Change Landscape

The investigator assessed a few of the landslide incidents near the quarry. During periods of severe rain, the soil and stones are carried down the slope. Large holes left over from stone mining produced this. Huge swathes of land were squandered and hung precariously from the highlands, leaving the land desolate. The stone quarries are located far down the slope and are active despite the risks involved. The majority of respondents—84.4% of locals and 67.2% of quarry workers—said that stone quarrying had high negative consequences and significantly altered the landscape as a result of quarry activities in the research area, as

potentially cause the extinction of some species (Figure 2).



Source: Field Survey (2020)
Figure 1 *Losses of Biodiversity, Habitat and Deforestation*

Table 11 below illustrates. Furthermore, just 15.5% of locals and 37.2% of quarry workers responded that stone quarrying has not significantly altered the terrain.

After stone quarrying was introduced into the area, there was evidence of landscape destruction, loss of plant cover, disruption of water channels, etc., according to information gathered from the local elder key informant interview. Similar to this, field observation also noted a few instances of soil erosion and landslides near the quarrying site. When it rains a lot, the stones and soil could be washed downstream. Large holes left over from stone mining produced this.

Huge landmasses were squandered, hanging precariously from steep terrain, and the land was left naked.

The destruction of the natural landscape, the creation of open space in the ground, and the creation of mountains of easily disposed-of rock waste are all common negative effects of extracting minerals from the earth's surface, according to Florence E. (2014)'s study on the effects of quarrying activities on the environment in Nairobi County—a

case study of Embakasi district. Furthermore, quarrying is one of the main anthropogenic activities that alter the landscape, according to Flavenot et al. (2014). According to Aremu et al. (2010), mining operations revealed rich fields and left behind paddocks, constructed dams, abandoned ponds, and a startled landscape. It has also put the lives of wildlife and plants at jeopardy.

Table 11

Quarrying Activity Has Change Landscape

Response of quarry workers	Frequency	Percent	Response of local residents	Frequency	Percent
Yes	27	67.2	Yes	49	84.4
No	16	37.2	No	9	15.5
Total	43	100	Total	58	100

Source: *Field Survey (2020)*

Effects on the Health of the Quarry Workers

The following problems were reported by the workers who were afflicted with health issues: 23.2% of fatal accidents, 37.2% physical injuries, 18.6% chest problems, 13.9% respiratory infection, 2.3% other conditions like coughing and the common cold, and only 4.6% were unaffected. This resulted from their lack of appropriate working equipment, as Table 12 illustrates.

The researcher has seen how stone quarrying operations produce deep gaping pits and sheer rock cliffs on the surface during the observation programme. These elements characterised the stone workers' workplace as hazardous and exposed them to mishaps and fatalities. According to the respondents, stone

workers suffered injuries from falling walls, which harmed their life and made it harder for them to carry out profitable quarrying operations. As a result, the outcomes of their livelihood were also impacted. The incidence of these illnesses tends to indicate that the activities associated with stone quarrying and processing have a negative impact on the health of quarry workers. Similarly, Abate (2016) lists some of the health issues that quarry workers face, including respiratory issues, physical injuries, and deadly accidents. Furthermore, Wanjiku et al. (2014) discovered that both quarry owners and workers believed that poor health conditions were caused by quarrying activities in their study on the occupational health of quarrying (Table 12).

Table 12*Effect on the Health of the Quarry Workers*

Effects to the workers	Responses	
	Multiple responses	Percent
Fatal accident	10	23.2
Physical injury	16	37.2
Chest problem	8	18.6
Respiratory disease	6	13.9
Others	1	2.3
No effect	2	4.6
Total	43	100

Source: Field Survey (2020)

Challenges Facing Workers

The king conditions, such as a lack of proper workingquarry workers are faced with several problems in their workplace. 32.5% complained of poor wor gear; 44.1% complained of low income in relation to the hard job that they do; and 16.2% did not have permanent employment; they were temporary

workers. In line with this study, Mengesha and Bekele (1998) found that the workers are at risk of inhaling particulate matter, which has impacts on their health. Inhalation of the dust can cause severe health problems, including respiratory and pulmonary problems, while dust deposition causes skin and eye problems (Table 13).

Table 13*Challenges Facing Workers*

Problems facing workers	Responses	
	Multiple responses	Percent
Poor working conditions	14	32.5
Low wages	19	44.1
No permanent employment	7	16.2
None	3	6.9
Total	43	100

Source: Field Survey (2020)

Effects of the Quarrying Activity on the Area Residents

Quarrying activities have negative impacts on the health and well-being of the people living near the quarry sites. Mainly due to the dust that was produced from the quarrying activity and the poor roads used by the trucks used for transporting the products, it affected people's health. The most prevalent health problems among the nearby residents were identified as nasal infections, respiratory diseases, eye

infections, etc. Accordingly, 27.5% of the population had respiratory infections, 13.7% had eye infections in children, 41.3% had the common cold, and only 17.2% had no health problems (Table 14). Similarly, Lad and Samant (2014) reported that understanding the perceptions of the communities around quarry areas on issues related to quarrying and post-quarried land state is crucial as it influences their relationship with quarrying firms and the post-quarried status of the quarried land.

Table 14*Effects of Quarrying Activity to the Area Resident*

Effects	Response	Multiple Response	Percent
Respiratory infection	16		27.5
Eye infections in children	8		13.7
Common cold	24		41.3
No effect	10		17.2
Total	58		100

Source: *Field Survey (2020)*

Other social impacts of quarrying**Accidents and fatal deaths**

Risky working conditions in quarrying work expose workers to a high risk of fatal occupational diseases such as silicosis and tuberculosis. Workers are also obligated to carry very heavy weights, mainly in shallow quarries and non-mechanised plants.

As observed by the researcher, stone quarrying activities create steep rock cliffs and deep, gaping pits on the surface. These structures characterised the working environment of the stone workers, making them susceptible to accidents and fatalities. According to the respondents, accidents occurred due to the collapse of walls on the stone workers, which affected their lives and reduced their capability to engage in income-generating quarrying activities, hence affecting their livelihood outcomes as well. As a result, the quarry worker's death was reported while digging out from the bottom of the quarry site. These who died in such accidents were as many as 34 and 38-year-old men

in the area. Also, due to the house at the edge of the abundant pits, the local community is psychologically filled with worry, especially for their children.

Mitigations to Reduce the Effects of Quarrying on the Social and Environmental Issue

There are different methods through which stone quarrying's negative effects can be alleviated. In such a manner, the investigation proposed some recommendations to informants with the specific end goal of determining their level of consent to the given options. The change in environmental management and modernization for decent economic benefit is the way to make the community understand and agree on the new rules of economic growth, which include the increase of educational facilities and improvements in environmental quality with attention paid to substitute costs on natural resources (fauna and flora) that would be affected (Mabogunje, 1980).

Table 15*Recommended Measures to Mitigate Quarrying Effects*

Statements	Strongly agree	Agree	Disagree	Strongly disagree
Quarry workers to be provided with necessary protective wear	82.1%	14.8%	2.9%	
Strict measure to be taken to rehabilitate abandoned quarry site	79.2%	17.8%	2.9%	1%
Quarry waste must be used to restore degraded land	83.1%	14.8%	1.9%	0%

Table 15 continues...

Quarries close to residential places should not be licensed	49.5%	19.8%	16.8%	13.8%
Delivering training for the quarrying enterprise and workers	76.2%	18.8%	4.9%	0%
The improvement of the financial social and physical capitals of stone quarrying communities.	57.4%	27.7%	8.9%	5.9%

Source: *Field Survey (2020)*

Practically all of the investigation's respondents agreed that quarry workers should exercise caution by providing them with basic protective equipment (82.1%), reclaiming restored sites (83.1%), enhancing the material, social, and financial capital of stone-quarrying communities (57.4%), developing the capacity of quarrying businesses and employees (76.2%), and enforcing strict measures to rehabilitate abandoned quarry sites (79.2%) of the total respondents (Table 15).

In addition to the interviews with locals, the Occupational Safety and Health Act requires that the quarry be fenced in order to prevent accidents such as people falling into the pits. Other suggestions made to lessen the effects included paying compensation for accidents and damage caused by the quarrying activity in the area, as well as having the roads repaired or built in conjunction with the quarry companies.

CONCLUSIONS

In Aira's Doyo area, widespread unregulated stone quarrying operations have resulted from rising demand for aggregates and stone, worsening socioeconomic tensions and environmental damage. The outcome demonstrates that creating jobs is one of the advantages that stone quarrying has brought about in the research region. On the other hand, land degradation in the study area has changed significantly as a result of stone

quarrying. The absence of a quarry pit restoration plan and/or after-use plans, along with the presence of abandoned quarry pits and piles of quarry waste, caused the land to deteriorate and the natural vegetation to be reduced. The results of this study demonstrate that a large number of resource-poor, landless, and vulnerable individuals worked directly in quarries in order to both generate cash and safeguard their livelihood. Preserving topsoil from newly created quarry areas and creating a comparable area of vegetation in another degraded and similarly impacted location are two ways to lessen the environmental impact of stone quarrying. Workers in the quarry should be sufficiently informed about the harmful health effects of exposure to quarry dust and the significance of wearing personal protective equipment while at work in order to lessen the social impacts of stone quarrying in the study area, particularly the health impact that exposed the workers to accidents and deaths.

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DECLARATION

There are no competing interests in this paper.

DATA AVAILABILITY

The data of the findings are available from the corresponding author.

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