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IMPACTS OF TRADITIONAL EXTRACTION OF BUILDING MATERIALS ON BIODIVERSITY CONSERVATION AND LIVELIHOODS OF RESIDING COMMUNITIES IN MWANZA CITY- TANZANIA

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ABSTRACT: *Traditional extraction of building material is one of the economic activities in Mwanza City that supplies aggregates, sands, gravels, and stones. This study aimed at investigating the impacts of traditional extraction of building materials on biodiversity conservation and the livelihood of residing communities. Purposive sampling was used to obtain mining sites. Data were collected using households survey, focus group discussions, field visits, and the experiment. The sample size was 180 respondents. The sampling unit was people near mining sites, miners and ward leaders. The study revealed positive and negative impacts on biodiversity conservation and residing communities. The noted positive impacts included a source of income and a strategy for levelling building sites. On another hand, the perceived negative impacts were found to be land degradation, the disappearance of biodiversity, air pollution, uncovered areas/lands, effects on human health, and is the source of conflict. The study concluded that traditional extraction of building materials in residential has impacts on biodiversity and livelihoods of residing people. The study recommends that the government should develop an efficient and effective legal framework with strict laws. In addition, ward and wards leaders should be involved in the inspection and verification of genuine permits.*

KEYWORDS: Traditional extraction-building material-biodiversity-residing communities-stone and gravel.

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INTRODUCTION

Globally, production of natural stone products witnessed a substantial increase over the last decade, with an increasing number of countries involved in the extraction of natural stone, and gravels (Awoke, 2019). Worldwide, the extraction of natural stone has increased by 30 percent in the last 10 years (Gizaw, 2020). This is because, aggregate resources are vital for our way of life as they are the major raw materials used in construction and building of homes (Martínez-Ruiz, 2007). The extraction of stones, sand and gravels can be an open-pit surface mining from which rock or minerals are extracted. It is obvious that mining and quarrying are agents of destroying the biodiversity as they involve the destruction of natural habitats and loss of ecosystems (Sinha, 2000).

The destruction and fragmentation of habitat is the greatest threat to biodiversity and the primary reason behind the species extinction (Aronson et al., 1993). Even if the habitats are not directly removed by traditional extraction and excavation, they can be indirectly affected and damaged by environmental impacts such as changes to ground water or surface water that make some habitats to dry out or others to be flooded. Even noise pollution can have a significant impact on some species and affect their successful reproduction (Awoke, 2019). Indeed, the extraction of building and construction material such as stone crushing is a global phenomenon, and has been one of the causes of concern everywhere in the world, including the developed countries (Lammeed and Ayodele, 2010).

Extraction of building material has substantially been modifying the routing of recharge and water quality is degraded (Awoke, 2019).The removal of the overlying vegetation and soil caused by excavations leaves the land bare In temperate areas, removing vegetation and soil reduces evapo-transpiration and decreases effective rainfall. Unless measures are taken to control runoff and sedimentation, deterioration of ground water is likely (Gizaw, 2020).

In Tanzania, specifically in Mwanza City, like other places with abundant building materials, the area is also characterised by rocks that are used for building and construction purposes. The availability of these building materials has led to the emergence of two methods of excavation as per level of science and capital used. The first being the traditional methods of extraction *(the use of hand based tools such as pickaxes, hammers, charcoal, spade and iron bar to excavate and segment building materials from the ground).* The second are modern methods of extraction (*the use of technological tools such as machines*).The latter method is used by mining companies such as Nyanza Construction Company. The sites where modern methods of extraction are applied are far from residential areas compared to the traditional methods of extraction that are conducted illegally and carried out in the residential areas.

Sati (2015) maintains that stone quarrying, whether small or large scale, are inherently disruptive to the environment, producing enormous quantities of waste that can have noxious impacts for decades, and that the environmental deterioration caused by stone quarrying occurs mainly as a result of inappropriate and wasteful working practices and rehabilitation measures.

In this perspective, the study concentrated on the traditional extraction of building materials such as natural stone, sand, gravel, and crushing of rocks done in the residential areas which have become an alarming issue as the complaints about quarrying activities were voiced as far back as the 2010s.. It is unfortunate that impacts brought by the traditional extraction of

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building and construction materials to the livelihoods[1] of residing communities and to biodiversity conservation in Mwanza City are not yet known. The magnitude and degree of effects, coverage, people affected, people involved in extraction and socio economic impacts stimulated by such activities are also not well known. Regrettably, up to the current time that is, 2021 the mining sites have not yet been managed and no any formal laws and directives have been formulated for environmental sustainability and for protecting the residing communities.

In mining sites have been experiencing the quarries collapsing and there are no measures taken to rehabilitate such quarries since most of them are left open (*uncovered with trees and glasses*). In this regard, (Gizaw, 2020) asserts that environmental problems are further aggravated by the lack of adequate mitigation measures by the respective quarry operators. This in turn affects the ecological sustainability thus posing a threat to the overall economic sustainability. Concerning the prevailing environmental legislation and its enforcement, there are no efforts that have been made to monitor, rehabilitate, restore or institute post-mining programmes for minimization of adverse environmental livelihood impacts.

In this context, a need arose to conduct a research on the traditional extraction of building material on biodiversity conservation and livelihoods of residing communities in order to explore its magnitude then suggest remedy measures.

This study was guided by the Sustainable livelihood Framework (Fig. 1). This framework is a tool used to improve the understanding of livelihoods, particularly the livelihoods of the poor. It emphasises understanding the vulnerability context and the organizational and institutional environment within which poor people draw upon assets of different types in order to implement a livelihood strategy. The livelihoods approach is based on the premise that the asset status of the poor is fundamental to understanding the options open to them, the strategies they adopt to attain livelihoods, the outcomes they aspire to and the vulnerability context under which they operate distinguishes five categories of assets (or capitals) – natural, social, human, physical and financial. Points out that an analysis of assets is a review of what people have (and recognition of what people do not have) rather than an analysis of needs. The asset analysis also considers how access to assets has changed over time, what changes are predicted, what the causes of changes are and how access and control of assets differ between social groups.

[1] *A livelihood comprises the capabilities, assets (including both material and social resources and activities required for a means of living: a livelihood is sustainable when it can cope with and recover from stress and shocks and maintain or enhance its capabilities and assets both now and in the future (Ming'ate and Mohamed, 2016)*

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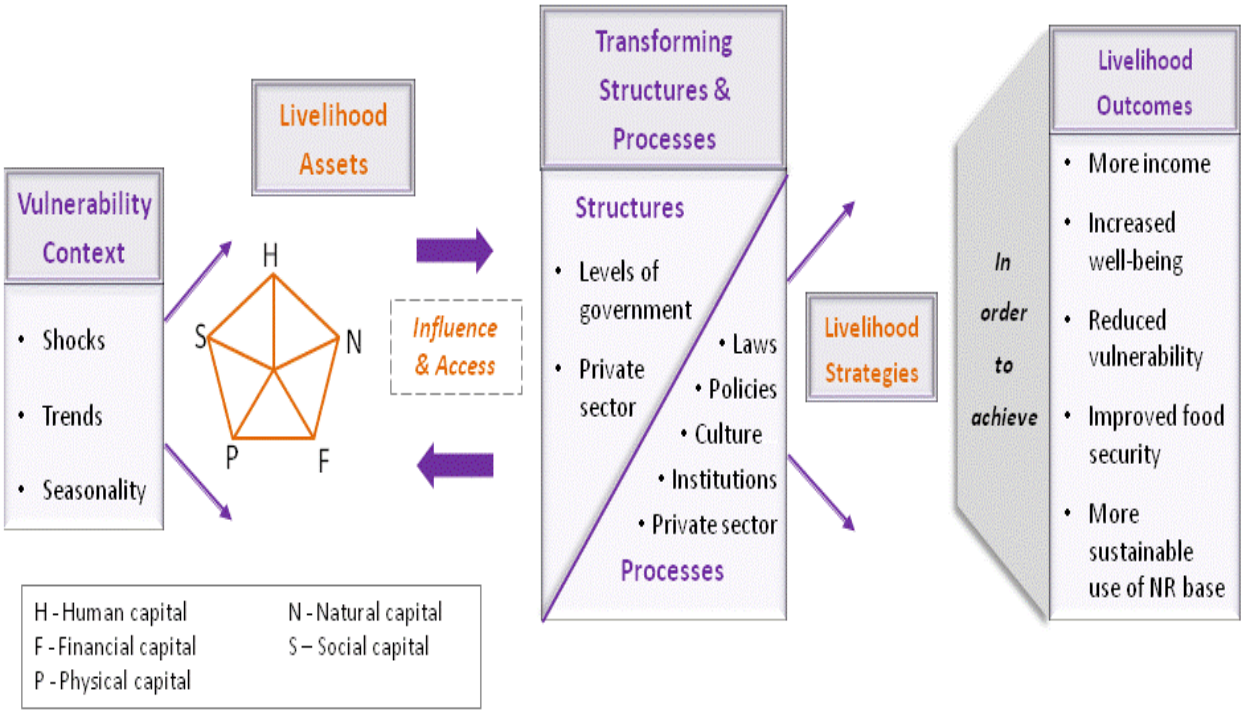

Figure 1: Sustainable livelihood framework

Source: DFID (1999)

MATERIALS AND METHODS

The study area

Mwanza is located in the northwestern zone of Tanzania on the shore of Lake Victoria. It is the second-largest city in Tanzania, with an area of 1325 Km^2 of which 425 km^2 is dry land and 900 Km^2 is covered by water. Of the 425 km^2 of dry land, about 86.8 Km^2 is urbanized while the remaining areas consist of forested land, valleys, cultivated plains, grassy and undulating rocky hill areas. Mwanza City comprises of two districts, namely Nyamagana and Ilemela (See Fig.2) with 21 wards. These wards are rural wards –Ilemela (Sangabuye, Buhongwa, Ilemela, Buswelu) - Nyamagana (Igoma, Buhongwa and Mkolani). Urban wards: Ilemela - (Kirumba, Kitangiri, Nyamanoro, Pansiasi, Nyakato) -Nyamagana- (Pamba, Isamilo, Mkuyuni, Nyamagana, Mbugani, Butimba, Mirongo).

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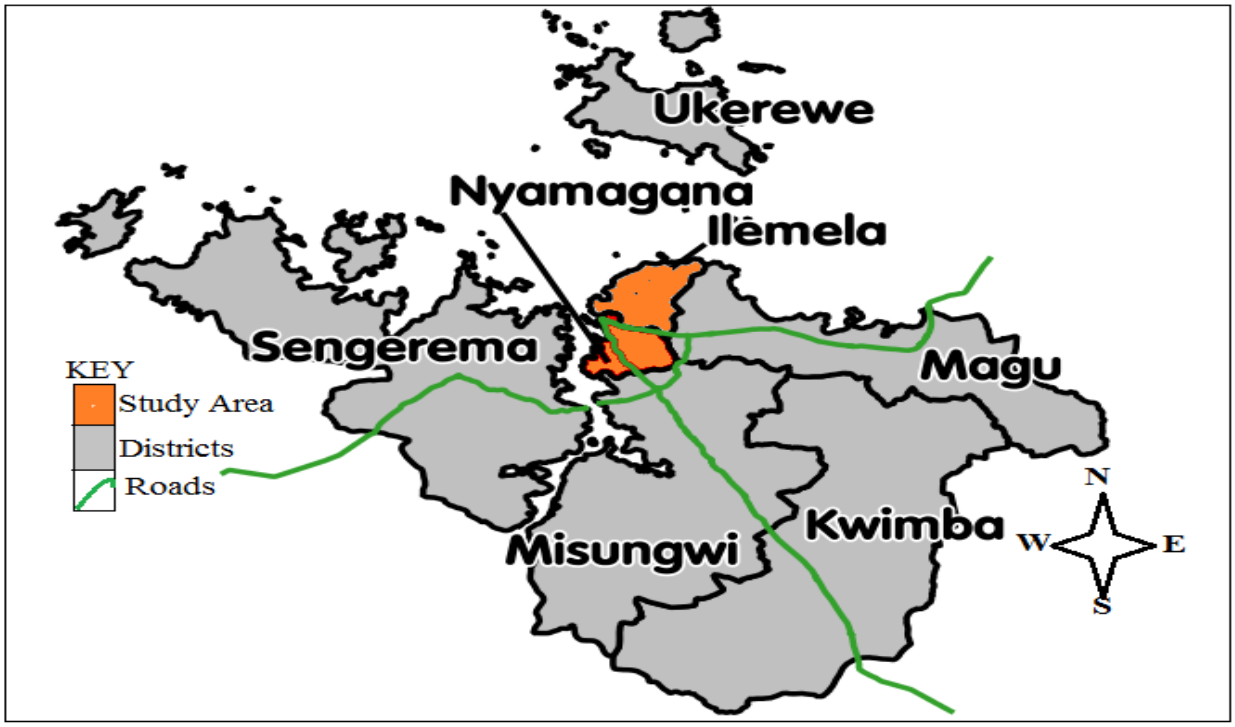

Figure 2: The map of Mwanza City showing the study area

According to the 2012 National Census, Mwanza City had 706,353 people whereby Nyamagana District had 363,352, in which the number of females was 185,640 and that of males were 177,812). In Ilemela District, the total population was 343, 001 where females were 178,283 and males were 164,718).

Mwanza City lies at an altitude of 1,140 metres above sea level. Its mean temperature ranges between 25.7^{0}C and 30.2^{0}C in the hot season, 15.40C, and 18.6^{0}C in the cooler months. The City experiences rainfall between 700 and 1000mm per year, falling in two fairly distinct seasons i.e., between the months of October and December and between February and May. The City is characterized by gently undulating granites and granodiorite physiographic with isolated hill masses and rock inselbergs. It is also characterized by well-drained sandy loamy soil generated from coarse-grained cretaceous. The vegetation cover is typical savannah with scattered tall trees and tall grass. There are 25 hectares of Land in the Ilemela District and 21 hectares in the Nyamagana District, which are suitable for irrigation. The main economic activities in Mwanza City are fishing, trading activities, manufacturing, agriculture, tourism, and livestock keeping which include chicken, goats, cow, and sheep.

Sampling techniques and Data collection methods

Households residing mining area were sampled using simple random sampling. Simple random sampling was chosen over other sampling techniques for two main reasons. First, the method ensures the likelihood of any individual element in the population to have an equal chance of being selected and being representative, hence minimizing sampling biases. Second, it was due to the homogeneous nature of the population.

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In each ward, a sample size of 35 respondents was picked thus making 140 respondents from the four wards, who filled in the questionnaires. Focus groups discussants involved were 10 from each ward thus making 40 discussants from four (4) wards involved in the study. The respondents involved as discussants were purposively selected to obtain people with heterogeneous viewpoints and position. Therefore, Ward Executive Officers, workers involved in extraction of the building materials, and people residing near mining sites were involved as discusants. The sampling unit of this study focused on the people residing near the mining sites, the leaders of each ward and the miners (see Table 1)

Table 1: The Sampling unit

Wards	Number of Houses Near mining sites	Sample taken from each Ward
Nkurunduma	105	45
Msalabani	95	45
Nsumba	97	45
Mahina	89	45
Total Sample Size	386	180

Data collection methods

Data were collected by using a questionnaire survey, focus group discussion, field visits, and experimentation (measurement of particulars in the air). The questionnaires were of both closed and open-ended questions. Open-ended questions gave the respondents a chance to state and give their perceptions without being influenced by the researcher. The closed-ended questions were appropriate and good in gathering quantitative data, hence simplified data scrutiny. The aspects included in the questionnaire were: i) types of building materials extracted from the mining sites; ii) tools used to excavate building materials; iii) impacts of the traditional extraction of building materials on biodiversity conservation and residing communities' livelihoods.

The researcher pre-tested the questionnaires before administering them. The main aim of pre-testing the questionnaires was to check the sequencing of questionnaires, wording, and layout. Pretesting was also used to serve as a practice of administration and a way of evaluating the respondents' understanding of the concepts of the study. The pre-testing helped the researcher to make him know if the respondents had understood the concepts and ideas in the same exact way.

Focus group discussion in each ward, involved both males and females. Each group comprised of five people, making 40 group members. Both of the groups were involved in order to capture members' views as they were likely to perceive issues differently even with the same problem (Creswell, 2012). During the discussion, the author was mainly a facilitator. This had an advantage to participants as they were able to discuss issues at hand freely and without fear.

Direct field visits were paid in the mining sites to observe the impact of traditional extraction of building material upon the local communities' livelihood and measuring the quantities of particles in the air. It was important to measure the quantities of particles in the air because

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when the level of Particulate Matter (PM2.5 and PM10) is very harmful to health of human being. When people are exposed to them, they penetrate deeply into the lungs hence causing health impacts like breathing problems, burning or sensation in the eyes, etc.

Through field study (visit), the researcher was able to; i) observe the impact of extracting building materials on biodiversity conservation and people residing near mining sites and ii) measuring the concentration of particulate in the air. The data for the analysis of air was collected using an absolute instrument system (AIS), model Aerocet 531S used to measure the total suspended particulate matter (Pm_{10}) that measures the concentration of particulate in the air. Therefore, direct observation and Direct measurements were adopted.

Data gathered were qualitative and quantitative in nature. Therefore, the nature of data necessitated the use of qualitative and quantitative data analysis techniques. In this perspective, both qualitative and quantitative information was analysed separately to complement and supplement each other. The qualitative data collected from the focus group discussants adopted content analysis method. The themes were classified where every answer was patterned in relation to a theme in question. Subsequently, quantitative data were collected through questionnaires, and were analysed through a statistical analysis where data were edited, coded, summarized, and analysed using the Statistical Package for Social Sciences (SPSS) version 27 and Excel Computer Programme.

RESULTS AND DISCUSSION

Types of building materials

The study revealed three kinds of building materials (normal stones, gravels, and sand) that have been extracted in the study areas (See Plate 1). However, the dimension of stones differed in terms of size, nature of the rock (igneous, sedimentary, and metamorphic). It was noted that igneous stones were greatly valued for their aesthetic appeal, durability, and ease of maintenance. The gravels were made by traditional/local crushing of big stones into small pieces (the identified tools used is a big hammer to partition big stones and a small hammer for making gravels).

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Plate 1: Types of building material extracted traditionally in mining sites

Factors for the traditional extraction of building materials

Field results indicate that extraction of building materials namely gravels, stones, and sand in the study area was highly started to be a serious problem affecting biodiversity conservation and resident communities' livelihoods in Mwanza City since 1990s and continues to affect them up to date. It was also observed that all the four wards studied have been experiencing the impacts of traditional extraction of building materials. The main gauges associated with the situation were mainly lack of formal employments which was pinpointed by 51% (N=140) of the respondents, high demand of building materials e.g. sand, stones and gravels mentioned by 17.5% (N=140) of the respondents, availability of the wanted materials revealed by 23.5% (N=140) of the respondents, and lack of strict by-laws mentioned by 8% (N=140) of the respondents (See Fig. 3).

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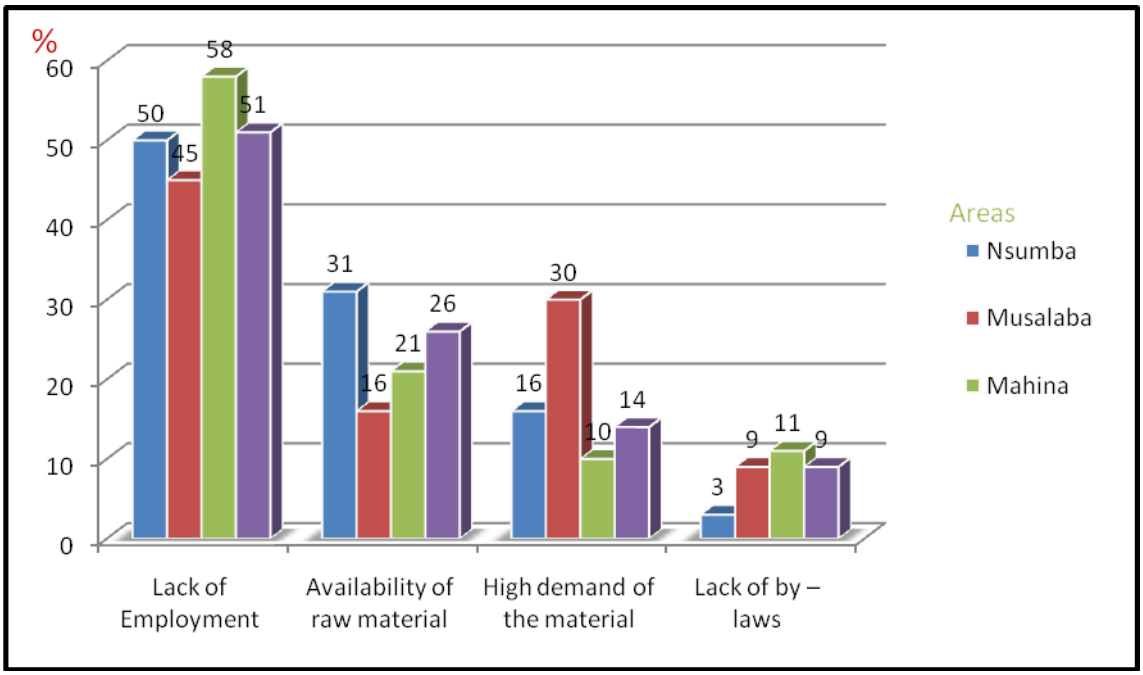

Figure 3: Factors for the Emergence of Traditional Extraction of Building Materials

At ward specific level, in Mahina, Nkurunduma, and Nsumba, the results indicate 58 percentage n=35, 51% n=35, and 50% n=35 of the respondents respectively perceived lack of formal employment opportunities as the main cause for traditional excavation of building materials. In this context, lack of formal employment was highly perceived in Mahina, Nkurunduma, and Nsumba wards. During discussion with discussants in Mahina Ward, the study revealed that if the extractors could be employed informal institutions, then they could not be able to involve themselves in this activity. The study revealed that traditional excavation is done as a livelihood diversification strategy among local communities in their area.

It was noted that the availability of these building materials e.g., stones and sand was another factor for some people to decide to engage themselves in the traditional extraction of the building materials. The reason (availability of raw materials) was signified by respondents in Nsumba, Nkurunduma, and Mahina by 31%, 26%, and 21% (n=35) respectively. The respondents stated that they could not have intruded on the mining areas if the areas were empty. They were excavating stones in the areas where there were enough to satisfy the demand.

Methods and tools used to excavate building materials

The methods used to excavate the building materials in four sites were digging, wedging, blasting, and heating blasting. However, the use of these methods has been varying from time to time basing on the nature of rocks to be extracted as follows: -

The first method is digging or excavating stones and sand, this method is used where stones and sand to be extracted are found under the surface/earth. The digging of sand and stones

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was pointed by 70% (N=140) of the respondents in the study area. This category of excavating building material from the ground was preferred in all sites where building materials were being extracted. The respondents revealed that during the excavation of the building materials (stone and sand), they were using various tools such as pickaxes, hammers, charcoal, spades, and iron bars (See Plate: 2)

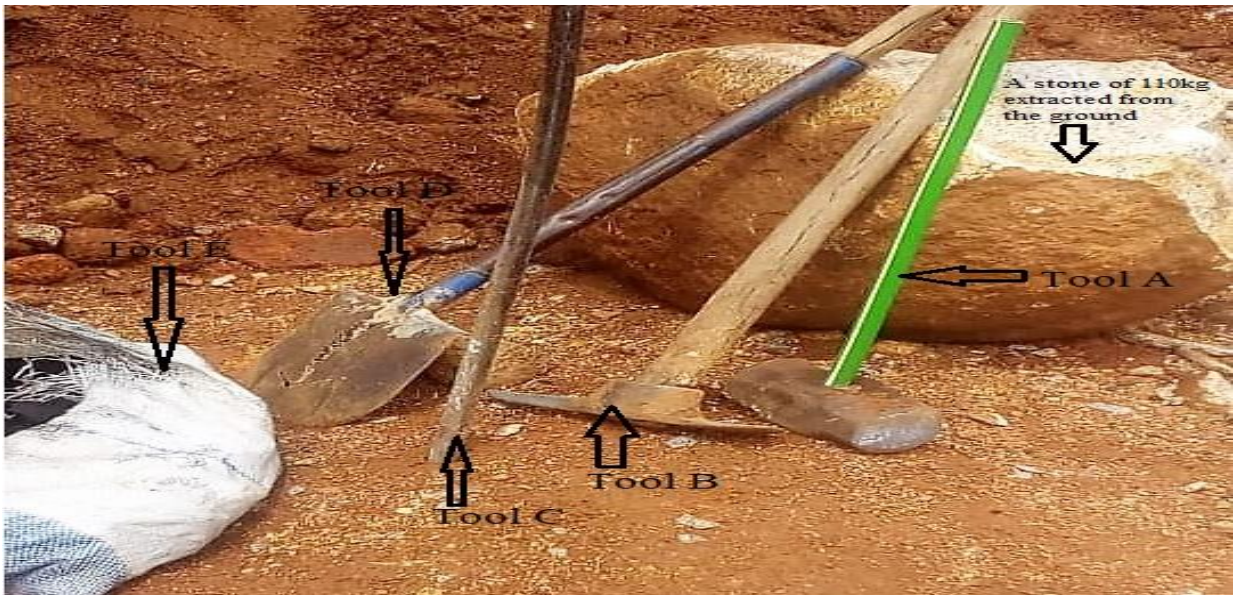

Plate 2: Tools used during excavation of building material (stones and sand)

Key for the Above Tools

Tool A is a Hammer of 18kg with a plastic handle to allow flexibility and easier movement when used to crush big rocks into pieces.

Tool B is Pickaxe is a T- shaped hand tool with a wooden handle used to break hard surfaces, especially when extracting stones found underground.

Tool C is an Iron bar used to enlarge cracks and separate stones which are closely bound

Tool D is a Spade hand tool used to shift a pile of soil or gravel of a hand surface to another place or into trucks

Tool E is Charcoal in a sack for heating/burning hard rocks. It was revealed that when hard rock are burnt they intend to expand and create cracks which make easier for the excavator to break it into small pieces.

The second method revealed was a wedging method, which was mostly being used upon soft rocks such as sedimentary, and sandstone where the hammer was the most preferred tool. The wedging method was used by 10% (N=140) of the respondents (See Fig.4). This is because the sites had few sedimentary rocks but with full of igneous rocks which suggested the use of digging and explosion methods.

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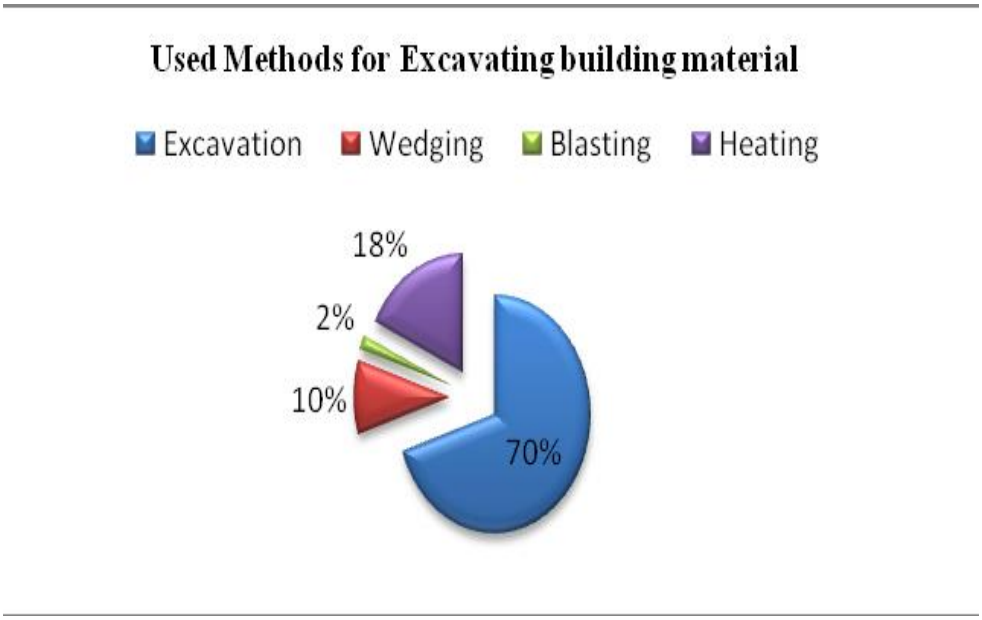

Figure 4: Methods used to excavate building materials in the studied sites

Figure 4 also indicates that blasting stones was another method that was being used. It was revealed to have been used by 2% (N=140). The study pinpointed that the method (blasting) was being used when stone to be excavated was very hard like an igneous rock and it seemed to miss cracks. It was stated that the method was used in few cases as it was against the law of Tanzania.

The result in Figure 2 indicates that 18% (N=140) of the respondents pinpointed heating as one of the building materials quarrying method used. It was revealed that heating was applied on the large rocks so that they could easily be broken into pieces during the quarrying process. It was noted that loosened rock portions were being broken down into pieces of preferred dimensions and were being detached with the aid of pick-axes and crowbars. Occasionally, intermediate layers would be alienated from the top and bottom layers. In course of time, the intermediate layer would be healed electrically and the expansion would separate it from the other two (See Plate: 3)

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Plate 3: Traditional heating of rocks in the studied sites

Impacts of traditional extraction of building materials to local communities

Positive Impacts

Employment Opportunity for Local People

Overall, in the four wards combined, 48 % (N=140) extraction of buiding materials was perceived as the method of providing employment opportunity to some people who were unemployed. The impact in each ward varied, where in Nkurunduma, Mahina, and Nsumba the impact was pointed by 52.7%, 51%, and 50% (n=35) respectively (See Table 3). Employment opportunities to local people in the sites where extraction of building materials was taking place are categorized into four main categories. The first category as it was identified by the discussants in four wards were the extractors who were extracting stones and grouping them into groups of seven (7) tons for each ready to be picked by lorries for distribution (See Figure, 2), the second category was made up of those who were crushing stones into gravels, the third category was of those who were excavating gravels and the fourth group was made of those who were concerned with distributing by transporting the ready-made building materials such as sand to the buyers (See plate 4).

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Plate 4: A truck taking sand at Nsumba mining site

In this context, the study revealed that there were more than 381 people employed in the process of building materials extraction and distribution in the four mining sites studied. At the wards level, the results indicate that the number varied.For example, in Nkrunduma centre, the number of employed people employed was higher than in other centres which was 130 (males and females inclusive), followed by Msalabani with 102 employed people (see Table 2). The reasons as to why Nkrunduma and Msabani had a big number of employed people was not established but this could be due to the large size of the population found in Nkrunduma ward as it was noted to have been serving Mukuyuni, Mwananchi, and Igogo residents.

On the other hand, sex ratio of the self employed people in the extraction of building materials varied.It was noted that the number of males was higher than females with a range of 1:7 (one woman for seven males). The reasons as to why the number of males was higher than that of females were that: i) the nature of work was very hard which needed high tolerance and ii) in Tanzanian cultural context, males are the ones who take care of the families hence forcing them to go out to find income to feed the family.

Table 2: Number of employed people in the process of extracting building material

Categories of Workers	Nsumba		Msalabani		Mahina		Nkurunduma		Total	
	Male	Females	Male	Females	Male	Females	Male	Females	Male	Females
Stone Extractors	31	1	52	0	18	3	55	1	156	5
Gravels Maker	12	9	18	13	17	2	16	13	63	37
Gravels Excavators	3	0	4	1	9	1	10	3	26	5
Distributors	20	0	14	0	23	0	32	0	89	0
Total	66	10	88	14	67	6	113	17	334	47

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The findings revealed that traditional extraction of building materials is an employment opportunity and livelihoods diversification activity. This result is in line with (Ukpong, 2012) who asserts that quarrying as a labour-intensive work creates substantial job opportunities in many countries. Similarly, the excavation of building materials is identified as one of the livelihood strategies and facilitates the availing resources of land, credit, tools, training, and information to those who want to be engaged in the activity. Hence, in the study area, many people were engaged and employed in quarrying and related activities to meet their livelihood need (See plate 5).

Plate 5: Self-employed men and women in the extraction of building materials

Table 3: Positive impacts of traditional extraction of building materials

Positive Impacts	Areas				
	Nsumba	Msalabani	Mahina	Nkurunduma	Average
	%	%	%	%	%
Employment	50	39	51	52	48
Source of Income	31	12	21	23	21.75
Cheap prices of extracted material	10	29	10	10	14.75
Levelling of building site	3	9	9	8	7.25
Availability of gravels	6	11	9	7	8.25

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Source of Income

Overall, 21.7% (N=140) perceived the source of income as an impact of traditional extraction of building materials in the local communities where excavation was being done. At the wards level, the source of income was perceived to be more serious in Nsumba, Nkurunduma, and Mahina (see Table 2) by 31%, 23%, and 21% (n=35) respectively while in Msalabani the impact was less perceived. The main reason for pinpointing the income aspect in the study area would be attributed to the non-taxable amount of money that the excavators have been earning daily, monthly, and annually as evidenced by earning status after engaging in this activity (See Figure 4).

It was found that the uncertainty of income generation had led some local communities in Nsumba, Nkrunduma, and Mahina to move to areas with available stones rocks, and gravels to diversify their livelihoods. Indeed, the livelihoods of those people involved in building materials processing and distributions were noted to have been improving a lot to the extent of attaining human basic needs for their families, paying school fees for their children, building permanent houses, and opening small businesses.

During discussions with discussants in Nsumba and Nkrunduma extraction centres revealed that extractors were getting much money . This is because one stone trip of a seven tonned lorry was being sold at a price of Tsh 60,000 equivalent to 24 USA dollars at the current exchange rate of Tsh. 2,500 per dollar. The discussants revealed that among the building materials produced in their centres gravel was the highest price fetching material of the as it was sold at Tsh.150,000 equivalent to 60 USA dollars per trip. The reason for purchasing gravel at such high price was due to the process involved in crushing them into small sizes. It was reported that it might take one week to crush gravel that would make one trip of a seven tonned truck which was the mostly preferred unit by customers. On other hand, the **murram** price was similar to that of the stones trip. In this context, extractors, gravel makers, and gravels excavators were earning more than Tsh.700,000 equivalent to 280 USD dollars per month. This implies that the building materials extraction process and distribution is a well-paying economic activity. The result is in line with (Asante et al., 2014) asserts that stone quarrying provides varying economic benefits to the local economy.

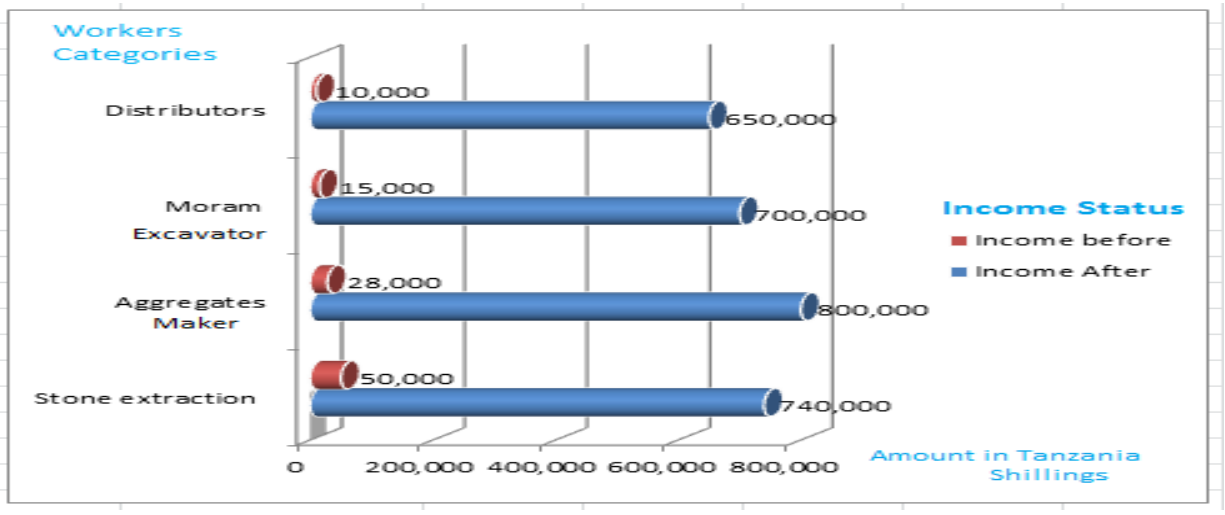

Figure 5: Variation of Income before and after engaging in extractions

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The results from focuss group discussion in four studied mining sites, revealed that there were positive impacts of extraction of building materials on local communities namely, levelling of building sites by removing tall stones and the availability of building materials (see table 4).

Table 4: Perceived positive impacts by FGD

Impacts	Areas			
	Nsumba	Msalabani	Mahina	Nkurunduma
Men	Employment Availability of gravels Source of Income Levelling of building site	Employment Cheap prices Levelling of building site	Employment Availability of gravels Cheap prices Levelling of building site Source of Income	Employment Availability of gravels Cheap prices Levelling of building site Source of Income
Females	Employment Cheap prices Levelling of building site	Employment Availability of gravels Cheap prices Levelling of building site	Employment Availability of gravels Cheap prices Levelling of building site	Employment Availability of gravels Cheap prices Levelling of building site

Other positive impacts

Through questionnaires and focus group discussion in four studied sites, the findings revealed other positive impacts of building materials extraction on local communities namely, levelling of building sites by removing tall stones, the availability of building material (see Table 2 & 4).These were such as pieces of stones, gravels, and gravels sold at a lower price comparing to those provided by formal stone crushing companies such as Nyanza. It was noted that one trip of gravels made traditionally was Tsh.150, 000 while that made by Nyanza Road Construction Company in same quantity was being sold at Tsh.500, 000 which is equivalent to 200 USD dollars.

Negative effects of traditional extraction of building materials

Land degradation and conversion

Overall, in the four sites combined, 58.5% (N=140) felt the land degradation (see Fig 6). The effect in each site varied where Mahina, Nsumba, and Nkurunduma were being seriously tarnished as perceived by 75%, 60%, and 54% respectively. The study, through the site visit, and semi-structured interviews revealed that increase in land degradation, was influenced by three main ways namely by: i) the removal of vegetation cover through the excavation of stones, ii) the excavation of gravel soil for building purposes, and iii) through trucks which were transporting the materials from the sites to the buyers.

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The focus group discussants revealed that land-use change and degradation were among the significant impacts arising out because of excavation of gravels and quarrying activities, which is essential in the system of alteration of landscape due to excavation, piling of topsoil, and loss of land due to the soil erosion. Hence, the resident people are affected psychologically and in terms of crop productivity. These results concur with the study conducted by (Land and Samant, 2014) who asserts that the impact of stone quarrying on local environment evidence has a very high impact on the physical environment.

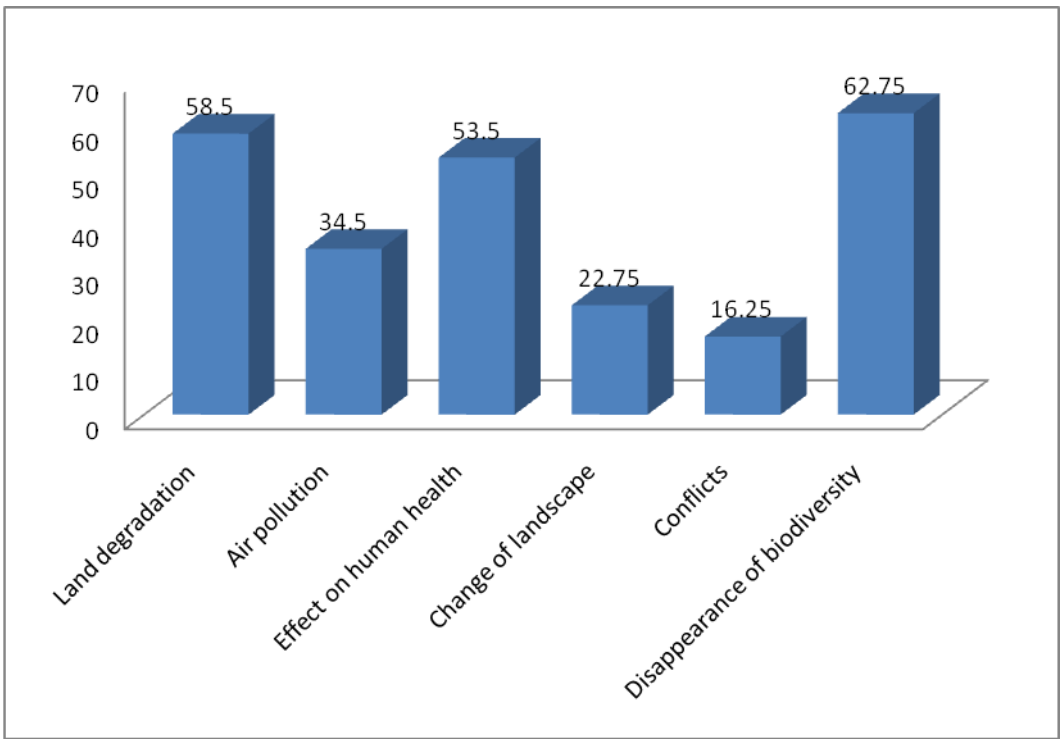

Figure 6: Negative Impacts as perceived by household respondents *

Disappearance of Biodiversity

Overall, in the four sites combined, 62.7% (N=140) felt the disappearance of biodiversity (see Table 5). The effect in each site varied where Nsumba, Mahina, and Nkurunduma were seriously smudged as it was alleged by 70%, 68%, and 62% respectively. The study revealed that the ecosystems were constantly changing and species were always disappearing as environmental conditions change and some plant and animals species were no longer able to survive hence affecting the ecosystem at the mining sites.

On other hand, the mean was 62.7%. This indicates that as long as the extraction of the materials continues, it is likely that the unique species of plants and glasses will be lost because extractors remove them.

It was noted that traditional extraction of building materials had badly affected the biodiversity in the studied areas. Effects were noted on soil cover, animals, birds, plant species, etc. It was revealed that unsustainable extractions of natural resources like stones,

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sands had been a key factor for the degradation of biodiversity. It was noted that the vegetation in the stone areas had been under constant threat because of the unsustainable exploitation of the stones and sand thus leading to formations of pits and holes. In this study, it was further pinpointed that traditional extraction of building materials had made the land as plant species had been removed to allow expansion of extraction of the building materials. These findings align with those of (Abate, Z. 2016)who assert that the negative impact caused by the extraction of building materials was the formation of steep slopes that were very dangerous for the miners. Others were air pollution, lots of open lands, dusty and sandy soil, landslides, frenzied miners, dirty air due to processing and the roads that were traversed by the mine transporters were quickly damaged due to overload.

Effect on human health

The increase of human health problems is one of the negative impacts influenced by traditional extraction of building materials. This effect was pinpointed by 53% (N=140) of the respondents. At the site level, the results varied where in Nkurunduma site the effects were highly perceived by 59% (n=35) followed by Mahina and Nsumba where they were reported at 56% and 50% respectively.

In Msalabani the consequence of health problems was perceived by 49% of the respondents. It was noted that most of the affected people were those who had been affiliated with the process of extracting the building materials. Quarrying of building material in Mwanza city was found to be related to some health implications to communities as well as to excavators.

The study noted that the major health problems cited were cough and asthma, muscle pains, skin diseases, chest pain, injuries in the form of bodily cut, sleepless nights and eye infections, and malaria that was infecting people due to the presence of breeding grounds for mosquito larvae and holes that were storing water during the rainy seasons.

However, it should be noted that the results on the health condition varied from one site where building materials were being extracted from one site to another. For instance, the muscles pain problem was perceived almost in all sites but it was highly noted in Mahina by 50%, and Nsumba by 48% while in Nkurunduma site, it was pinpointed by 32% of the respondents. In the case of skin infection problem, the study revealed that in Nkurunduma site, the extractors were affected by 59% and in Nsumba; the effect was by 31%.

In Msalabani and Mahina sites, the problem was not much alarming as it was depicted at 14% and 11% respectively. The findings indicate that another health problem noted was chest pain, which was highly perceived in Msalabani by 42% and in Mahina by 30%. The asthma problem was not much bigger as per obtained data as the alarming point was only Msalabani site where it stood at 3%.

The study revealed that traditional extraction of building materials had influenced the eruption of dusts and smokes that were harmful to human health. The extraction activity influenced the blow of smokes and finest particles into the atmosphere and as a result, they polluted the air. The complex reactions of chemicals like Sulphur dioxide and Nitrogen oxide influenced several human health problems such as lung problems and eye problems to the people involved in extracting the building materials and to resident people near the mining sites. The results of experiment conducted indicated that the volume of PM 2.5 was higher in the atmosphere hence affecting the people exposed to the mining sites (see Fig.7). Due to

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small in size both PM2.5 and PM_{10}, these particles were acting as gas, which would be easily inhaled. Then when people breathe, these particles they penetrate into the lungs, which in turn would lead to cough, and asthma attacks as well as high blood pressure, heart attack, stroke etc. Serious diseases may occur and which would result into premature death.

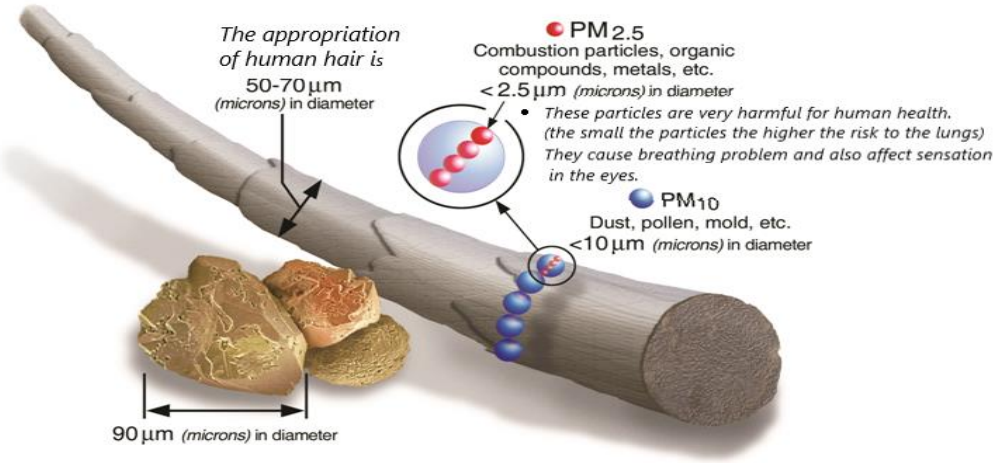

Figure 7. The particulate matter in the air

Source: *The originality of the diagram is www.irceline.be.com and modified to syrupy the study by the author, 2021.*

During FGD one woman in Nsumba stone quarrying site (who preferred anonymity) had these to say on the impact of extraction of building materials on health issues:

> *"The extraction of these building materials which are stones, gravels, and sand is a very difficult activity and as a result, it induces health-associated problems into our bodies. Sometimes stones blast into particles that cause injuries to our skins, burning of skins, and sometimes it can cause death if the person involved in the activity is not careful. During extraction of building materials, you can find many dusts entering our noses and micro or small particles of stones frequently enter our noses and mouths. All these contribute to respiratory problems and heart diseases"*

The findings as highlighted above are in line with those of (William, 2020) who revealed that stone mining causes many health problems. The problems that were emerging temporarily were mainly related to flying of stone dust. Stone dust contains chemicals that can cause lung disease. The disease appears in people who are at the sites for the extraction of building materials /a rock quarry, or in the area of rock transportation who due to their activities inhale rock dust continuously. Those who are at risk are workers (See Fig. 8).

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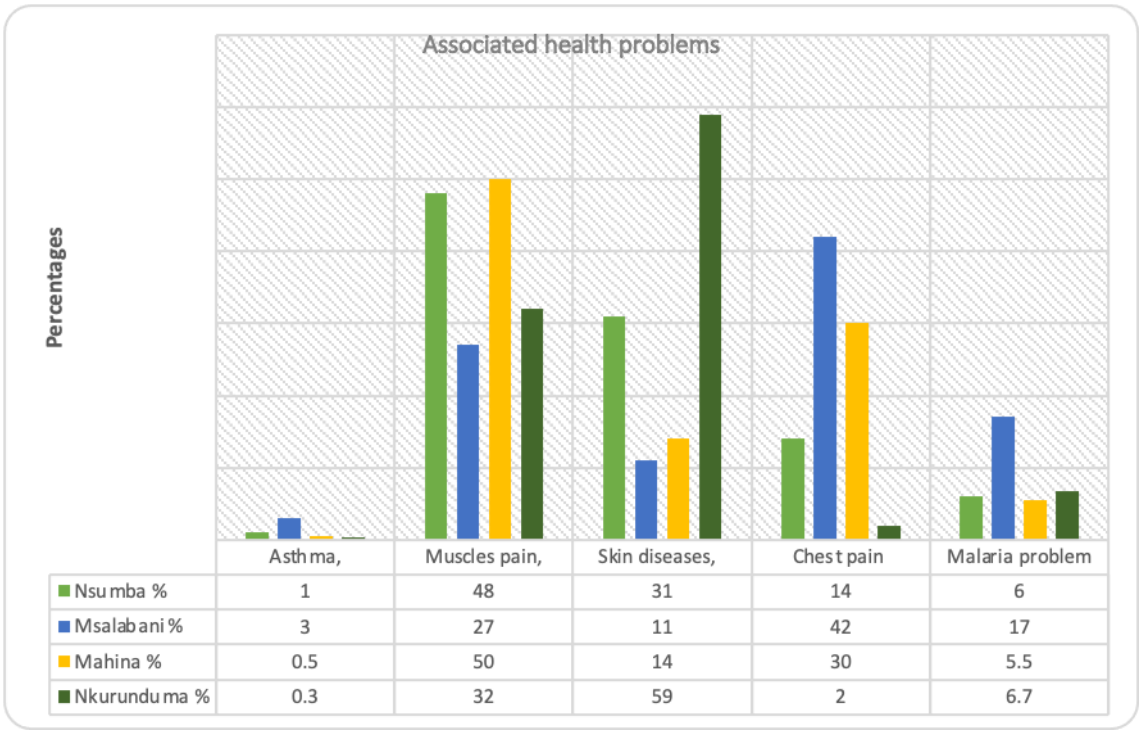

	Asthma,	Muscles pain,	Skin diseases,	Chest pain	Malaria problem
Nsumba %	1	48	31	14	6
Msalabani %	3	27	11	42	17
Mahina %	0.5	50	14	30	5.5
Nkurunduma %	0.3	32	59	2	6.7

Figure 8: Health problems associated with extraction (quarrying) of building materials:

In addition, (Awoke, 2019) maintains that 4 million people die annually from acute respiratory problems in developing countries. These problems emanate from environmental pollution, sandblasting, and the emission of dangerous chemicals. Similarly, (Lameed and Ayodele, 2010),

identifies physical injuries, respiratory problems, and fatal accidents as some of the health challenges that confront workers in the quarry sites.

Ukpong (2012) asserts that uninterrupted sleep is known to be a prerequisite for good physiological and mental function of healthy persons. In contrast, he stated that, sleep disturbance on the other hand is considered a major environmental noise effect. The primary physiological effects that can be induced by noise during sleep including increased blood pressure, increased heartbeat, increased finger pulse amplitude, verso constriction, changes in respiration, cardiac arrhythmia, and an increase in body movement (William, 2020) .

Therefore, the results obtained from the focus group discussion were authentic and trustworthy because the discussants cited almost the same health problems namely, - body, waist and chest pains, snake bites, inhaling problem, skin problem, asthma and malaria, headache, major and minor injuries in the form of bodily cut, sleepless nights and eye infections were also identified.

Air pollution

Overall the results from the four studied sites show that air pollution is one of the impacts associated with the quarrying of building materials by an average of 34.5% (N=140). However, the results for each site differed. For example in Nkurunduma and Msalabani the impact was highly pointed by 62% (n=35) and 35% (n=35) respectively. The air pollution

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problem was also cited in Nsumba and Mahina by 18% (n=35) and 13% (n=35). Although in Nsumba and Mahina sites, the air pollution seems to be low compared to Nkurunduma and Msalabani sites. Nevertheless, the results showed that the incident might increase as time passes by.

The study revealed that air pollution was being caused by various aspects. These were as follows; i) stone particles which were being blown by the wind; ii) smokes which were being released into the air during local burning of stones by using tires, charcoal, and firewood's; iii) explosives used to disintegrate big stones into parts, and iv) trucks transporting the material which were destroying the topsoil and sand hence facilitating erosion. The study noted that building material quarrying activities in the studied areas were influencing the creation of specks of dust (small particles generated by excavators) with a diameter of 1-70µm. It was cited that particles with aerodynamic diameters of less than 49µm (termed Total Suspended Particulate matter, or TSP) were suspended into the atmosphere, and those with aerodynamic diameters of less than 10µm termed PM_{10} (inhalable particles) could be transported over long distances and enter the human respiratory system.

During FGD one male respondent in Nsumba stone quarrying site (who preferred anonymity) had these to say on the impact on air pollution; -

> *"This act of using explosives to blast large rocks into parts for easier carriage and transportation leads to air pollution as smokes enter into the atmosphere and also cause heart attack, and high blood pressure. They also lead to eruption of a mass of particles to the air...the vibration and air blast produced cause buildings of the indigenous to have cracks and this has been resulting into conflicts between owners of buildings which appear adjacent to the quarrying sites and the excavators"*

Change of landscape

Overall, the results in the four sites combined, pointed to the change of landscape associated with building material excavation (quarrying) by 22.75% (N=140). Of the four sites, change of landscape was high in Nkurunduma and Nsumba sites in which 35% (n=35) and 25% (n=35) of the respondents felt the change of landscape was a problem influenced by the building material extraction process. In Msalabani and Mahina, the proportion was 11% (n=35) and 10% (n=35) respectively. The study revealed that the landscape of the sites where stones and sand as building materials were being extracted had changed permanently. It was noted that before the extraction of building-materials started, the mining sites were covered with vegetation covers and they had natural landscape, but after the commencement of extraction the sites' landscape changed and it came to be characterized by depression and holes.

Increase of conflict

An increase in conflict was one of the negative impacts pinpointed by the respondents in the study area. It was noted that overall four sites combined 16.25% (N=140) of the respondents cited the impact. On other hand the results from each site differed where in Nkurunduma site the impact was highly felt by 37% (n=35), followed by Nsumba where the impact was cited by 12% (n=35). In Msalabani and Mahina the results stood at 9% and 7% (n=35)

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respectively. In this perspective, it can be stated that quarrying activity should be done out of the residential areas.

During the focus group discussion, one of the respondents stated that,

> *"Sometimes it is difficult for us who are residing near these stone quarrying areas to have a rest during the day because of noise. We just hear the noise of these people who are cracking stones into pieces… sometimes; they use blasting weapons but without permission from the government. These weapons result in very big sounds that cause crakes in our houses. That is why we don't need them here, we are requesting the government to come and take all of them from this site"*

The study noted that sound and noise pollution were being caused by different aspects: - i) blasting of big stones into small pieces; ii) cracking of stones by using small hammers; iii) trucks that were coming to take gravels and stones iv) building material excavators.

Results from FGD (See Table 6) on building material excavating impacts show that there were some generic impacts to those mentioned by respondents who filled in the questionnaires. Some of these impacts included land degradation, air pollution, noise pollution, change of land use, change of landscape, conflicts, effects on human health problems which were waist and chest pains, snake bites, inhaling problem, skin problem, asthma and malaria, headache, major and minor injuries in the form of bodily cut, common cold, dislocation, sleepless nights and eye infections.

Also, during FGD in Nkurunduma site, one of the male respondents (who preferred anonymity) had these to say on stone quarrying as a source of conflicts:

> *"Stone quarrying has left us distressed; it is a cause of daily conflicts with these excavators who think only about getting money. They do not think about our houses, our health, and our relationship with other people. It is a tragedy that I don't want to see, it is a worse practice that we don't want to see it continue".*

Table 5: Perceived negative impacts by focus group discussants

Impacts	Areas			
	Nsumba	Msalabani	Mahina	Nkurunduma
Men	Land degradation Air pollution Noise pollution Effects on human health Conflicts Change of land use Change of landscape	Change of land use Change of landscape Land degradation Human health problem Conflicts	Noise pollution Effects on human health Conflicts Change of land use Change of landscape	Conflicts Change of land use Change of landscape Noise pollution

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Females	Noise pollution Effects on human health Conflicts Change of land use Change of land scape	Land degradation Air pollution Noise pollution Change of land use Change of land scape	Land degradation Air pollution Noise pollution Change of land use Change of land scape	Effects on human health Conflicts Change of land use Change of land scape

In this context, results from focus group discussion indicate that land degradation, air pollution, noise pollution, change of land use, change of landscape, health problems and conflicts were the main negative impacts of traditional extraction of building material on the residing communities.

CONCLUSION

The traditional extraction is regarded as a crucial economic activity for the people living in Mwanza City. Though it plays a significant role in the sustenance of livelihoods, it also has a significant negative impact on the biodiversity conservation as well as to the residing communities.

Data from the field revealed that economic hardship, unemployment, among others, were the factors contributing to people's engagement in stone quarrying despite the hazardous nature of the work. The results indicate that traditional extraction of building materials contributes to the well-being of workers and their families to the residing communities as the activities that enable the availability of stones, gravels and sand for building permanent houses. However, it was also observed that stone quarry has negative implications on environment as well as to the biodiversity. The traditional extraction of building materials in Mwanza City has contributed to land degradation, erosion, destruction of vegetation, arable lands, and loss of habitats for some animals and plant species as well as air pollution. This adversely affects the ecological balance of the area.

Finally, it has also been observed from the field that stone extraction in Mwanza City is not devoid of health problems. Eye problems, bodily pains, chest problems, coughing, respiratory problems, scorpion, snakebites, and injuries are some of the health challenges that confront workers in the industry. It is therefore concluded that despite the fact that stone quarrying contributes significantly to livelihood survival; it has greater health implications on workers in the mining sites.

RECOMMENDATIONS

The researcher recommends to the National Environment Management Council (NEMC) – Tanzania, The Lawyers' Environmental Action Team (LEAT) and to Mwanza city officials in the department of natural resources management and environmental conservation to do the following: -

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i. To develop an efficient and effective legal framework with strict laws including the imposition of heavy fines and long jail terms to miners who were extracting without the mining rights and licenses.

ii. The ward and village leaders should be involved in the inspection and verification of genuine permits to reduce the use of fake documents. The amputation of trucks from illegal miners is necessary as a way of prohibiting illegal mining exercises.

iii. Extraction of building materials must be done in a manner that minimizes unfavourable impacts on both humans and ecosystems comprising of biota and habitats.

iv. The environmental conservation organ should establish laws and conduct environmental impact assessment before extraction of building materials is allowed.

v. The environmental conservation organ to educate the excavators on the impacts of extracting building materials near the human residence.

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