

# THE EFFECTS OF INFORMAL QUARRYING ON PEOPLE'S HEALTH: A STUDY OF LUSAKA DISTRICT

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## ABSTRACT

*The construction sector in Zambia was leading by demand of the mining industry, shopping centres, infrastructure development, residential buildings, and offices. This growth contributed to informal quarrying in Lusaka. The quarrying is done in various areas within and around Lusaka. This study looked at the effects of quarrying on the health of the people of Lusaka who were directly involved in informal quarrying industry. The study had three objectives namely: to identify the quarrying sites, to examine the methods of extraction and processing of the quarry material and to establish the health risks and hazards of quarrying on the people.*

*Lusaka is located at 15° 25' S and 28° 17' E in Lusaka Province. Lusaka District was chosen because of its geological landscape. There were a lot of strongly folded Precambrian metamorphic rocks which were truncated by the Mwembeshi dislocation. The study was qualitative with a sample size of 51 respondents. These were broken down as follows: Companies (20%), Transporters (23%), Stone crushers/traders (53%) and Key informants (04%).*

*The results revealed that even though the quarry business was quite lucrative, the people were exposed to various risks and hazards. The risks were: accidents (21%), Lung cancer (20%), Body pains and backache (15%), physical injuries (49%), Respiratory infections (47%) and Sight impairment (9%). While the hazards were: disused quarries, used car tyres, noise and motor vehicle unfitness. Most of the respondents knew of the health implications considering that they quarried without any protective wear. But due to the fact that they got the most desired income and that it was good business more especially during the dry season, they continued against any odds.*

*The Ministry of Minerals and Mines, The Zambia Environmental Management Authority (ZEMA) and Public Health Department of the Lusaka City Council should work together to regulate the activity. Behavioural health campaigns should be instituted in order to enhance health mining as this would reduce on the impact of quarrying on the health of the people.*

**Key words:** *Hazard, Health, Informal, Quarrying, Risk.*

## INTRODUCTION

Quarrying was a mining activity which was used in the extraction of minerals, sand, aggregate, stones, laterite and gravel for trade and infrastructural development such as roads, houses, industries, shopping malls and many other structures in the property and construction industry.

Quarrying in Zambia was becoming an important economic activity because of the tremendous growth of the construction industry. The industry contributed 8.1% of the Gross Domestic Product (GDP) in 2010 and led in the category of secondary industries (Central Statistical Office [CSO] 2010) [1].

In 2014 the construction sector contributed 27.5% of the GDP with the growth rate of 12% within this same year (Mfuno 2016) [2]. Lusaka had experienced unprecedented levels of construction works in various spheres. What used to be open spaces before, have continued to be filled up with shopping complexes such as Garden City, Levy Park, Manda Hill, Twin Palm and Waterfalls; housing complexes, hotels and lodges to mention just a few. Other than spatial land filling, some parcels of land under the agricultural land use have changed their status to residential. Housing units have since been constructed in formerly farmlands and some of such areas were the Vorna Valley, Ndeke, Kwamwena under the Meanwood Properties whose land formerly belonged to Gaulunia Holdings (an agricultural investment company), and Ibex Hill farms. The Ibex hill farms' landscape has slowly been changing to high class residential settlement.

Construction in Lusaka had sprawled to the fringes of Chibombo, Chilanga and Chongwe Districts. The district boundaries, more especially between Chibombo-Lusaka and Chilanga-Lusaka were no longer visible. A conurbation has since developed. These constructions have altered Lusaka's natural aesthetic environment affecting its value as 'the Garden City'.

The construction industry in Lusaka District has greatly contributed to the development and expansion of informal quarrying. The industry has also enhanced support activities such as wood works (doors), metal works (window and door frames), concrete pillars and blocks, brick and paving tile making. This study however, focused on the effects informal quarrying on people's health.

## **STATEMENT OF THE PROBLEM**

The extraction of sand, stones, gravel, aggregate and laterite disturbilize the ecosystems and compactness of the earth and the underlying rocks. Quarrying creates vast craters and trenches which become filled with water thereby creating ideal conditions for vector and bacterial breeding. These areas become prone to diseases such a malaria, cholera and schistosomiasis.

Quarrying produced dust, noise, smoke (from the vehicles and burnt used car tyres) and accidents of which may end up in injury. The transportation of the quarried materials also polluted the roads causing a danger to other road users. It was imperative to find out what the situation in Lusaka District was, and more so on the health of the people in informal quarrying.

## **OBJECTIVES**

The study had three objectives. The first one was to identify the quarry sites; the second objective was to examine the methods of extraction and processing of the quarried materials and the third was to establish the health risks and hazards associated with quarrying in Lusaka District.

## STUDY AREA

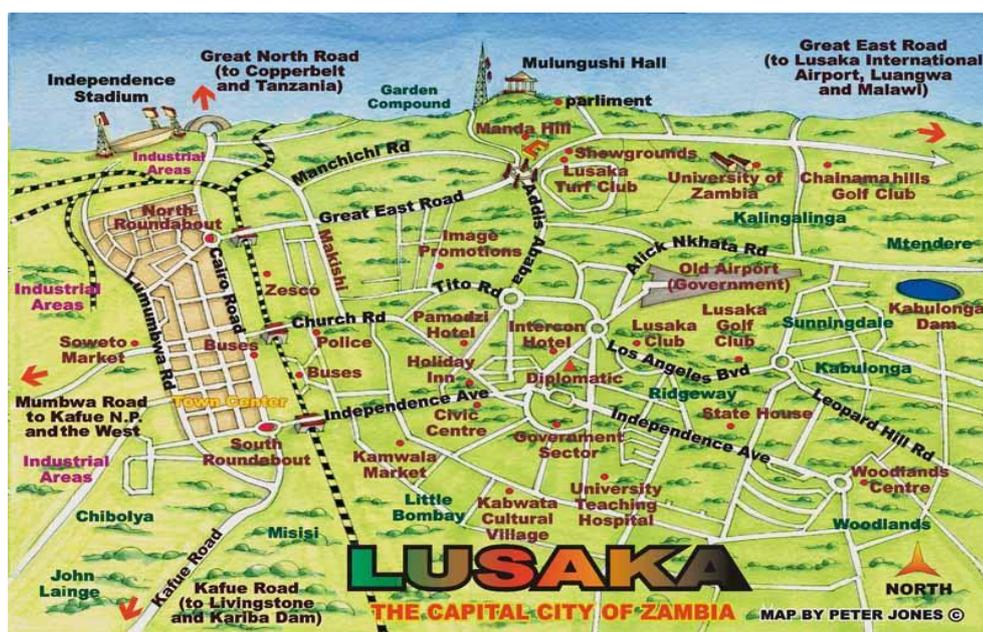


Plate 1: Location of Lusaka

Source: Google Maps (Retrieved on 24<sup>th</sup> February, 2017) [3]

The study was done in Lusaka District which was located at 15° 25' S and 28° 17' E in the Lusaka Province. Lusaka is the national administrative capital and it became the capital city of present day Zambia in 1935 (Williams 1986) [4].

### Geology

Lusaka lies in an area of strongly folded Precambrian metamorphic rocks. These include a variety of lithologies such as marbles, schists, quartzites and gneisses. All except gneisses belong to a 50 kilometre (km) wide belt of metasedimentary rocks which are bounded on each side by gneisses. This belt is truncated in the North by a West South Western (WSW) fault zone known as the Mwembeshi dislocation zone and terminates at the faulted margin of Zambezi Rift valley (Turner and Turner 1986) [5].

Lusaka District occupies one of the higher parts of Central African Plateau which descends to the Lukanga Swamps (NNW), the Lusemfwu (NE), the Kafue-Zambezi escarpment (SSE) and the Kafue Flats (SW). The stratigraphic of the plateau is divided into:

- Ridge way schist
- Lusaka Dolomite
- Barrastone schist and Dolomite
- Matero quartzite

Lusaka District depicts a landscape of a lot of rock out crops and hills. These provide ideal conditions for quarrying.

### **Drainage**

The drainage of Lusaka District revealed a radial pattern in conformity with the landform.

### **Climate**

Lusaka District experienced three seasons. The hot and wet (No-Apr), the cool and dry (May-August) and a short hot and dry (Sept-Oct) seasons.

## **METHODOLOGY AND SAMPLE SIZE**

### **Methodology**

The study was qualitative and descriptive in nature as no random sampling procedures were executed. The interviewees (respondents) and the key informants were purposively selected. Observation was an added tool to data collection.

### **Sample Size**

The sample constituted the road side traders who were at the same time stone crushers, the transporters of the quarried materials, the companies that are involved in quarrying and key informants.

**Table 1: Sample categories**

	<b>Respondents</b>	<b>Transporters</b>	<b>Companies</b>	<b>Key Informants</b>	<b>Total</b>
Frequency	27	12	10	02	<b>51</b>
Percentage	53	23	20	04	<b>100</b>

**Source:** Field data, 2016

## **RESULTS AND DISCUSSION**

The results and discussion have been grouped under demographic characteristics, quarry sites, methods of extraction and processing and, health risks and hazards associated with informal quarrying in Lusaka District.

## DEMOGRAPHIC CHARACTERISTICS

### Age

The study revealed that the ages of the people that were engaged in quarrying and trading ranged from 17 years to 66 years.

### Gender

The transporters and company owners were all males while the stone crushers/traders 9 were males and 18 females. There were a total of 31 (63.3%) males and 18 (39.7%) females.

### Educational Attainment

The education attainment for the respondents ranged from Grade 5 to Grade 9 as illustrated in Table 2.

**Table 2: Respondents educational attainment**

Grade	Frequency	Percentage	Whole sample (%)
5	3	15	14.3
6	3	15	14.3
7	6	30	28.6
8	2	10	9.5
9	6	30	28.6
<b>Total</b>	<b>20</b>	<b>100</b>	<b>95.3</b>

Source: Field data, 2016

Grade 7 and Grade 9 has 30% each of the respondents who had attained those levels. This showed that those who could not continue with education from the two levels ventured into informal quarrying. The lower grades had 15% of the respondents. Four point seven percent (4.7%) of the respondents did not go to school at all.

### Employment opportunities

Informal quarrying provided employment and source of income for the households. All the 49 respondents considered quarrying as a lucrative activity despite the risks and hazards involved. The income realized ranged from ZMK10 to ZMK900 (US\$1 to US\$90). The ZMK10 was the amount of money demanded for a small pre-pack of a re-used cement bag. The amount of money made per day and ultimately per month was dependent on how much of those small bags were sold per month. While those that sold per truck load charged an average of at least ZMK900 (US\$90) per load. The quantities varied in that the sizes of the trucks were different so were the costs. The charges for the truck loads ranged from ZMK300 to ZMK900 (US \$30 to US\$90). Depending on the construction site, a heap of rocks arranged in an inselberg feature cost ZMK 70 (US \$7). The amount varied from place to place.

The companies employed 4 to 43 workers who earned ZMK600 (US\$60) per month. This figure was however, below the government stipulated low income boundary of ZMK750 (US\$75) per month.

## THE QUARRY SITES

The quarry materials were obtained from within Lusaka District and surrounding areas. The stone crushers/traders used quarries within residential and industrial areas such as Chalala, Kamwala South, Kanyama and Chinika Kanyama, Plate 2 shows area of one of the quarries. Other sites were in Lusaka West (Chilanga), Katuba and Mungule (Chibombo), Kasisi (Chongwe) and Kapopo in Kafue.

Lusaka West was a vast area that lay between Mumbwa and Mungwi roads into the districts of Chilanga and Shibuyunji. The materials find their way into Lusaka District because of the high potential market for construction works.



**Plate 2:** A Quarry in Kanyama Area

**Source:** Field data, 2016.

## THE METHODS OF EXTRACTION OF THE QUARRIED MATERIALS

The material of greater concern are the stones which people repeatedly crush. For sand, even though it is equally a pollutant and a health risk, the people that dig it out were on short contracts of one to two loads if they were lucky.

The stones were extracted from the already mentioned rocky sites by the use of hammers, picks, used car tyres and in rare circumstances dynamites. Used car tyres were used to induce heat to the boulders and rocks in order for them to prize apart. Then hammers and picks are used to break the rocks through the crevasses. The huge stones were then ferried to a destination for further crushing into 20 millimeter, 10 millimeter and 5 millimeter dimensions.

Men and women crushed these anywhere near a construction site, but in this, the study was along the four trunk roads. The crushed stones were then packed into empty cement bags as Plate 2 shows. The price determined the quantity of the packaging.



**Plate 3:** Packaging of stones

**Source:** Field data, 2017.

During the process of tyre burning, a lot of soot and dense smoke were produced thereby reducing the areas. Dynamites were rarely used by these informal miners. It only happened when someone was in possession of it. In such cases, they were usually mishandled and turned out to be fatal.

**Table 3: Length of operation in the Informal quarry industry (in years)**

	Stone crushers/traders	Transporters	Companies
Duration (years)	2 - 26	4 – 25	4 - 14

**Source:** Field data, 2016

## EFFECTS OF QUARRYING ON PEOPLES' HEALTH IN LUSAKA

### Health Risks

The respondents identified the following as health risks they were susceptible to:

- |                           |       |
|---------------------------|-------|
| • Accidents               | 21.1% |
| • Body pains and Backbone | 15.0% |
| • Lung cancer             | 20.0% |
| • Physical injuries       | 49.0% |
| • Respiratory infections  | 47.0% |
| • Sight impairment        | 8.8%  |

These risks were classified into two namely: Respiratory tract infections and physical body injuries.

### Respiratory tract infections

This category of risks accounted for lung cancer, bronchitis, influenza and common cold. These were the ailments that they suffered from time to time. Lung cancer however, was not as common as the rest. These ailments were as a result of particulates they inhaled during the stone crushing. According to Rao and Rao (1998) [6] the dust generated from crushing and grinding stones, sand and cement were hazardous to human health. An average human being breathed 22,000 times a day. Where the air was polluted, the people were subjected to breathe contaminated air. This exposed them to various respiratory challenges such as silicosis (silica), asbestosis (Asbestos) and throat irritation (Chipungu and Kunda 1994) [7]. This research found out that respiratory tract infections were common amongst the respondents.

### Physical body injuries

The respondents suffered a lot of injuries more especially in their hands, fingers and feet; body pains and backache as a result of sitting for too long and hammering of the stones.

Injuries were incurred during the breaking of stones. Some stones heat the eyes and depending on the size and velocity, so was the impact. Some crushers/traders experienced visual impairment. Owing to the magnitude of the work involved in this extraction industry. Chest and body pains (15%) were cited as common ailments.

Accidents caused by motor vehicles constituted 21.1% of the total risks. These accidents resulted from

- Overloaded vehicles whose load either flew stones on the road or flew to hit any target on its path and this was also revealed in Wikipedia as something that was common (Wikipedia 2006) [8];
- The transporters were supposed to cover their materials using tarpaulins according to the Zambia Environmental Management Authority (ZEMA) guidelines in order to minimise the street sweepings (Mwanamwalye 09/02/2017) [9]. This was not followed by most transporters monitoring by ZEMA was not efficient;

- Faulty lighting system more so for those that choose to transport the materials at night when the law enforcement officers have knocked off. Such vehicles are not easily visible so they are detrimental to other road users;
- Breaking system was faulty for most vehicles. The impact on other road users was higher than that of lighting as these vehicles moved both at night and day. In 2016 one of such a vehicle rammed into a minibus from Mumbwa and killed more than 10 people.

### Health Hazards

The health hazards that were stated by the respondents were: quarries, used car tyres, noise and motor vehicle unfitness.

### Quarries

These became a health hazard especially during the rainy season as they became dams as illustrated in Plate 3.



**Plate 4:** A disused flooded quarry

**Source:** Field data, 2017.

This was one of the biggest informal quarries in the Chinika Industrial area. The quarry had since been discussed and had become a health hazard as it was also garbage disposal dumpsite. This facilitated ideal conditions for communicable diseases such as malaria and cholera. An areas were used to dispose of bodies that were murdered in unexplained circumstances (Ng'andwe 23/02/2017) [10]. The children used the dams as swimming pool.

### Used car tyres

The used car tyres were burnt over the rocks in order to induce heat to expand the rocks. This would make the rocks develop crevasses as lines of weaknesses to facilitate the easy breaking of the rocks into stones. The combustion of the tyres produced also heavy smoke with a lot of scot that contributed to air pollution. The people were subjected to inhale contaminated air.

Das and Behera (2008:65) [11] argue Heat “air pollution meant the presence of gaseous, liquid and solid substances in the air.” And it was further stated that air pollution was the presence of deleterious substances in the atmosphere above accepted levels. The question that arose was ‘what

were the acceptable levels for a pollutant to be considered a health hazard? A pollutant is a pollutant no matter how small. These people had been doing this activity on a small scale but repeatedly for a period between 5 – 25 years. This therefore put them at risk and tyre burning was a health hazard. The people were subjected to gaseous primary pollutants of carbon monoxide (CO) hydrocarbons (HC) and suspended particulate matter (SPM). This was the more reason why 47% of the respondents cited respiratory infections as one of the health hazards.

### **Noise**

The crushing of stones was accompanied by noise which was considered as insignificant by the stone crushers as they had been accustomed to it. What they did not realize was that they were developing hearing impairment as shouting became a way of communication. Noise as a health hazard was in three categories:-

- Auditory effect
- Non-auditory effect and
- Behavioural effect

The auditory effect of noise induced temporary or permanent hearing loss. Das and Behera (2008) [11] stated that occupational hearing loss was the man perceived health hazard to day-to-day exposure to noise pollution. This therefore, does not leave out the small scale stone crushers/traders who were always breaking the stones.

The non-auditory effect caused physiological damages due to exposure of varying intensity of noise for different periods of time. These included:

- Cardiovascular disorder –change in the heart beat;
- Respiratory disorder –change in the breathing aptitude
- Ocular effect – pupillary dilation that leads to impairment of night vision
- Galvanic skin effect – change in the electrical resistance of the skin and;
- Biochemical response – eosinophilia

The most common effects of informal quarrying on the people of Lusaka were respiratory disorders and galvanic skins. The people had developed different skin colour and texture on their faces, arms and hands. The hands more especially the fingers were hardened.

The behavioural effects of noise were: annoyance, irritability, performance inefficiency, lack of concentration and loss of speech intelligibility. Annoyance and irritability were visible among the stone crushers/traders along the roads under the study. This gradual transformation was not realized all.

### **Motor vehicle fitness**

Motor vehicle fitness was also looked at after the other respondents concern about the road accidents that were caused by some of the trucks that transported quarried materials especially

stones. The transporters had been in business for a period from 4 years to 25 years. Sixty percent (60%) of the transporters owned the vehicles they used and 40% were employed as drivers. Table shows a record of road worthiness of the trucks (motor vehicles).

**Table 4: Road worthiness of the motor vehicles**

	Serviced and roadworthy	Serviced and road unworthy	Not serviced and road unworthy	Total
Frequency	02	05	05	12
Percentage	16.6	41.7	41.7	100

**Source:** Field data, 2016.

Fifty-eight point three (58.3%) stated that the motor vehicles were serviced and only 16.6% were fit for the road. The remaining 41.7% were road unworthy bringing the number of unworthy vehicles to 83.4%. These roads unworthy vehicles had mechanical problems such as lighting, breaking and engine malfunctioning that caused vehicular pollution. This clearly showed that the vehicles were a health hazard to the environment and other road users. Plate 4 shows one of the motor vehicles used to ferry quarried materials.



**Plate 5:** One of the motor vehicles used to ferry quarried materials

**Source:** Field data, 2017.

In addition, there were cases of flying stones that shattered wind screens of other vehicles. Apart from that, the roads were polluted with stones and gravel that became a detriment to safety.

Vehicular pollution sources were carbon monoxide (CO), Oxides of Nitrogen (NO<sub>x</sub>) and hydrocarbons (HC). These were emitted into the atmosphere as a result of different efficient levels of find combustion. Most of the vehicles however, produced thick smoke accompanied by soot from their exhaust pipes. Exhaust pipes contributed 70% to the vehicular pollution while crack case emission and evaporation of fuel from the carburetor accounted for 20% and 10% respectively (Das and Behera 2008) [11].

Vehicular pollution subjected the drivers and other people within the areas of operation to vulnerability of the following ailments: headache, psychological stress, respiratory tract infections, visual difficulty and carcinogenic effects. This meant that motor vehicles were equally health hazards.

## **CONCLUSION**

Even though quarrying is a lucrative business it equally possesses a lot of health risks and hazards to the people involved in this informal industry. There was need for sustainable quarrying methods that enhanced health as well. There was need for the Zambia Environmental Management Authority (ZEMA), the Ministry of Mines and Minerals, Road Transport Safety Agency (RTSA) and, the Lusaka City Council (Public Health Department) to cooperate in order to legalize the mining, enhance environmental friendly mining and processing of the quarry, ensure the fitness of the motor vehicles used in the transportation of the quarry and the sweepings of the roads.

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