

# ASSESSMENT OF OCCUPATIONAL HAZARDS AWARENESS AND SAFETY MEASURES AMONG QUARRY WORKERS IN BOMET COUNTY, KENYA

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**Abstract:** The quarry industry remains one of the most challenging workplace to work in because of the enormous hazards that are associated with the art of quarrying which may manifest long after the worker ceases to work in the quarry. This study assessed occupational hazard awareness and safety measures among quarry workers in Bomet County. To achieve the set objectives, a target population of 542 quarry workers from NEMA registered quarries by the time of study was used. Descriptive cross sectional study design was used where stratified random sampling and simple random sampling were used to draw a random sample of 230 respondents. The inclusion criteria for the study were workers above 18 years of age and had work experience of at least six months. A structured, self-administered questionnaire was used to collect data on awareness of occupational hazards and safety measures from the respondents as a result of their daily work activities. An observation checklist was also used to record how quarry activities were being performed by workers, while interview was conducted with quarry managers and the institutions involved in Occupational safety and Health. Data collected from the questionnaires was cleaned, coded, tabulated and subjected to statistical analysis. SPSS Version 21.0 was used to analyze the quantitative data. It was established that 81.7% of the workers were aware of occupational hazards in the quarry while the main source of information about hazards was from colleagues 45.2%. The most known hazard among respondent was manual handling of heavy loads 52.2% while the effect of hazard encountered by 60% of respondents was back/shoulder/waist/arm pain. Only 27.8% of the respondents were aware of safety measures in place. It was also established that lack of management commitment (97%) and lack of workers training (95%) were the top contributing factors affecting implementation of OSH measures in quarries. The study concludes that the level of awareness of occupational hazards was high among the respondents; however the respondents were insufficiently equipped with knowledge on safety measures to comprehensively mitigate occupational hazards. The study recommends that quarry management should carry out safety inductions to all workers before they commence their contracts so as to promote safety culture, provide the necessary PPE for workers and adopt other methods of dust suppression such as use of bag filters and scrubbers. It also recommends that the enforcement bodies (NEMA and DOSHS) should impose higher restrictions and enforcement guidelines for establishing quarries with proper provision for OSH services before granting licenses to quarry operators/owners.

**Keywords:** occupational hazard awareness, quarry workers construction industry, national economy.

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## 1. INTRODUCTION

Quarry is one of the many extractive industries playing important role in the economies of many countries including Kenya by creating employment, sustaining livelihoods and providing national income. Quarrying activity provides much of the materials used in traditional hard flooring such as granite, limestone, marble, sandstone, slate and even clay to make ceramic tiles (Aloh *et al*, 2017). Quarrying products are increasingly demanded for industrial, domestic, agricultural and other purposes so as to satisfy the needs of the rapidly growing population. According to economic survey of 2009 by the

Kenya National Bureau of Statistics (KNBS), there are over thirty thousand quarries scattered all over the country, employing over a million Kenyans either as permanent or casual labourers. These numbers of quarries is likely to increase due to the upcoming infrastructural projects in the country, especially the construction of roads, affordable housing and Standard Gauge Railway (SGR) (KNBS, 2009).

Quarrying is a non-renewable activity that involves the disturbance and excavation of surface and underlying strata including aquifers for the purpose of exploiting minerals, stone and sand. Extraction of stone, ballast, gravel, clay and sand is done in various parts of the Kenya, Bomet County included. This activity is on the increase within Bomet County due to increased demand of products as a result of rapid urbanization of Bomet town and the surrounding areas. In addition, poverty, unemployment, reduced farm sizes and increased population have all collectively exacerbated the activity which is labour intensive requiring low skilled workers earning low wages (Okoko *et al*, 2011). These jobs are seen as a quick way to earn money, yet they are not adequately paying and a lot of underage employees are recruited because they provide cheap labour, despite the deadly health risks the workers are exposed to in the industry (Kibet, 2014). It is this group of people that are at greater risk of work related injuries, chronic illness, stress and disability or death because of low education and literacy rates, unfamiliarity with work process and exposures and inadequate training (Lawan *et al*, 2016).

Quarrying has a reputation for being a particularly unhealthy industry because of its rate of work related injuries and illness is one of the highest of all occupational groups worldwide, due to physical nature of work involved, coupled with poor workplace health and safety standards (Wanjiku *et al*, 2015). According to Kenya quarry report (2010), there have been various quarry disasters associated with quarrying activities which have brought about safety, environmental and socio-economic concerns that need to be addressed such as notable accidents that compromise the workers' health and land degradation due to inadequate rehabilitation and after use plans of the quarry. As noted by the National Environment Management Authority (NEMA, 2010), quarrying in Kenya suffers from a number of constraints including lack of basic knowledge on safety precautions, poor working conditions, low socio economic status, lack of clear quarrying legislation and environment degradation that call for special attention.

Quarrying greatly affects the environment because the vegetation has to be cleared first, fertile soil is removed and after excavation, pits are left unfilled. Some abandoned pits can fill with water, creating artificial lakes. These lakes also act as breeding ground for mosquitoes which spreads malaria. The abandoned quarries are dangerous spots where several children have drowned in them and people killed and thrown into them. Abandoned pits act as hiding place for organized crime and drug peddlers while others act as dumping site making area with quarrying activities very scary to live in (Okoko *et al*, 2011).

Work within the quarry industry is both physically and mentally demanding. Workers are exposed to various hazards resulting from the inhalation of airborne particulates and the use of machines and equipments which poses a lot of danger to their health and safety. These hazards include but not limited to cuts and injuries, falls from heights, vibration, effects and complications of noise, inhalation of dusts and fumes and bites from animals e.g snakes. Air-borne particulates pose a potential health risk to quarry employees in the form of respiratory, dermal, ocular irritation and damage. A particular concern in some quarries is the inhalation of dust containing silica which can lead to silicosis, an irreversible lung disease resulting in inflammation of the lungs and breathing difficulties which progresses even when exposure stops (Aigbokhaode *et al*, 2011).

## 2. OCCUPATIONAL HEALTH AND SAFETY HAZARDS IN QUARRIES

Muchemedzi and Charamba (2006) explain according to his study that accidents do not arise from a single cause but from a combination of factors which act simultaneously. A potentially unsafe situation does not cause an accident until someone is exposed to it. Accidents are caused by the result of unsafe acts or practices (the human element that results from poor attitudes, physical conditions and lack of knowledge or skills to enable one to work safely). They are also caused by the result of unsafe conditions of equipment or materials. The following occupational health and safety hazards are encountered during quarrying activities;

Working on the faces and clearing-up operations

Risks around the faces are related to the instability of the face, loose material falling from the face, and vehicles driving over the edge of the face due to missing face protection, because of driver failure or technical problems with the vehicles (Safe maintenance, 2015).

### Vehicle operations

Vehicles are necessary for transporting goods and people. However, many people die and are injured due to being struck, crushed or run over by reversing vehicles, overturning, collision with other vehicles, or falling while entering or leaving the very high cabs of many vehicles used in quarrying operations. Accidents may also occur as a result of technical failures such as faulty brakes and steering, or because of driver misjudgments. According to the Irish Health and Safety Authority (HSA) nearly half of all fatal accidents in quarries involve vehicles (HSA, 2009). Crush injuries can have a wide range of serious effects, including fractures, internal injuries, head and brain injuries and back injuries. In some cases, a crush injury may result in amputation and permanent disability of the affected worker (HSE, 2004).

### Machinery-related accidents

These occur as a result of workers being trapped, entangled, crushed, and stabbed or abraded by the tools and machines used in quarries or falling from it during maintenance. According to the German statutory accident insurance organization for the quarrying industry, 5% of all confirmed occupational accidents in 2008 were associated with moving conveyor belts. In the same period, stone crushers were associated with 8.6% of all confirmed accidents in the sector (Safe maintenance, 2015).

To prevent machine related accidents, train employees on safe work methods, avoid wearing loose clothing when working near moving machinery and conveyors, working near conveyors and moving machinery should be avoided as much as possible, install machine guards that are needed on and around all moving parts, repair and maintain all hand and power tools, emergency shut-down switches should be installed for all machines in the crushing unit, train workers in their use (Work safe New Zealand, 2016).

### Slips, Trips and falls

Slips and trips are seen as the most common workplace hazards and contribute to over a third of all major injuries (Hughes *et al*, 2011). According to statistics from the HSE, slips and trips are the single most common cause of injuries at work, and account for over a third of all major work injuries. They occur in almost all workplaces and 95 % of major slips result in broken bones (HSE, 2004). The study done by Tindiwensi *et al* (2000) on the United State of America (USA) revealed that slips account for 18% of all injuries and 25% of workers' compensation payments. Slips contributed to 85% of falls on the same level and over 30% of falls from height as well as a significant number of musculoskeletal injuries sustained after slipping. They can also be the initial cause of a range of other types of accidents, such as falls from heights. Slips and trips are caused when materials are scattered everywhere haphazardly, the floor is wet or greasy, inappropriate footwear is worn, mainly by casual employees and visitors, something large or heavy is being carried, reducing one's balance, and when the lighting is poor.

Controls includes: For mobile structures access to heavy vehicles should be by a well-constructed ladder or steps. Ladders or steps should be well built, properly maintained and securely fixed. Where steps or ladders extend to the ground, the use interlock systems to prevent the vehicle moving or starting; until the ladder or step has been correctly stowed. For fixed structures; Access routes must, among other things have adequate activity space, be free from dangerous obstructions and from any projections likely to cause an obstruction, have a safe cross fall, and safe slope in the direction of travel, have adequate slip-resistant walking surfaces. Access routes must also have handrails which are smooth, reachable and graspable so they provide support and to assist with movement along a stair or ladder, are adequately strong and rigid (Wagner *et al*, 2009).

### Dust

Dust is present at all quarries because of the work processes involved, such as cutting, drilling, breaking or crushing of stones. Both activities generate dust and pebbles. The dust and pebbles can be a nuisance and they can also be harmful to the body by causing physical harm. Dust may get into the eyes when poorly protected or not protected at all, it can interfere with vision thus causing accidents, affect the skin causing all kinds of skin problems and it can cause problems when inhaled, depending on its kind. Dust can cause a variety of respiratory diseases amongst quarry workers. Pneumoconiosis, the general term given to a range of lung diseases caused by breathing dusts, typically causes chest tightness, shortness of breath and coughing. Dust from rocks (quartz) when inhaled can cause lung problems including silicosis (Thebe P, 2011). According to the findings of a study conducted by Nwibo *et al*. (2012) in Ebonyi State, Nigeria

to determine the prevalence of respiratory problems and lung function impairment among quarry workers; the respiratory problems found were chest pain (47.6%), occasional cough (40.7%), occasional shortness of breath (6.5%) and wheezing (5.2%). A similar study by Olusegun *et al.* (2009) on the impact of granite quarrying on the health of workers in Abeokuta Ogun State, Nigeria established that, 26% of the workers suffered predominantly from cough, 20% from catarrh and 15% from sinusitis.

### 3. RESEARCH METHODOLOGY

A descriptive cross sectional study design was employed for this study. The study was carried out at selected quarries in Bomet County, Kenya. The sample size used for this study was 230. Stratified random sampling method was used in the study. The quarry sites were divided into four strata depending on material being quarried. A structured, interviewer-administered questionnaire containing both open and close ended questions was used to collect qualitative information. Permission to conduct this study was obtained from Jomo Kenyatta University of Agriculture and Technology and management of the respective quarries. Data collected was checked for completeness before being analyzed by using descriptive statistics. Percentages are most widely used and understood by many people. The findings were analyzed further using the Statistical Package for Social Science (SPSS) Version 21.

### 4. RESULTS

All the respondents filled in and returned the questionnaires giving a response rate of 100%. This means that the results are adequately representative of the target population from which it was drawn. Majority of the respondents were male [182 (79%)] while female were very few [48(21%)] in this study. This was attributed to the high level of physical labour needed as nature of job entails physical activity like chiselling and breaking of rocks, lifting heavy loads and use heavy vibrating machines.

#### **Awareness of occupational hazards, source of information and effects of hazards**

The study results revealed that 188 (81.7%) of the respondents, were aware of hazards within their workstations. This could be explained to some degree by level of education and also the length of work experience observed in the majority of the respondents, where 218(94.7%) had been on work for at least one year and above. The longer the workers stay in the quarry industry, the better the awareness on occupational hazards, safety measures and use of safety equipments. Studies have demonstrated that the more a worker has experience, the more they are conscious in their work environment and less prone to accidents and injuries. The study findings corroborates that of Wanjiku *et al* (2015), among workers in Mutonga quarry in Kenya and Adeoye *et al*(2015), among sawmill workers in Nigeria, where high level of awareness was also observed. On the contrary, Osagbemi *et al* (2010) reported a generally low level of awareness of occupational hazards.

The main sources of information of occupational hazards were mainly from colleagues' 104 (45.2%) and personal experience 75 (32.6%), This is a good development and it is likely to minimize workplace injuries as similarly reported by Omotosh *et al* (2012) who carried out a similar study among workers in a cement factory in Nigeria. This findings also concurs with that of Diwe *et al* (2016) where personal effort and on job training were attributed to as main sources of awareness of occupational safety and health. However, it contrasts with that of Osagbemi *et al* (2010) where the main source of information was mainly from employers.

The most known hazard by respondents was manual handling of loads 120(52.2%) followed by dust 118(51.3%) and falling rocks 92(40.0%). This is also similar to what was reported in a study in Kenya by Wanjiku *et al* (2015), where some of the hazards reported by the respondents were manual handling of heavy loads(42.4%), being hit by the tools(14.7%), exposure to dust (12.5%) and falling of rock block(6.6%).

The effect of the hazards encountered by 138(60.0%) of the respondents while on duty was back/shoulder/waist/arm pain. This was attributed to a lot of manual works in quarries which includes scooping of sand from pit, loading of rock blocks, sand and murrum into Lorries, cutting of rocks into specific sizes which requires a lot of bending and twisting of body while working in awkward positions. Also the use of hand tools which includes hammer, drill and wedge might have contributed to pain in arm.

**Table 4.1: Awareness of safety measures**

Variable	Category	Aware of safety measures in workplace		
		Yes	No	Chi-square
Gender	Male	40(22.0%)	142(78.0%)	$\chi^2=8.073,df=1,$ P=0.004
	Female	2(4.2%)	46(95.8%)	
Age	18-29 years	15(18.1%)	68(81.9%)	$\chi^2=3.316,df=4,$ P=0.506
	30-39years	16(22.2%)	56(77.8%)	
	40-49years	8(20.5%)	31(79.5%)	
	50-59years	3(8.6%)	32(91.4%)	
	60 and above	0(0.0%)	1(100.0%)	
Highest level of education	No formal education	3(8.3%)	33(91.7%)	$\chi^2=60.318,df=4,$ P=0.000
	Adult literacy	2(50.0%)	2(50.0%)	
	Primary	10(10.5%)	85(89.5%)	
	Secondary	12(15.6%)	65(84.4%)	
	Tertiary	15(83.3%)	3(16.7%)	
Length of work at the quarry	Below 1 year	3(25.0%)	9(75.0%)	$\chi^2=7.918,df=5,$ P=0.161
	1-4 years	11(14.1%)	67(85.9%)	
	5-10 years	12(23.1%)	40(76.9%)	
	11-14 years	5(15.2%)	28(84.8%)	
	15-20 years	7(36.8%)	12(63.2%)	
	Above 20 years	4(11.1%)	32(88.9%)	

Table 4.1 shows that 64(27.8%) were aware of these measures while 166(72.2%) were not aware of the safety measures. The results indicated that male respondents (25.8%) were aware of safety measures as compared to the female respondent (35.4%). This association of awareness of safety measures and gender of the respondents was statistically significant at 95% confidence level with  $\chi^2=8.073,df=1$ , since  $p=0.004$  was  $< 0.05$ .

A higher proportion of middle age respondents (40-60 years,) were more aware of safety measures as compared to the younger respondents. This association of awareness of safety measures and age of the respondents was not statistically significant at 95% confidence level with  $\chi^2=3.316,df=4$ , since  $P=0.506$  was  $> 0.05$ . This is similar with the early finding where older respondents were more aware of occupational hazards. The reason for such finding could be that older respondents recognize the exposure as hazardous after being exposed to it for many years thus recognize the safety measures in place.

All the respondents that had Tertiary education (100%) were more aware of safety measures as compared to the other levels of education. This association of awareness of safety measures and level of education of the respondents was statistically significant at 95% confidence level with  $\chi^2=60.318,df=4$ , since  $p=0.000$  was  $< 0.05$ .

Respondents with above 20 years (100%) working at the quarry were aware of safety measures as compared to other respondents. The association of awareness of occupational hazards and length of time working at the quarry of the respondents was not statistically significant with  $\chi^2=7.918,df=5$ , since  $P=0.161$  was  $> 0.05$ . This could be due to the fact that they might have worked for a longer period in the quarry, since duration of years spent in the quarry improves awareness of safety measures as seen in this study.

**Table 4.2: Factors affecting implementation of OSH measures in quarries**

Variable	Frequency of analysis/No. of Respondents					Mean index	Percentage
	1	2	3	4	5		
Lack of management commitment	0	5	1	8	216	4.89	97
Lack of employee training	0	7	4	34	185	4.73	95
Lack of Government support	1	1	5	120	103	4.40	97
Lack of employee participation	0	30	6	50	143	4.32	84

The study has established that 97% (mean index 4.89) of respondents felt that lack of management commitment and support as the main factor affecting the implementation of the implementation of health and safety measures in quarries. This may be as a result of the perception that safety is only cost related. This was noted during site visits where it was found that none of the quarry companies had any safety policies and materials, there were no warning signs and some workers seemed unaware of the risks they face as they worked and accident investigations and documentation were essentially non-existent as evident by the non-availability of accident/injury records in all the sites visited. This clearly indicates that the level of management commitment towards health and safety was low.

## 5. CONCLUSION AND RECOMMENDATION

The study concludes that the level of awareness of occupational hazards was high among the respondents and the source of awareness was colleagues, however the respondents were insufficiently equipped with knowledge on safety measures to comprehensively mitigate occupational hazards. The study found that awareness was positively influenced by age, educational attainment and work experience. This is not surprising because educational attainment facilitates easy assimilation of instructions; similarly maturity and work experience are expected to increase awareness of occupational hazards.

The study recommends that the quarry management should carry out safety inductions to all workers before they commence their contracts so as to promote safety culture, develop OSH programmes to guide employees to work safely, provide the necessary PPEs (helmet, dust masks and safety boots) for workers and adopt other methods of dust suppression e.g use of bag filters and scrubbers. It also recommends that the enforcement bodies (NEMA and DOSHS) should impose higher restrictions and enforcement guidelines for establishing quarries with proper provision for OSH services before granting licenses to quarry operators/owners.

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