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The Environmental Impacts of Small Scale Quarrying and Mining on the Environment in Cooks/Nyerere Compound of Lusaka

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Abstract: The impact of illegal small scale quarrying on the environment in Cooks compound of Lusaka was investigated. This area is located within the city of Lusaka making it a perfect example of the effect of small scale quarrying by the poor on the city environment. Structured and non-structured interviews were used on a sample of 130 respondents from the study area (80 miners and 30 residents) and 5 respondents from government departments. Field observation was used as well to gather information from the study area. The results showed that there was increased environmental degradation due to intensive quarrying in the area. The presence of craters and pits left after quarrying paused great danger to the miners and the residents in the area. The dangers faced by miners included inhaling of dust, smoke from burning tires and logs to soften the rocks, falling rocks, falling into the pits and accidents with tool. The residents also faced danger from the pits left by quarriers like falling into the pits and pits serving as breeding places for mosquitoes leading to diseases like malaria, decentry and cholera. However, the residents use these pits for dumping waste, building latrines as well as collecting water during the rain season. The results indicated the need to curb this illegal quarrying as it leads to environmental degradation and endangers the lives of the residents within the study area.

Key words: Environmental degradation, Craters, personal safety, dangers

INTRODUCTION

Man has been so dependent on his environment since his existence on planet earth. In man's continued quest for better life within his surrounding, the activities he has engaged in have tended to have had a negative impact on the environment. This has resulted into a scenario where the sustainability of the environment has been always interfered with.

It is well documented in previous studies (Yona, 2005; Sebastiao, 2001; Kambani, 1999; Birabwa, 2006) that quarrying of limestone, gravel and sand has been identified to have both negative and positive effects to the community and the environment. Negative aspects are linked to change of landscape and land degradation, destruction of roads and bridges, reduced air quality, industrial waste damping sites and poor health sanitation. Pollution of quarrying limestone includes dust, sediment run-off, open pits and erosion. Sources include cutting of stones, crushing and screening, loading and haulage. The effects are run off sediments dust causing siltation of stream and effects nearby agriculture fields and degrading the landscape. The positive aspects are job creation, income generation, government revenues and others.

Kambani (1999) argues that sand mining creates open pits and dust from digging, loading and haulage. It causes dust and particulates on the road, which destroys the road cover whereas dust emission affects people living near the road and the area of sand digging. Also the natural vegetation on the site is devastated. Lusaka is rich in dolomitic marble outcrops (Kaiser *et al*., 1998) this has led to massive exploitation of this resource (stones) by both large scale and small scale quarrying, legal and illegal quarriers for over 2 decades now. The area under investigation is Cooks/Nyerere compound of Lusaka, Zambia. This place is currently experiencing increased illegal small-scale quarrying activities. Most of the small-scale quarrying involve both stone quarrying and sand mining, mainly gravel sand. These quarrying activities are carried out by the urban poor found in these settlements.

This research therefore, proposed to investigate the magnitude of this small scale illegal quarrying its impact on the environment as well as the major factors which have enhanced this illegal activity and finally, find ways to prevent further degradation of the environment in Lusaka and other affected areas of Zambia.

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MATERIALS AND METHODS

Cooks compound is located on the southern periphery of Lusaka City between 28° 16′ to 28° to 18′ east and 15° 26′ south; it is about 2.5 km from the city center. By relative location, the compound is located second to the south of the city center after Misisi compound; it is located between Chawama compound to the south and to the north lies Misisi compound. To the east lies Kamwala South and the west is bordered with the Kafue road and John Laing compound (Fig. 1 and 2).

Two sources of data were used in the field and these are primary and secondary sources of data. These 2 sources of data were used in this research to supplement and complement each other in order to make the findings liable of the study (Birabwa, 2006).

Primary sources included the miners, residents and the government departments (Ministry of Tourism Environment and Natural Resources, Ministry of Land, Environmental Council of Zambia and Lusaka City Council). Field observations also constituted primary sources of data is this research. The secondary sources included University of Zambia library, Environmental Council of Zambia Documentation Center, topographic maps, aerial photos and field camera photos.

This study used qualitative and quantitative methodology since it aimed at describing phenomena through rich contextual data by unearthing information that could not be easily quantified. The close-ended questions aimed at obtaining miners socio-demographic characteristics and any other quantifiable information related to their livelihood which was useful during the interpretation of the research findings. Similarly, the open-ended questions provided systematic contextual knowledge about the respondents and their source of income (Nichols, 1991).

The other method that was used in the collection of data was Personal Observation. Peil *et al*. (1982) also asserts that observation in social studies is more than just observing. This helped in understanding the real situation as it was obtaining on the ground (Hay, 2000). Apart from this, a fruitful discussion was conducted with a group of representatives of the miners within the study area (Lewis-Beck *et al*., 2004). The questionnaire was tested before going onto the field proper. The field study was done from July to October in 2007. Both probability sampling and non-probability sampling methods were used. Systematic Random sampling was used to select the 80 miners. The sampling frame was a list of 120 mining sites which I had identified in Cooks compound; from which I selected 80 respondents out of 120 workers for the semi-structured interviews. And random sampling was also used to pick a total of 30 residents within the study area. Purposive non probability sampling was used to select the (4) individual respondents from the ministry of lands, Ministry of natural resources environment and tourism, Environmental council of Zambia and the Lusaka City Council. Although, this method had a weakness of biasness but it was the best method to acquire the relevant data.

For the analysis of the data SPSS software was used and data was manually inputted and all the tables and graphs were derived using SPSS. And percentages were used for easy interpretation of the data.

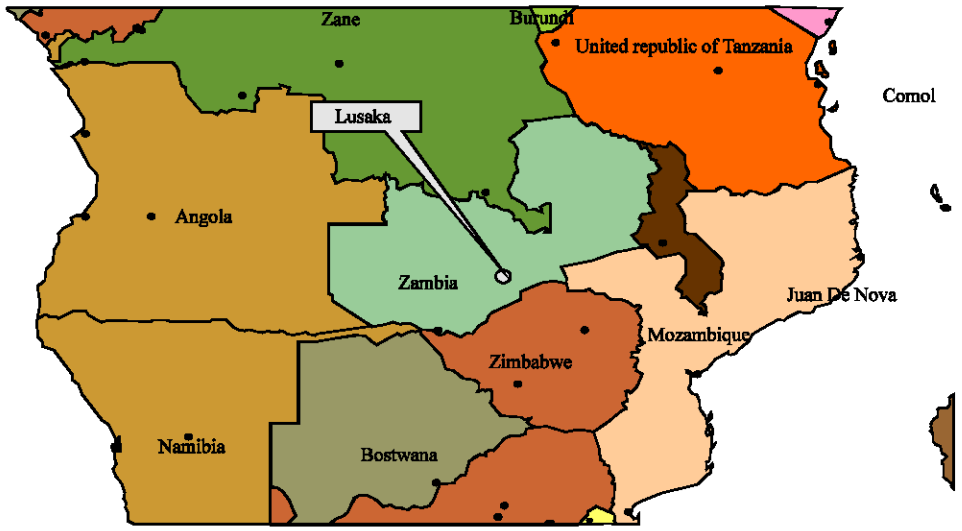

Fig. 1: Location of Lusaka, Source: (Muyunda, 2007)

Fig. 2: Study area: cooks compound source: (Google Earth, 2007)

RESULTS

Small scale miners according to gender and age: The sample of miners had a total of 80. The females in this sample were 50, amounting to 62.5% of the total. The males were 30, which is 37.5% of the total.

As regards the age of the miners, the average age was 37.75 years with the youngest age being 16 years and the oldest 57 years.The majority of the respondents were in the age between 32 and 38 years.

Marital status of the miners: Fifty six (70%) of the miners were married and had families. Divorces were 12 (15%) of the total number of respondents in this category and 11 (13.8%) were widowed only 1 (1.2%) accounted for singles.

Education level of miners: Fifty five of the respondents had a primary level of education amounting to 68.8 and 17 (21.3%) had secondary education. A total of 3 (3.8%) had higher education whilst 5 (6.3%) represented those without any form of education.

Number of mines owned by miners: Thirty six (45%) of miners owned one mining site, 35 (43.8%) of the miners had no mining site. And 7 (8.8%) of miners had 2 mining sites and only 2 (2.5%) had 3 mining sites.

Type of commodity the miners are dealing in (Sand and Limestone): It was revealed from the field interviews that that the small scale miners were dealing in either limestone or sand. Three groups emerged, those dealing in limestone, those dealing in sand and the last group dealing in both limestone and sand mining 36% dealt with limestone only, sand had 48% and those dealing in both commodities accounted for 16%. Total 86% of those dealing in sand were males while 76% of the respondents dealing with limestone were females. The male constituted 79% of the respondents dealing in both limestone and sand mining. This biasness towards the males was because the activities were labour intensive.

Income of miners per day in US$ (S Dollar): From the 80 respondents 19 (23.8%) had an income of US$1.00, 1 (1.3%) had US$2.00 and 8 (10%) of the respondents had US$3.00, 7 (8.8%) had US$400, 18 (22.5%) had US$5.00, 30 (16.3%) having US$6.00, 9 (11.3%) had US$7.00, 3 (3.8%) had US$8.00 and 1 (1.3%) represented those whose income was 9.00 and US$10.00, respectively.

Miners' dependence on small scale quarrying: Fortynine (61.2%) of the small scale miners dependent on quarrying and 31 (38.8%) did not depend on quarrying alone as a source of income.

Miner's period taken in quarrying: On how long each miner had been mining, a large percent indicated 2-5 years 52%. Those from 6-12 years accounted for 46 and 15 years only 2% and none of the respondents had mined for 15 years and above.

Miners reason for quarrying: All the miners indicated that the major reason for their quarrying was economical. 30% of the miners indicated that they quarried due to lack of employment, 57% were doing it to supplement their income 13% had no alternatives.

Miners reasons for not being in formal employment: A total of 30% indicated they were never employed due to lack of education and skills. And 58% of the miners indicated that they were once employed and 12% were either retired, quit or dismissed from their job.

Miners Awareness of the Environmental Effects of Quarrying: Sixty six of the miners were aware of the environmental effects of their quarrying activities, 14 (17%) were not aware of the environmental effects of their activity shown in Table 1.

Miners with small scale mining license: None of the miners had a mining license (100%). All of them argued that the licenses were too expensive for them to buy considering their poor income.

Personal dangers encountered by miners: The distribution of dangers encountered by the small scale miners in the area were as follows; crushing 36.25%, rock falls recorded 37.50%, inhaling of dust 10%, falling in pits 8.75% and dangers from smoke during burning of the rocks was 7.5% shown in Fig. 3.

Miners willing to quit quarrying if given alternative job: From the 80 respondents 37.5% said that they were very much ready to leave small scale quarrying if they were given alternative job. A total of 52.5% of the miners indicated that they were ready to leave small scale quarrying if given alternative. And only 10% said they were not ready to leave no matter the offer to do so Fig. 4.

Miners who refill the pits after mining: When asked whether the miners refill the pits after mining, 8 (100%) or all the respondents said that they did not refill the pits. The main reasons being labour intensiveness of refilling and lack of time to refill.

Miners who where told to stop quarrying by government officials: Miners who agreed that they had been told to stop quarrying in the area accounted for 73 (91.2%) and only 7 (8.8%) said they were never told to stop quarrying refer to Table 2.

Miners who received assistance from government to start business: Four (5%) miners received assistance from government and 76 (95%) of the miners stated that they did not benefit from the initiative. It was observed that most of the respondents could not reveal that they had received the money from government for fear of being left out in the next turn. Others were just afraid of being asked to account for the money since it was revealed that nearly all those who had benefited from the money had continued with small scale quarrying.

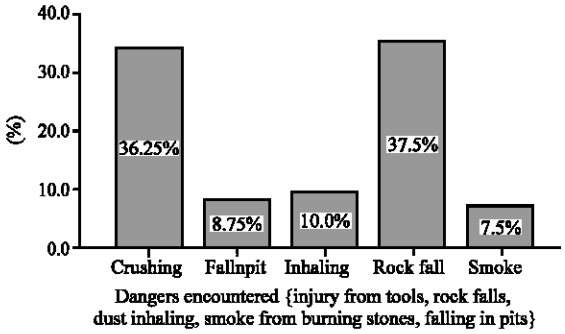

Fig. 3: Dangers encountered by minres

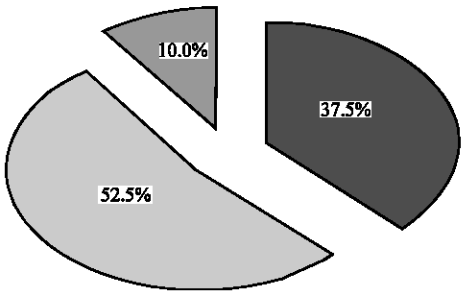

Fig. 4: Miners willingness ro quit quarrying (Field, 2007)

Table 1: Miners awareness of environmental effects of quarrying

Miners' awareness		Frequency	(%)	Valid (%)	Cumulative(%)
Valid	no	14	17.5	17.5	17.5
	yes	66	82.5	82.5	100.0
	Total	80	100.0	100.0	

Source: Field 2007

Table 2: Miners who were told to stop quarrying by govt officials

Number of miners	Frequency	(%)	Valid (%)	Cumulative(%)
Told	73	91.2	91.2	91.2
Not told	7	8.8	8.8	100.0
Total	80	100.0	100.0	

Source: Field 2007

Findings from residents within the study area

Age and marital status of residents: The total number of residents interviewed was 30 and the minimum age was 16 years and the maximum age was 57 years. The average age of respondents was 36.77 years. As for the marital status of the residents, 13.33% were divorced, 76.67% of the residents were married, 3.33% were single and 6.67% accounted for those who were widowed.

Education level attained by residents: Educational levels reviewed 6.67% had no formal education, 10% had secondary education and 30% had higher education whereas 53.33% had primary education. Over 50% of the residents had primary school education.

Employment levels of residents: On employment levels, 26.67% of the residents were employed, 56.67% not employed and 16.67% of the residents indicated that they were involved in quarrying.

Plots encroached by quarrying: According to the responses obtained from the field, 20 (66.7%) of the residents indicated that their plots were encroached and 10 (33.3%) said their plots were not encroached shown in Table 3.

The cost of refilling the pits left by quarriers: Most of the residents indicated that the cost of refilling the pits left by the small scale miners in the study area was very expensive. A total of 20 respondents which is 66.7% of the total residents interviewed said that it was very expensive to refill the pits. About 23.3% of the residents argued that it was expensive and only 10% of the residents said it was not expensive to refill the pits left after quarrying shwon in Table 4.

The benefits of small scale quarrying in terms of land use: The residents who indicated that small scale quarrying had some benefits in terms land use accounted for 80% and those who said it was wasteful was 20%. Of all the residents 70% indicated that the quarrying was also illegal and 60 of the residents said that only creation of employment would reduce small scale quarrying in the area.

The banning of small scale quarrying: Twenty five residents who felt that small scale quarrying should be banned (83.3%) and 5 (16.7%) were for those who felt that small scale quarrying should not be banned.

Use of the pits left after quarrying: On the use of pits left after quarrying, 43.33% of the residents said that they used the pits for damping waste, 20% used the pits for building toilets and 36.67% used the pits for drawing water.

Table 3: Plots encroached

Plots	Frequency	(%)	Valid (%)	Cumulative (%)
Encroached	20	66.7	66.7	66.7
Not Encroached	10	33.3	33.3	100.0
Total	30	100.0	100.0	

Source: Field 2007

Table 4: Cost of refilling the pits

Cost of refilling pits	Frequency	(%)	Valid (%)	Cumulative (%)
Very exp	20	66.7	66.7	66.7
Exp	7	23.3	23.3	90.0
Not exp	3	10.0	10.0	100.0
Total	30	100.0	100.0	

Source: Field 2007

The dangers of pits left by small scale quarrying and mining: Of the 30 residents interviewed in this study 70% indicated that the pits were a danger to the personal safety to the residents. Most argued that children were more vulnerable in falling into this pits which are normally deep. And 30% indicated that disease was also a danger faced by the residents due to pits left after quarrying.

Degradation caused by small scale quarrying in the study area: On the contribution of small scale quarrying and sand mining to environmental degradation in the area 98% of the residents indicated that small scale indeed did degrade the environment. Only 2% of the residents argued that small scale mining does not contribute to the degradation of the environment in the area.

Findings from the ministry of tourism environment and natural resources: During the research interview the official at the ministry headquarters in-charge of environmental issues said that the Ministry of Natural Resources Environment and tourism was mandated by government to deal with the policy matters regarding all the natural resources in the country. It was furthered discovered that although the ministry was in-charge of environmental issues, all issues pertaining to the implementation and monitoring of the environment was in the hands of the Environmental Council of Zambia.

The ministry emphasized the desire to meet the millennium goals and implement government's goal to meeting the targets presented in the National Development Plan set by the new deal government.

Research findings from the ministry of lands: The Ministry of lands is in-charge of all issues pertaining to planning and offering land to all who seek legal ownership of land in Zambia. The ministry issues title deeds within the city and on the out skirts for commercial, residential, agricultural or industrial purposes.

The title deeds do not include rights to minerals found underneath this land. Titles deeds concerning mining and quarrying in Zambia are given by the Ministry of Mines and Mineral Development. However, the City Councils deal with land rates on residential, commercial and industrial land within the city boundaries. And the City Councils in Zambia deal with encroachment matters; they can revoke the title deed and also force the land lords to pay land rates, demolish illegal structures and even evict illegal miners and quarries from the land.

The Ministry does not know anything concerning land degradation and every owner takes the responsibility of rehabilitating the land once they have bought it. The Ministry has no information regarding encroachment and

depends on individuals who report such problems. There is department dealing with environmental issues to monitor the status of the environment on the land.

The Ministry seems to have many difficulties in terms of managing land issues in the country. These problems include lack of manpower especially the survey department, inadequate funding resulting in lack of important tools like maps and also lack of qualified personnel to run the newly imported machinery. Despite all these problems, the ministry was of great help and provided the researcher with aerial photos.

Research findings from the environmental council of Zambia: In 1985 Zambia adopted the National Conservation Strategy, there was also the promulgation of the Environmental Protection and Pollution Control Act (EPPCA) enacted in 1990. This led to the creation of the Ministry of Tourism Environment and Natural Resources (MENR) in 1991. Eventually, we had the establishment of the Environmental Council of Zambia (ECZ) in 1992, for the purpose of acting as an advisory body to the government on all matters relating to the environment. It was stated during the interview with the spokes person that ECZ carries out environmental monitoring exercises and enforces the laws through government.

Findings from lusaka city council: The Lusaka City Council is in charge of the planning and zoning of the city and deals with all the issues regarding land use within the city. The City Council also issues ownership deeds for residential plots and has been given power even to collect land rates within its boundaries. In terms of environmental monitoring, the council depends on the Environment Council of Zambia thereafter the council has the duty to deal with the small scale miners who degrade the environment. However, the council has not enough man power to carry out enforcement related tasks thereby rendering their presence a mere rhetoric. The council usually relocates the miners and quarriers though this happens when there is alternative land. Currently the council has found a new place (Shantumbu) far from the city center where the miners and quarriers are supposed to carry out their activities but it is too far for the miners. The council does also reclaim and rehabilitate the degraded land though this is a rare case due to financial incapability. Though the council is much aware of the degradation of the land in Cooks compound there is not much it can do due to its many tasks and shortcomings.

Research findings from observations in the field: From the field it was observed that more women were involved in the quarrying than sand mining which was predominantly male and those involved were either in their thirties or early forties when it came to age. Children especially girls were seen helping their grand parents or elderly people. Most of the miners live in poor surroundings with no proper sanitation and water facilities.

There was also a tendency of beer shelters littering the mining and quarrying sites as those who were involved in the business used the beer and food for their meals and also relaxation purposes. It was also observed that there existed a cluster of pits left after mining which in most cases were used as damping sites, some pit were used for drawing water for domestic purposes especially in during the rain season and others used the pits for building toilets. A lot of contaminated water collected in these pit appeared a health hazard to the residents in the study area.

There is a vast amount of land that has been heavily degraded rendering it derelict.However, the many desperate residents have acquired this land illegally and some how they have built houses near the pits or at times in the shallow craters. The craters left by the miners and quarriers have affected the gravel roads within the area as they have at times extended near the road making some portions of the road too narrow and impassable by vehicle.

DISCUSSION

The Socio-economic Status of Miners and Quarriers There are more females than men that are involved in small scale quarrying and mining in Cooks/Nyerere compound. As indicated in table 5.1, 62.5 % of the total miners were female and males accounted for 37.5%. This is so because most of the males in the area tend to be youths and shun such type of jobs. The average was 37.7 years and the maximum being 57 years. The major reason for this trend is that most residents at this age happen to have families to take care of and they are usually married people. This is evident from data which indicates that 70% of the miners were married and only 1.2% was single.

On the issue of education most of the miners had a primary school level of education. According to the information obtained in the field 68% had primary level of education and 21% reached secondary education very few had tertiary form of education. This was because most families were living in poverty. With the increase in population coupled by lack of understanding he need to sustainable use of the environment there has been increased environmental degradation in the area.

The economic status of the miners in the area is quite poor. There is wide spread unemployment among the

people in the area. Those who had casual jobs were either retrenched or sucked and those who are working earn low incomes and this has increased the poverty levels forcing those with families to opt for small scale quarrying and mining. There were 61.2% of the small scale miners dependent on quarrying and 38.8% did not depend on quarrying alone as a source of income. And some of the miners own their own mining sites; 45% owned one mining site each. This was influenced by their daily income where 23.8% had an income of US$1.00. This problem also affected the miners' willingness to quit quarrying as most of them had no hope of any formal employment if they had to leave quarrying. 37.5% said that they were very much ready to leave small scale quarrying if given alternative means of earning their living. A total of 52.5% of the miners indicated that they were ready and 10% said they wee not ready to leave quarrying. This result could have been affected by the fact that the miners thought government was organizing jobs for them, so most of hem agreed that they were ready to leave quarrying. This is because the Ministry of Local Government had given some money to miners within the area to start business but the beneficiaries went back to quarrying.

There is also the increase of social behavoiural problems amongst the small scale miners and quarriers. Because of the income realized from the activities within the mining and quarrying areas people resort to drug abuse, prostitution fights and all sorts of social disorder. This has been also recorded in other works before (Birabwa, 2006; Sebastiao, 2000).

In terms of taking responsibility after quarrying or mining, the miners tend not to care about the environment as they leave the pits unattended to or not refilled. Total 100% or all the miners indicated that they did not refill the pies after mining. Where the pits have been refilled individual effort has been always at play. The council or any other government wings responsible for the allocation of land or plots do not refill the pits sighting lack of funds.

There is also the problem of lack of environmental inspections being carried out regularly to check on the illegal quarrying and mining in the area. Though the Environmental Council of Zambia does inspect occasionally there is need to have a regular inspection so as to curb the vice.

Residents' view on the increase in quarrying activities: Some of the residents felt that in terms of land use small scale quarrying and mining were a major cause of environmental degradation. Those who argued that these activities were a nuisance accounted for 20% and those who indicated that it was beneficial were 80% of the respondents. This is due to the fact that most of the residents got their build materials like stones and sand for their houses from the miners and quarriers. Apart from that some of the residents were depending on quarrying for their daily living. The miners never refill the pits a situation that has led to degradation of a vast area of the land within the study area. The pits have also become a concern to the safety of the residents as many risk drowning during the rain season especially the children. Those whose houses are near the pits risk their houses collapsing when there is heavy rainfall.

Healthy risks faced by residents as a result of quarrying in the area: Most pits near the residential area tend to be used as dumping sites by the residents. Others use the pits to draw water for the household chores during the rain season some even after the rains. These pits have also been used as cheap facilities for construction of pit latrines. This is evident from the research findings where 43.33% of the residents said that they used the pits for damping waste, 20% used the pits for building toilets and 36.67% used the pits for drawing water. However, diseases like malaria tend to increase in the area because these pits are breeding place for mosquitoes.

Physical safety of residents: Plots were being encroached, vast land was degraded and some of the ditches caused land subsidence. Deaths risks from accidental falls were a threat to the residents in terms of safety. The most vulnerable people were children. The average death rate from pits was 6-7 per year this was usually during rain season.

Environmental impacts of small scale quarrying and mining in cooks/nyerere compound: The environmental impacts of small scale quarrying and mining in the area include; landscape and land degradation, the destruction of gravel roads and loss of value of the land. Soil erosion due to change of the elevation of the land, the pollution of the air from the smokes of burning tires and logs of wood, the contamination of underground water from the garbage in the pits as well as the accumulation of contaminated water which lead to breeding of mosquitoes causing diseases like malaria all impact the environment.

Findings from the ministries, LCC and environmental council of Zambia: The Ministry of lands seems to have no touch with what is happening in most of the areas within the city and depend on public outcry which is not good for the nation. Though, it lacks man power the zoning should be done frequently. There is need to empower this ministry so that maps and other resources needed are in place for it to be effective.

The Ministry of Tourism Environment and Natural Resources has to do with the policies concerning the environment and seem not to be in touch with other regulating departments like the Environmental Council of Zambia to assist in policy sensitization programs so as to easy the burden of the council.

The Environmental Council of Zambia does perform its duties though the need for adequate funding and equipment acquisition is agent. Also, the lack of co ordination with other relevant ministries and stakeholders affect its operations as well. However, the council is doing a good job as far as environmental monitoring is concerned.

The Lusaka City Council is also not doing much as regards environmental degradation in the area claiming that it is the duty of the Environmental Council of Zambia. However, there has been a step taken further in this regard bring all the ministries, the Environmental Council of Zambia and the Lusaka City Council together in order to fight this illegal activity in the city.

CONCLUSION

It is of great importance to state that small scale quarrying and mining in Cooks compound and Zambia as a whole is much of an economic issue than it is an environmental issue. Most of the people involved in this activity are unemployed and tend to look after big families. This problem has been aggravated by the prevalence of HIV/AIDS and high levels of poverty. However, the environmental impacts of this activity have become so open and adverse for anybody to ignore. The degradation of the land, healthy risks and air pollution can not be ignored anymore. The government has also taken a step by identifying this problem through the Environmental Council of Zambia and has already moved in and found an alternative place for the quarriers and miners in the study area.

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