International Journal of
Environmental Science
(IJES)

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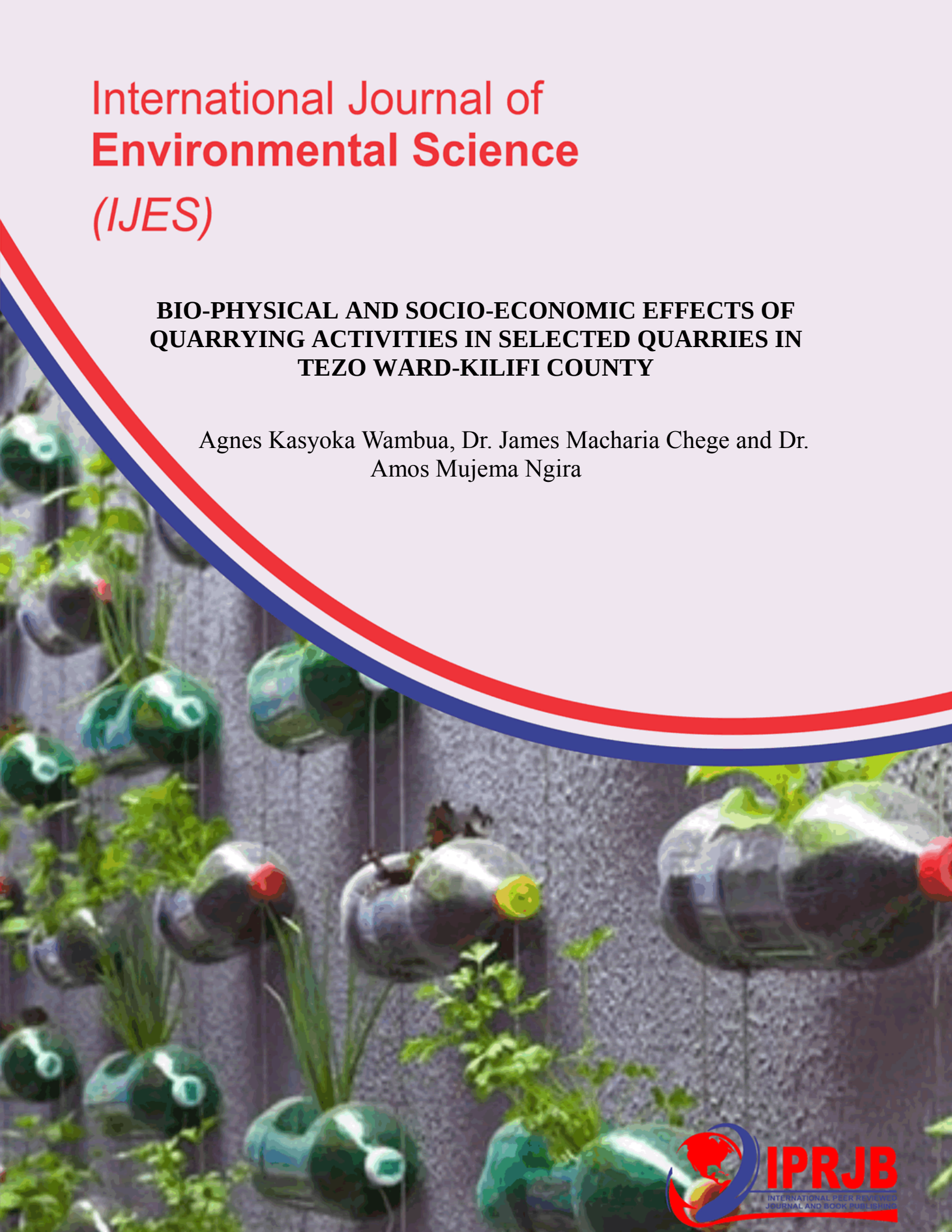

IPRJB
INTERNATIONAL PEER REVIEWED JOURNAL AND BOOK PUBLISHING

International Journal of Environmental Sciences
ISSN 2519-5549 (online)
Vol.4, Issue 1, No.1. pp 1 - 17, 2021

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BIO-PHYSICAL AND SOCIO-ECONOMIC EFFECTS OF QUARRYING ACTIVITIES IN SELECTED QUARRIES IN TEZO WARD-KILIFI COUNTY

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Abstract

Purpose: Using a Systems' Approach, this study explores what aspects are essential for stone quarries to adopt a functional environmental management plan and whether compliance with environmental laws enhances business performance. The specific objectives of the study were: To evaluate the bio-physical effects of quarrying activities in selected quarries in Tezo ward and to evaluate the socio-economic effects of quarrying activities in selected quarries in Tezo ward.

Methodology: The study adopted descriptive survey design; the research data collection instrument was questionnaires. The study adopted purposive sampling; a survey of 134 respondents representing 80 quarry workers, 40 quarry owners, 10 EIA Experts, 3 NEMA staff and 1 County geologist were sampled purposively. Weighted and the Consolidated Scores were entered on Microsoft Excel for cleaning and later transferred to Statistical Package for Social Sciences (SPSS version 23.0) for statistical analyses. Data was presented inform of graphs, pie-charts, tables and narration in the thematic areas.

Findings: The study found out that there were health and ecological problems associated with quarrying. The application of heavy quarrying machines resulted to soil erosion, destruction of flora and threatens biodiversity aesthetic. The study revealed that quarrying was a source for livelihood among the community and more men (90%) were involved in quarrying due to masculinity nature of the task. EMPs were found to be significant in management of quarries. The development of EMPs and EIA was influenced by different actors and informal sector was a significant influencer of EMPs implementation. The study concluded that EMPs were effective in management of quarries despite varied challenges facing the NEMA official and the EIA experts.

Unique contribution to theory, practice and policy: The study recommends the need for transparency in the EIA as well as in the development of EMPs, to avoid discrimination and non-adherence. Further research is needed to understand the perception of community members on the effectiveness of EMPs in sustainable management of quarries and environment in general.

Key words: *Quarrying, Environment, Socio-economic*

1.0 INTRODUCTION

Quarrying is a form of land-use that is concerned with the extraction of non-fuel and non-metal minerals or aggregates from rock (Upkong, 2012). This is achieved by open-cast mining often involving rock drills and dynamite on natural igneous, metamorphic or sedimentary rock and subsequent crushing, washing and sizing. The results are generally categorized into aggregates (sand, gravel and crushed rock) or dimension stones (blocks of stone with a regular shape). About 15 billion metric tonnes of aggregates are produced this way globally and this translates to about USD 70 billion annually (Adinkrah-appiah *et al*., 2016). Quarries are classified based on their mean annual output measured in cubic meters per year (m^3/yr). Based on these, quarries can be Small, Medium or Large with an output of below 10,000, 70,000 and above 100,000m3/yr, respectively.

There has been a sharp rise in the number and output of stone quarries all over the world in the past 25years. Failures in the agriculture sector and a steady growth in the construction industry contribute largely to this demand. The construction industry makes up about 80% by volume of the total aggregate market, globally. Likewise, over 70% of the demand in aggregates results from major infrastructural projects such as highway and port construction (Adinkrah-appiah *et al*., 2016).

The growth has had its benefits, such as creating employment, promoting trade, increasing public access to social services and infrastructure and supporting the industrial and technological revolutions of the 21st century. Nonetheless, these benefits have come at a huge cost on the natural environment and surrounding communities such as chemical pollution, health hazards, accidents, displacement, alienation from water, farm and pasture lands, and violent conflicts (Lad and Samant, 2014). This paradox of socioeconomic and ecological impacts from the exploitation of natural resources is referred to as the resource curse and is remarkably prevalent in many parts of the world and with numerous minerals.

There is widespread admission that until the resource curse is resolved it would be impossible to guarantee local communities in regions endowed with extractive resources a decent or sustainable livelihood. This has been observed in parts of Asia such as in the Kolhapur District in India. According to Lad and Samant (2014) residents of the district blame the 7 stone quarries operating in the area for a 50% decline in their crop yields due to noise and excessive vibrations. More than 76% of the residents complained of eye and respiratory infections as well as hearing disorders due to the dust and noise. More than 306 ha of land have suffered incredible scarification that has left very deep and dangerous gravel pits of up to 40m deep unfenced and unrestored. The study found that though operators were required by law to inhibit noise and vibrations and rehabilitate mines after decommissioning, none complied and none was prosecuted even after the community filed a suit in court.

In Africa, where the supply of housing and infrastructure is still far below the demand, stone quarrying may continue in open defiance of existing regulations. In Ghana for example, about 41,000 houses are built annually against a demand of 160,000, the country requires about 90 million cubic meters of aggregates to supply about 3.6 million houses by the year 2025 (Adinkrah-appiah *et al*., 2016).

The situation is not any different here in Kenya and studies in places such as Mandera County already indicate the disaffection among residents towards noise, air and water pollution by stone quarries (Lamech, Ming, & Mohamed, 2016). Residents have also attributed the loss in pasture lands and crop declines on mining operations. In the coastal region and particularly Kilifi County where the study area lies, there has been considerable public outcry against the impacts of unregulated quarrying on livelihoods, public health and safety and on the natural environment. In a study of about 45 mining companies in Kilifi, Kwale and Taita Taveta counties, the Human Rights Agenda (HURIA, 2016) a local Non-Governmental Organization (NGO) encountered the challenges of livelihood losses, health impacts and threats to biodiversity as a result of air and noise pollution, excessive vibrations and severe scarification of the landscape due predominantly to the mining of coral blocks, stones and ballast. More than 82% of these companies quarried stones. The level of compliance with environmental regulations was shockingly low. For instance, only 40% of miners in Kilifi and Kwale counties had conducted an environmental impact assessment (EIA) and as many as 80% of those in Taita Taveta hadn't. In effect, this implied that as many as 70% of miners in the coast region hadn't anticipated the impacts of their operations on other land-users nor had they put in place measures to respond to these impacts. Similarly, it means that these operators have yet to appreciate the importance of effectively managing their mineral and other natural resources in their territories would be to business success.

Over the years, policy makers, donors and researchers have attempted a variety of strategies to not only reduce the negative impacts of stone quarrying but also enhance their benefits. The environmental management plan (EMP) is one such measure. The Environmental Management and Coordination Act together with the Mining Act 2016 have made it mandatory for all mining operations in Kenya to undertake an EIA and submit an Environmental Management Plan (EMP) to support the decision to approve, enforce and evaluate mining practices and licenses, respectively.

Nonetheless, the adoption of these measures has often targeted formal mining operations where levels of adoption remain relatively low to ascertain sustainable land-use goals for the sector. A vast informal stone quarrying industry has been left entirely unregulated despite its large volume of production and tendency to operate within sensitive environments or close to other sensitive livelihoods. As a result, stone quarrying has produced a cocktail of undesirable socioeconomic and ecological impacts that could become significant barriers to sustainable development of the communities. In many regions of the world, environmental degradation through quarrying is in most cases the major constraint to sustainable development (Shrock, 2002). For example, research done in Mbeya in Tanzania on limestone quarrying found out that majority of the community members (56%) were threatened by environmental degradation (Saxena *et al.*, 2005). For many years these mining processes have led to adverse environmental effects either during the mining process or long after the mines have been closed.

Various interventions have been made by governments in ensuring sustainable land management (NEMA, 2011). Though in some recent times some Africans countries have recorded some level of growth in mining sector, the sectors growth remained insufficient to adequately address the

issue of sustainable land management of quarries in Tezo Ward. Ironically, land owners are the most affected in terms of land degradation and poverty especially the small holder community members, though the rest of population in the construction industry depends on them for quarrying purposes. According to the economic survey, the mining sector contributes 0.8% to the country's GDP (GoK, 2019). These statistics are however not a true reflection of the entire mining value chain. For instance, the statistic fails to recognize the contribution of cement plants which utilize limestone, iron ore, gypsum and pozollana in their operations.

Tezo Ward is affected by unsustainable land use management of quarries because they are a source of environmental problems throughout their whole phase of operation. Both active and abandoned quarries are a threat to the surrounding environment, and more significantly results to the degradation of land and drainage problems because many are not rehabilitated after use.

Despite past efforts at minimizing degradation of environment by quarrying activities in Kilifi County by NEMA, County government and community participation in groups, degradation continues to manifest because quarry owners abandon them without adequate rehabilitation. During the rainy season, the pits floods and become breading sites for mosquito and can also cause accidents when not fenced. Environmental degradation is a problem of unsustainable land use management because quarry owners have failed to fully adopt an Environmental Impact Assessment (EIA).

Past studies have shown that in many regions of the world, effective Environmental Management Plan, the efficiency of Environmental Monitoring and Audit and proper implementation of mechanisms by County Government in sustainable land management of quarries are important at improving land use management of quarries. However, in Tezo Ward (Kilifi County) where a functional environmental management plan could truly result in sustainable management of quarries the relationship has not been explored through scientific research. The aim of this study is to bridge this gap.

1.1. Research Objective.

The objective of the study was:

Bio-physical and socio-economic effects of quarrying activities in selected quarries in Tezo ward-Kilifi County

2.0 RESEARCH METHODOLOGY

Research Design and Location of the Study

The study adopted a descriptive survey design to gather data. Survey data from persons working or operating around the quarries was used to determine whether impacts on biophysical environment affect ties within affected communities and whether this escalates poverty. Specialized information from experts was gathered by Key Informants Interviews and Review of historical data.

Tezo ward is one among 7 electoral units comprising Kilifi North Constituency in Kilifi County. It lies at 3.6219° S and 39.8502° E approximately 16.3 km South-west of Kilifi Town and about

507 km South-East of Nairobi, Kenya's capital. The Ward, largely rural, covers an area of about 57.4 km^2 with a population of about 44,129 inhabitants who are predominantly of the Agiriama ethnic group (KNBS, 2019). The main economic activities in the area include small-scale crop farming and pastoralism. In 2012, the National Commission for Revenue Allocation identified Kilifi among the most marginalized areas in the country. This indicates that a majority of people in Tezo live below the poverty-line and struggle to realize sustainable livelihoods. These attributes make Tezo well suited for exploring whether, how and why stone quarrying could contribute to socioeconomic empowerment and the conservation of natural resources in the area.

Tezo has about 41 quarries that extract sand, Mazera's stones, coral blocks at large, medium and small-scales. It is unclear, however, the exact location, size/output (small, medium or large), legal status (in/formal), age/years of operation and proximity to target groups, aspects the study wishes to document. These was determined in a reconnaissance prior to the actual data collection

Sampling Procedure and Technique

The study adopted both the purposive and random sampling technique and in deciding on the respondents. The choice of the purposive sampling technique was motivated by the fact that the information being sought was specific and therefore only quarry workers and quarry owners have the requisite experience for data that to be reliable. A simple random sampling was used to select 3 members of staff from NEMA, 10 EIA Experts and 1 member of staff from geology department. A census survey was conducted involving 80 quarry workers and 40 quarry owners available in the sites licensed by NEMA.

Data Analysis and Presentation

With slight adjustments from Bosompem, Kwarteng & Ntifo-Siaw (2011), a 5-point Likert-scale (Strongly agree, Agree, Neutral, Disagree and Strongly Disagree) was used to examine the perceived impacts of stone quarrying on livelihoods assets (natural, physical, social, human and financial). An additional 5-point scale (1-Least to 5-Most Important) was adopted to determine the relative weights of these impacts as perceived by the respondents. A weighted score of each impact was computed by multiplying the Likert score by the relative weight. Finally, a consolidated perception of the respondent towards stone quarrying was computed by simply summing up the total weighted scores of the impacts assessed.

Separate distributions for the Likert, Weighted and the Consolidated Scores were entered on Microsoft Excel for cleaning and later transferred to Statistical Package for Social Sciences (SPSS version 23.0) for statistical analyses. Initially, the general perception of the community towards stone mining's impacts on livelihood was analyzed as a percentage of respondents scoring Likert, Weighted and Consolidated, respectively and summarized as tables and pie-charts. These findings help compare the performance of various quarries vis-à-vis the community's livelihood status. Ultimately, a nonparametric test such as the Mann-Whitney test was used to judge whether samples with satisfactory EMPs also recorded commendable perception levels.

3.0 RESULT AND DISCUSSION

3.1 Awareness of Health Problems Connected to Quarrying

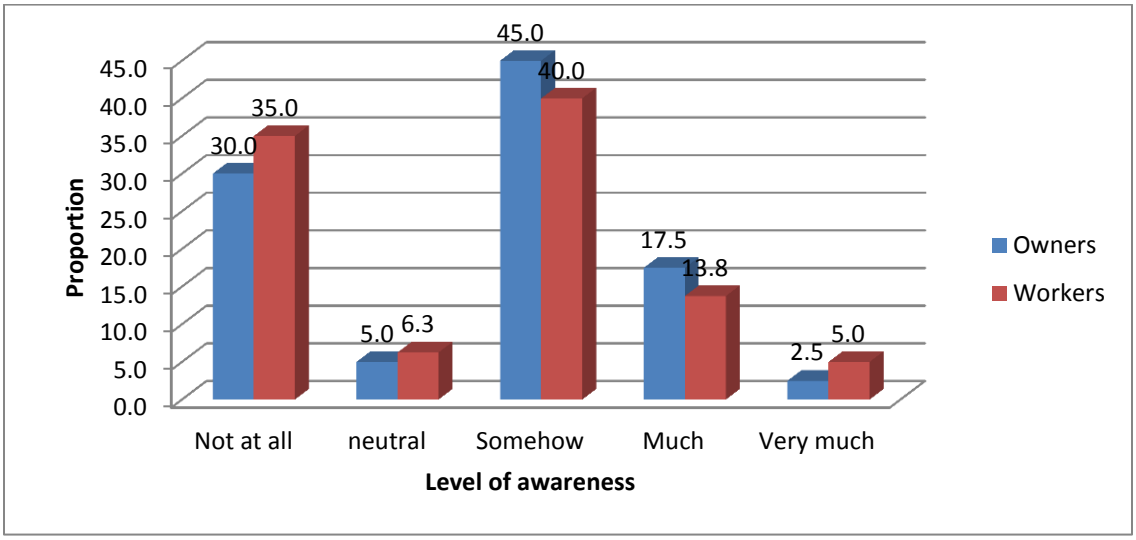

Figure 1: Awareness of problem

Results in Figure 4.4 shows that 30% of the quarry owners were not aware at all of any quarry problems, 5% were not sure if there were quarry challenges, 45% said that there were some quarry problems, 17.5% reported that they were much aware of quarry challenges while 2.5% were very much aware of quarry problem. Additionally, 35% of the quarry worker were not aware at all of any quarry problems, 6.3% were not certain of the quarry challenges, 40% reported they were somehow aware of quarry problems, 13.8% were much aware of quarry challenges while 5% were very much aware of the quarry challenges affecting different quarrying sites.

3.2 Waste Production during Quarrying Activities

Table 1: Waste generated from stone quarry

Presence of waste generated from stone quarry	Owners	Workers	NEMA staff
Yes	89.7	88.5	66.7
No	10.3	11.5	33.3

Table 1 shows that majority of the quarry owners (89.7%) and quarry workers (88.5%) said that there was waste generated from quarry stones while a small proportion of quarry worker (11.5%) and owners (10.5%) reported that there was no waste produced from the quarry stone. Majority reported that the quarry waste produced from the stones was used in backfilling of the quarry sites and pits, building houses, building roads. The waste from quarry stones was mixed with cement in making interlocking bricks, in other cased was mixed with sand and cement for construction. Farmers used the quarry waste as top soil for farming and refilling especially on

sandy soils. During quarrying the waste from quarry stones was used as nets to control dust and in other cases is used as surface finishing materials in highways.

3.3 Soil Erosion due to Quarrying activities

Table 2: Soil erosion taking place in quarries

Does soil erosion take place	Owners	Workers
Yes	5.0	27.5
No	95.0	72.5

Study findings in Table 2 shows that majority of the quarry owners (95%) and quarry workers (72.5%) reported that there was no soil erosion taking place in the quarry site while 5% of owners and 27.5% of the workers reported that there was soil erosion taking place in the quarries as the various quarrying activities take place. More profoundly, Figure 4.5 shows soil erosion was taking part at the quarrying site. This findings concurs with that of Goh and Tew (2006), they explain that, soil erosion and excessive sedimentation problems arising from stone quarry development can pose a threat to the environment if not controlled which can lead to the cumulative effects of siltation and sedimentation in streams and rivers downstream.

3.4 Effects of Quarrying Activities

Figure 2: Effects of quarrying activities

Findings in figure 2 reveal varied effects were experienced due to quarrying activities around Tezo. These included: destruction of flora as well as destruction of natural resources, dust particles interfere with plant growth resulting to environmental hazards. Due to heavy machine and destruction of ground alignment there was risk of diminishing ground water aquifer recharge potential. In other cases there is loss of habitats which threats biodiversity aesthetics and dust emission which eventually can cause respiratory diseases and air pollution. Quarrying activities create very large holes danger for children and animals, land degradation and erosion in quarrying thus makes the land infertility. Crushing of boulders produced a lot of noise which is seen as noise pollution, transportation and other plants operators produce dust land scape alteration. This findings supports those of Lad and Samant (2014) who asserts that residents of the quarrying sites blame stone quarries operating in the different area for a 50% decline in their crop yields due to noise and excessive vibrations. More than 76% of the residents complained of eye and respiratory infections as well as hearing disorders due to the dust and noise. More than

306 ha of land have suffered incredible scarification that has left very deep and dangerous gravel pits of up to 40m deep unfenced and unrestored.

3.5 Mechanism to Ensure Sustainable Quarrying

For continued social-economic benefit, varied mechanism can be employed to ensure sustainable stone quarrying. There is need to emphasis on rehabilitation of the quarry sites, ensure all stone quarries are regulated through EIA licensing process, annual environmental audit should be conducted, quarry sites should be clearly mapped out, regular auditing and monitoring of stone quarrying activities to ensure quarries are rehabilitated and adherence to EMPs in both EIA and EA

3.6 Support of Existing EMPs Interventions

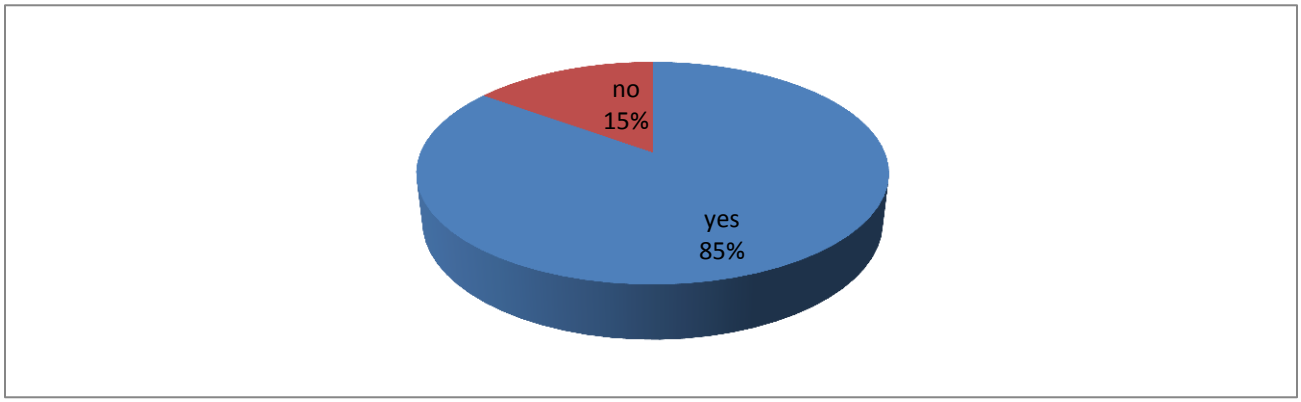

Figure 3: Support of EIA and EMPs

Findings in figure 3 shows that majority (85%) of the respondents supported the available EMPs and reported that they were adequate interventions against threats of quarrying activities while only 15% were not certain.

3.7 Actors in environmental conservation

Table 3: Actors in environmental conservation

Actor	Rating				
	Very low %	Low %	Moderate %	High %	Very High %
Proponent	0	20	30	30	20
Quarry Staff	30	30	30	10	0
Local residents	10	70	10	0	10
County Authorities	0	0	50	30	20
National Agencies	0	0	40	40	20
Civil society	10	20	40	20	20

Findings in Table 3 shows that half (50%) of the respondents reported that proponents were highly able to actualize EIA and EMPs intervention in rehabilitation quarries and ensuring sustainable quarrying with 20% being very able while 20% were lowery able.

Table 3 reveals that majority (60%) of the quarry staff were lowery able to fully actualize EIA and EMPs intervention to counter and prevent threats post by quarrying with 30% being very lowery able while 10% of the quarry staff were able to actualize EIA/EMPs stipulated.

Majority (80%) of the respondents reported that local residents were lowery able to actualize the EIA and EMPs interventions to ensure sustainable quarrying and curbing the results risk with 10% being very lowery able while 10% reported local residents were very highly able to actualize the EIA and EMPs interventions

Results in Table 4.5 reveals that half (50%) of the respondents reported that County authorities were highly able to fully actualize EIA and EMPs intervention to ensure continued and sustainable quarrying while the other half (50%) said that they were moderately able to actualize EIA and EMPs to curb the threats and risks associated with quarrying activities.

Table 4.5 shows that three quarter (60%) of the respondents reported that National Agencies were highly capable of actualizing EIA and EMPs innervations proposed to curb quarrying risk and threats while 40% reported that National Agencies were moderately capable to actualizing EAI and EMPs intervention for sustainable quarrying.

Finally, findings in Table 3 reveals that 30% of the respondents reported that Civils society was highly capable of actualizing the EIA and EMPs interventions for sustainable quarrying while 30% said that civil society was lowery able to actualize the EIA and EMPs interventions to curb the quarrying threats.

3.8 Socio-Economic Effects of Quarrying activities

Quarrying is a valuable source of livelihood to many people around the world and has in many places accelerated the penetration of infrastructure and commercial activities.

3.9 Perceived Quarry Benefits

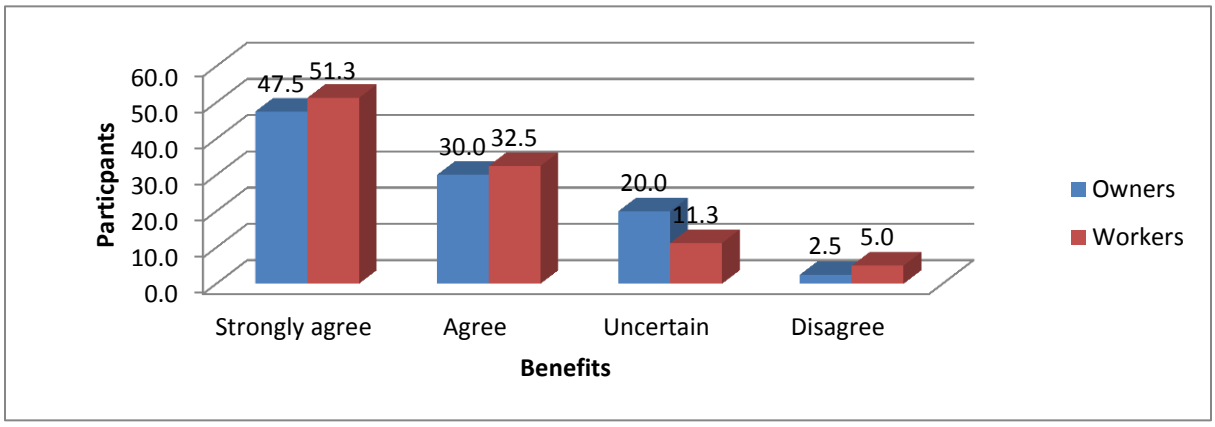

Figure 4: Socio-economic effects of quarrying activities

Figure 4 shows that over three quarters (77.5%) of the quarry owners agreed that there are benefits of quarrying activities in the area with 47.5 being strongly agreed while 2.5% of the reported that quarrying activities were not beneficial to the area. Over three (83.8%) of the quarry workers said that quarrying activities were beneficial to the community while 5% indicated that quarrying were not beneficial to the community.

3.10 Level of Income among Quarry Workers and Owners

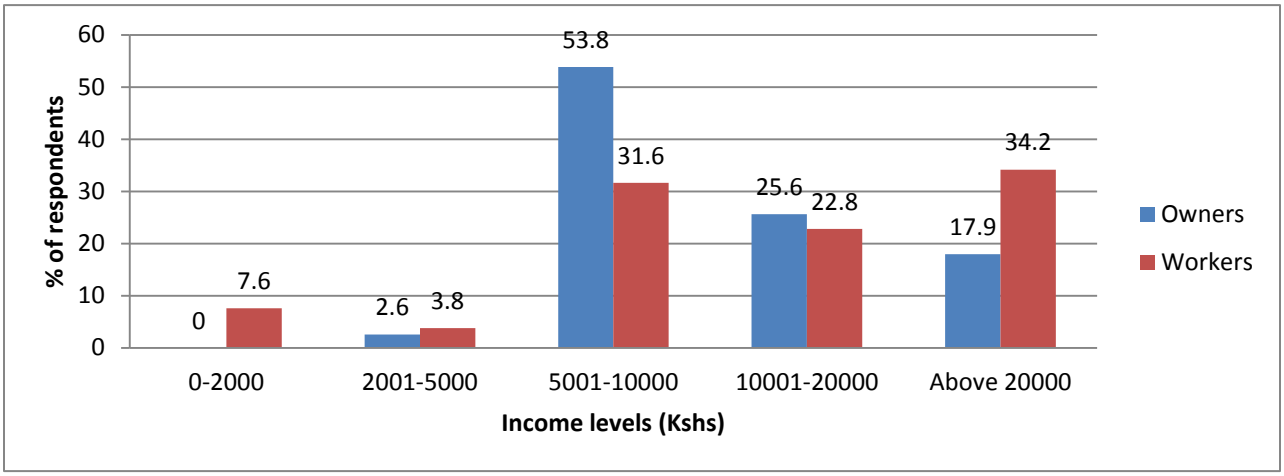

Figure 5: Distribution of Income among quarry owners and workers

Findings in Figure 5 shows that 2.6% of quarry owners earned below Ksh. 5000 monthly from quarry activities, 53.8% earned between Kshs. 50001-10000, 25% earned between Kshs.10001-20,000 while 17.9% earned above Kshs. 20000 from quarry sales. Study results reveal that 7.6% of the quarry workers earned below Kshs. 2000 monthly from working in the quarries, 3.8 earned between 2001-5000 monthly, 31.6% earned between Kshs. 5001-10000 monthly, 22.8% earned between Kshs. 10001-20000 while 34.2% earned above Kshs. 20000 monthly.

3.11 Presence of Policies to Ensure Economic Sustainability of Quarries and their Effectiveness

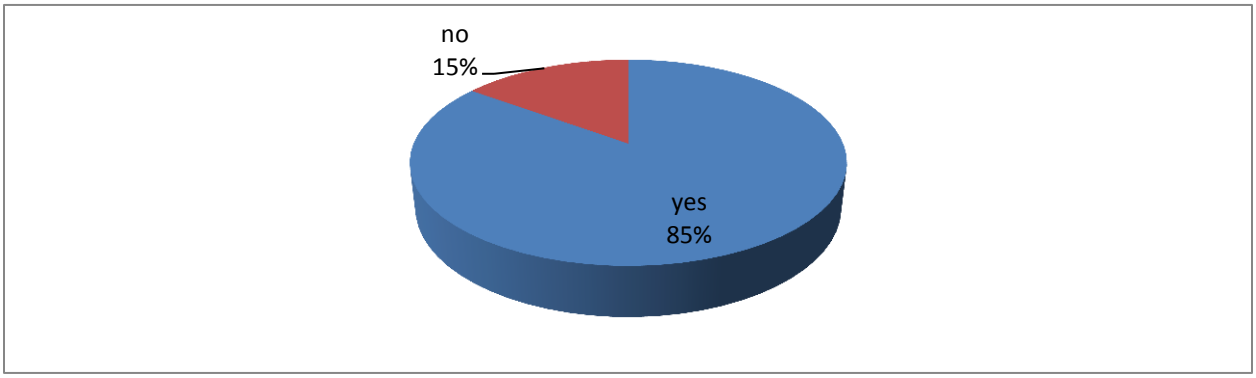

Figure 6: Presence of Policies for quarry economic sustainability

Study findings in Figure 6 reveals that majority (85%) of the respondents reported that there were policies placed by various actors to ensure economic plausibility of quarries while 15% of the respondents said there were no policies regarding sustainability of quarries and continued economic benefits. The respondents were further asked to rate the effectiveness of these varied policed paced by different actors. The study results on the effectiveness of the policies to curb the negative outcomes of stone quarrying for sustainable livelihood and public health.

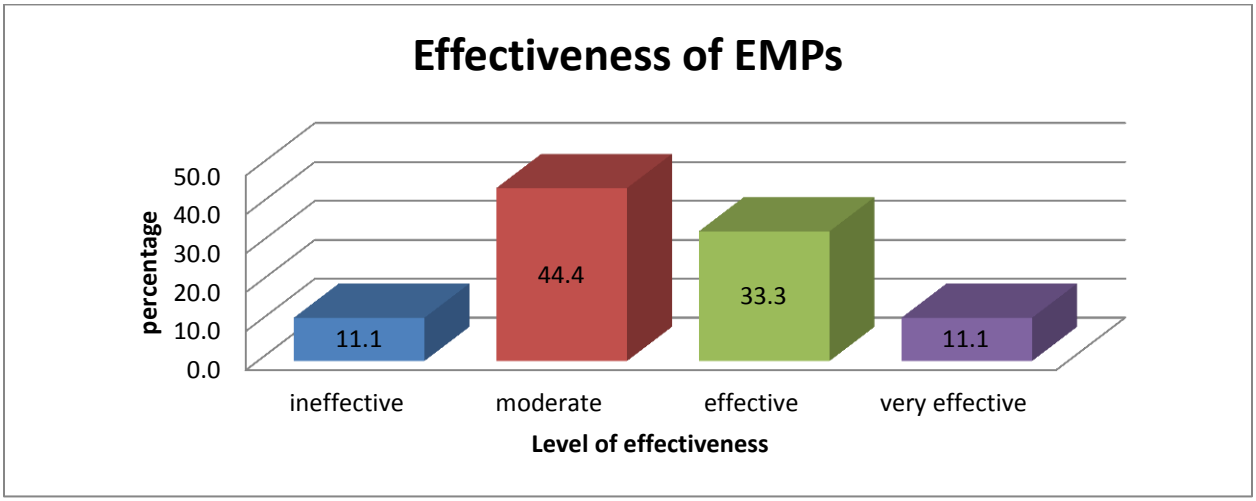

Figure 7: effectiveness of EMPs

Study results in Figure 7 reveals the 33.3 % of the respondents reported that the EMPs were effective in curbing negative outcomes of stone quarrying and provision of livelihoods among the local community with 11.1% being very effective, 44.4% said they were moderately effective while 11.1% said they were not effective in curbing negative outcomes of stone quarrying.

3.12 Provision of Funds and Effort to Rehabilitate Abandoned Quarries

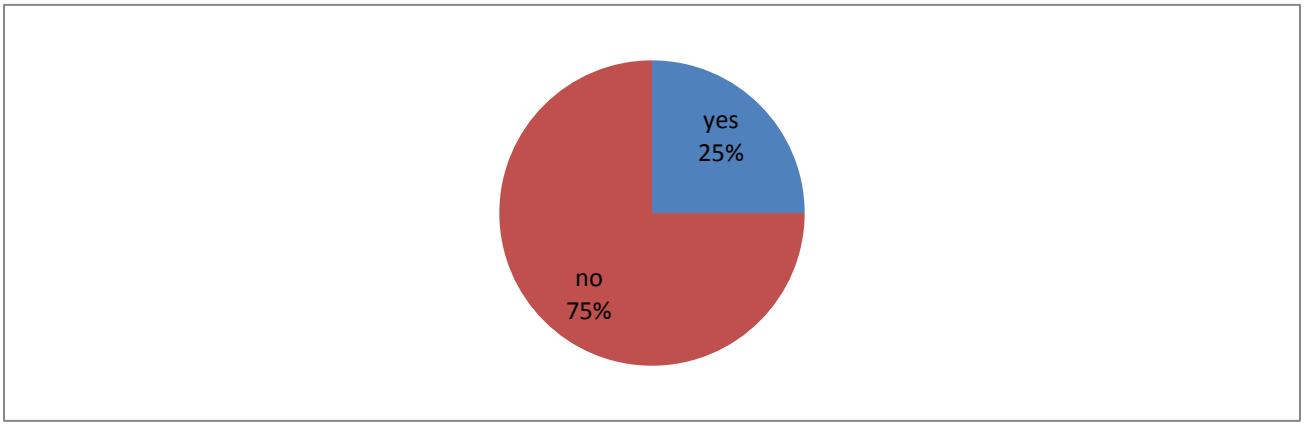

Figure 8: provision of funds to rehabilitate abandoned quarrying

The findings in Figure 8 shows that majority (75%) of the respondents reported there were no provision of funds and efforts to rehabilitate abandoned quarries for their economic plausibility

while 25% said there were provision to rehabilitate the quarries but they were slowly taking action and they were implemented by varied actors in order to enhance the livelihood of the community.

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary on Bio-Physical Characteristics of Quarrying Activities

Form the study results it emerged that majority of the quarry owners (65%) and quarry workers (59%) were aware of health challenges associated with quarrying activities. More importantly majority of the quarry owners (89.7%) and quarry workers (88.5%) reported there was wasted generated from quarry stone which was problematic but it was used in backfilling of the quarry sites and pits, building houses, building roads, making interlocking block, mixed with sand and cement for construction. A farmer used the quarry waste as top soil for farming and refilling especially on sandy soils, used as nets to control dust and in other cases is used as surface finishing materials in highways.

The waste produced was seen as soil erosion and Study findings revealed that quarrying were problematic for destruction of flora as well as destruction of natural resources. The dust particles interfere with plant growth resulting to environmental hazards. Heavy machine destroys ground alignment, therefore, risk of diminishing ground water aquifer. Quarrying activities led to loss of habitats which threatens biodiversity aesthetics and dust emission led respiratory diseases and air pollution. Very large holes left after quarrying activities were a danger for children and animals. Finally, the crushing of boulders produced a lot of noise which is seen as noise pollution for the communities surrounding the quarrying sites.

Summary on Socio-Economic Effects of Quarrying Activities

One of the objectives of the study was to evaluate the socio-economic effects of quarrying activities in selected quarries. The study findings relieved that majority (90%) of the quarry owners (87.5%) of the quarry workers were male proofing the masculinity of quarrying activities. Majority (87.5%) of the respondents were in marital unions which attributed their efforts for family provision. More importantly, most of the respondents (85%) were below 50 years which portrays the economic productivity of the quarry activities.

Findings show that quarry workers were low income earner for over half (56.4%) earned below Kshs. 10,000 monthly, while quarry earners were high income earner for over half (57%) earned Kshs . 10,000 and above monthly. The study found out that Majority of the quarry owners (83.9%) and quarry workers (77.5%) depended on the quarrying activities for their source of livelihood. Consequently, most (85%) of the respondents reported that there were policies placed by various actors to ensure economic plausibility for continued quarrying activities. The EMPs were found to be effective in curbing negative outcomes of stone quarrying and provision of livelihoods among the local community (88.9%). The findings shows that there no provision of funds and efforts to rehabilitate abandoned quarries for their economic plausibility (75%).

Conclusions

This section provides conclusion based on the study results.

From the study results it can be concluded that there were health challenges associated with quarrying activities. It can be deduced that waste was generated from quarry stone which was used in backfilling of the quarry sites and pits, building houses, building roads, making interlocking block, construction and used as top soil for farming. Quarrying activities resulted to soil erosion and further destroyed the flora and natural resources. The dust particles produced was an environmental hazard. The use of heavy machine destroyed the ground alignment and water aquifers. It can be concluded that quarrying activities affected biodiversity aesthetics and dust emission led respiratory diseases and air pollution. The crushing of boulders produced a lot of noise which is seen as noise pollution for the communities surrounding the quarrying sites and left open pits risky for human and animals.

The study concluded that quarrying is a masculine activities thus more men are involved in quarrying activities. Family responsibility forced people to work in various quarry sites. More importantly, quarry activities were undertaken by young people due to the labor-intensive nature of the task. It was concluded that quarry workers were low income earners while **quarry earners are high income earners**. Various policies had been placed to ensure economic continuity of the quarrying activities.

Finally, it can be concluded that there were various rehabilitation plans for quarrying sites. There were often quarry visits by NEMA authorities and EIA experts. The study concludes that EIA experts were effective in management of quarries by employing varied legal frameworks. The local communities were accommodative to EIA experts in countering negative social and ecological quarrying impacts. The participation of informal actors in stone quarrying has (proponents/ workers/ suppliers) significant affected the adoption and implementation of EIA and EMPs. There was limitation in using visual impact assessment approaches in evaluating the siting, operation and decommissioning due wrong GIS and mapping of quarry sites, lack of knowledge of conducting an impact assessment report.

Recommendations for Practice

Based on the research findings, the following recommendations are proposed in order to enhance effective environmental management plans. There is need for effective monitoring on the implementation of EMPs by lead agencies by increasing field inspections and customer feedback. Additionally, there is quest for peer assessment, participatory observation on existing socio-cultural issues and use of best practices. Further, there is need for transparency in the EIA as well as in the development of EMPs, to avoid discrimination and non-adherence. This can be made air tight via set Standard Operating Procedures (SOPs), to ensure community participation in the EMPs formulations. Lastly, the county and national government should conduct civil education on socio-economic benefits of quarrying activities. This should be integrated with the informal actors' recommendation for database record keeping for the quarry sites

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