African Journal of Environmental Science and Technology Vol. 4(11), pp. 740-750, November, 2010
Available online at http://www.academicjournals.org/AJEST
ISSN 1991-637X ©2010 Academic Journals

Full Length Research Paper

Effect of quarrying activity on biodiversity: Case study of Ogbere site, Ogun State Nigeria

G. A. Lameed[1]* and A. E. Ayodele[2]

[1]Department of Wildlife and Fisheries Management, Faculty of Agriculture and Forestry University of Ibadan, Ibadan, Nigeria.
[2]Department of Botany and Microbiology, Faculty of Science, University of Ibadan, Ibadan, Nigeria.

Accepted 18 October 2010

This study was carried out in quarry site at Ogbere town located at Ijebu-North Local Government Area of Ogun State; with main aim of assessing the impact of the quarry activity on bio-diversity within the unexploited site. The methods used for fauna survey are both direct and indirect by line-transect, while analysis of Mueller-Dombois and Ellenberg was adopted for vegetation. The research was carried out at both dry and wet seasons in 2008. The results revealed that species mostly abundant at the site are the reptiles. These range from families like Veranidae: black cobra *Naja melanloeuca,* Elaphidae*, Agama agama and Python with* 1.8/km *each.* A total number of thirty two species of avi-fauna varieties were sampled at the site, ranging from different families and species mostly fund are the clusters of village-weavers *Ploceus cucullatus* (1.8/km), swam-palm-bulbul *Thescelocichla leupleurus* (1.8/km), Senegal double Spurred francolin *Francolinus bicalcaratus* (0.9/km*),* Tambourine dove *Turtur tympanistria* (1.8/km). Five orders and fourteen families of mammals were recorded at the site. The most abundant are the Rodentia and Viverridae families, while the order Artiodactyla and Carnivora are at the verge of extinction due to prevailing unconducive condition at the site. The forest is dominated by secondary tree-strata with *Hildegardia barteri* with the species occupying mainly the hilly-rocky areas. Evidence of recent disturbance of the area with the presence of farmlands of *Manihot esculenta, Carica papaya, Musa* spp. was significant. The Diversity Index ranged from1.6 to 2.2 while the Equitability or Evenness Index ranged from 0.12 to 0.40, with approximately 200 trees per Km^2. It can be concluded that the forest ecosystem of unexploited plot of quarry at Ogbere is seriously a disturbed site due to scanty natural resources (fauna and flora species) that have been impacted by quarry activity.

Key words: Quarry, pollution, environment, fauna, flora.

INTRODUCTION

Rock quarrying and stone crushing is a global phenomenon, and has been the cause of concern everywhere in the world, including the advanced countries. Quarrying activity is a necessity that provides much of the materials used in traditional hard flooring, such as granite, limestone, marble, sandstone, slate and even just clay to make ceramic tiles. However, like many other man-made activities (anthropogenic factors), quarrying activities cause significant impact on the environment (Okafor, 2006). In particular, it is often necessary to blast rocks with explosives in order to extract material for processing but this method of extraction gives rise to noise pollution, air pollution, damage to biodiversity and habitat destruction.

Dust from quarry sites is a major source of air pollution, although the severity will depend on factors like the local microclimate conditions, the concentration of dust particles in the ambient air, the size of the dust particles and their chemistry, for example limestone quarries produce highly alkaline (and reactive) dusts, whereas coal mines produce acidic dust. The air pollution is not only a nuisance (in terms of deposition on surfaces) and possible effects on health, in particular for those with respiratory problems but dust can also have physical effects on the surrounding plants, such as blocking and

*Corresponding author. E-mail: lamakim2002@yahoo.com, lamgbola2008@gmail.com.

damaging their internal structures and abrasion of leaves and cuticles, as well as chemical effects which may affect long-term survival (Guach, 2001).

Unfortunately, quarrying involves several activities that generate significant amounts of noise. The excavation of the mineral itself involves considerable noise, particularly if blasting methods are used. Following this, the use of powered machinery to transport the materials as well as possibly processing plants to crush and grade the minerals, all contribute even more noise to the environment. Such extraction of raw materials from their natural habitats by mining, drilling, harvesting and those that relate to large scale water resources development projects, construction, agriculture, energy, industry and development projects, considerably affect the natural environment (Fedra et al., 2005).

One of the biggest negative impacts of quarrying on the environment is the damage to biodiversity (Anand, 2006). Biodiversity essentially refers to the range of living species, including fish, insects, invertebrates, reptiles, birds, mammals, plants, fungi and even micro-organisms. Biodiversity conservation is important as all species are interlinked, even if this is not immediately visible or even known, and our survival depends on this fine balance that exists within nature. Both positive and adverse societal impacts of modern manufacturing technologies have great consequences on economics, health, safety and environment in general (Anand, 2006).

Quarrying carries the potential of destroying habitats and the species they support (Mabogunje, 2008). Even if the habitats are not directly removed by excavation, they can be indirectly affected and damaged by environmental impacts – such as changes to ground water or surface water that causes some habitats to dry out or others to become flooded. Even noise pollution can have a significant impact on some species and affect their successful reproduction. Nevertheless, with careful planning and management, it is possible to minimize the effect on biodiversity and in fact, quarries can also provide a good opportunity to create new habitats or to restore existing ones (Tanko, 2007).

Again, like many other man-made activities, quarrying involves the production of significant amounts of waste. Some types of quarries do not produce large amounts of permanent waste, such as sand and gravel quarries, whereas others will produce significant amounts of waste material such as clay and silt (Wang, 2007). The good news is that they are generally inert and non-hazardous, unlike the waste from many other processes. However, there is still potential for damage to the environment particularly with water contamination. Plants are major components of the ecosystem – a complex interaction between the biotic and abiotic entities of the environment. The industry, unfortunately discharge dust that settles not only on land, plants and trees but also on surface waters used for drinking and other domestic chores by the community (Osha, 2006). The green plants especially, by virtue of their photosynthetic activities occupy an important position in the existence of life because of their ability to maintain a balance in the volume of Oxygen and Carbon dioxide which leads to the purification of the environment. They supply man with food, drugs, fibres, fuel, building and other raw materials and serve as ornamentals. The plants, by their activities, influence and determine to a large extent, the type of fauna to be expected and any change or tilt in their composition either vegetation, affects the animal life in terms of food, shelter, security and comfort. Such vegetation changes are the main concern of environmental botanists and ecologists in recent years who have advocated the careful and cautious approach to activities promoting such changes (Wang, 2007).

Air pollution generally and especially dust from quarry sites are known to be responsible for vegetation injury and crop yield loss and thus become a threat to the survival of plants in industrial areas (Iqbal and Shafig, 2001). Such dusts reduce plant cover, height and number of leaves. Apart from the dust emitted, toxic compounds such as fluoride, Magnesium, Lead, Zinc, Copper, Beryllium, Sulphuric acid and Hydrochloric acid are injurious to the vegetation.

While quarries can cause significant impact to the environment, with the right planning and management, many of the negative effects can be minimized or controlled and in many cases, there is great opportunity to protect and enhance the environment, such as with the translocation of existing habitats or the creation of new ones. Therefore to achieve the equilibrium between natural ecosystems, project planning, formulation and implementation is needed. In this study, we assess the environmental impact of unexploited site meant for quarry activity at Ogbere in Ogun State.

Study site

Ogbere quarry site is located at Ijebu-North Local Government Area of Ogun State, Nigeria in a locality called Ogbere town. The study was carried out in 2008 between the months February and November, spanned within dry and wet season. The town is a few kilometers (35km) along Ijebu Ode via Ore road. The project site generally falls within the Rain Forest Zone or the Lowland Forest Zone of Nigeria (Keay, 1959, Onochie, 1975) with its characteristic high density of trees and a highly stratified structure. Rainforests in Nigeria are known to cover an estimated area of 103,600 sq km out of the total land area of 90,879,138 ha in Nigeria (Gbile, 1992). Tropical rainforest is the most complex type of vegetation in the world. It has a characteristic general appearance which is easily recognizable though there may be different grades of complexity depending on communities, age and influence of man (Whittaker, 1975).The entire area of the site (both used and unexploited) is

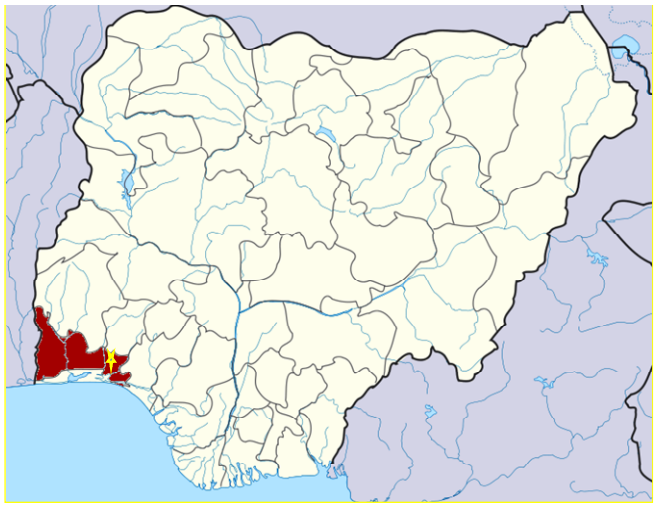

Figure 1. Map of Nigeria showing the location of Ogun State and Ijebu North local Government marked yellow.

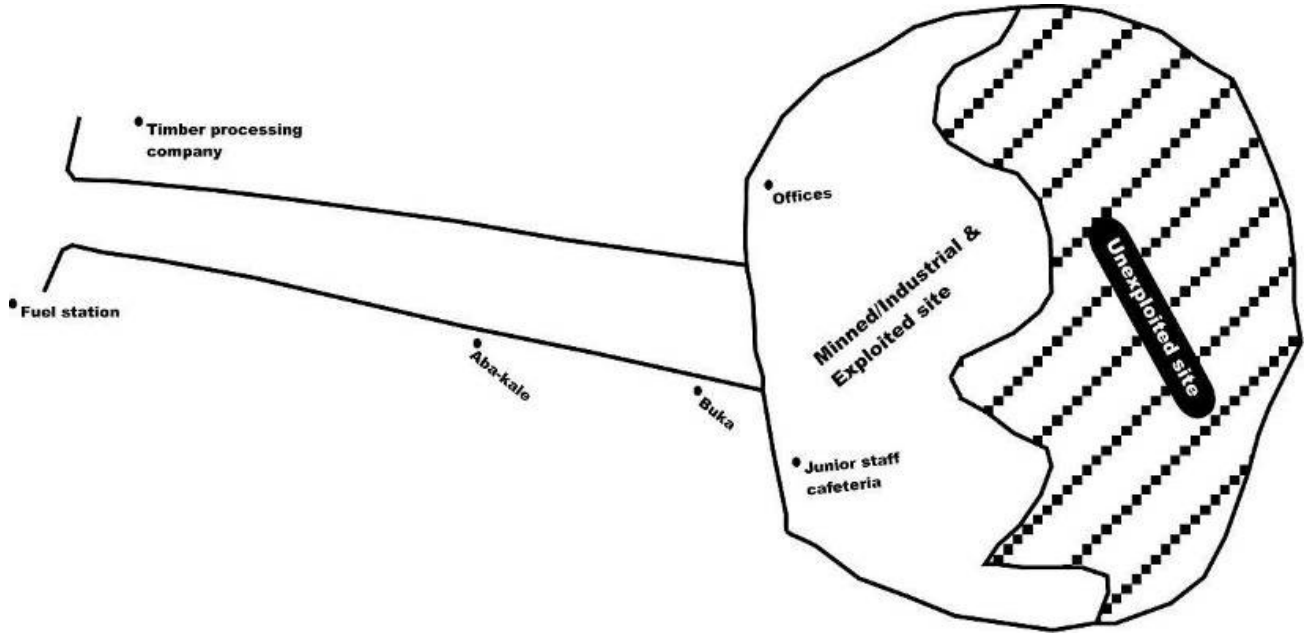

Figure 2. Showing the sketched map of the Quarry site at Ogbere, indicating both the exploited (industrial area) and unexploited sites (surveyed plot).

estimated to 900,000 km^2. Half of the entire area is already engaged in production and for administrative building (450,000 km^2), while the remaining half is unexploited site that require present EIA study.

There are many other Quarry Companies operating in this location, some of them are Ratcon quarry, Crushed dragon quarry and four others within the location. Only one existing village is located closer to the quarries, the name of the settlement is Aba-kale with distance of less than a kilometer to the quarry sites. There are some other significance of human hamlets dotted the area, which indicated presence of indigenes that engaged in the subsistence farming and other anthropogenic activities at the site.

According to the information provided, the Quarry operation has been in existence and actively operating for the past seventeen years. Figures 1 and 2 show the map of Nigeria indicating location of Ijebu ode North Local Government within Ogun State and the sketch diagram of the entire area of quarry site, indicating both the commercially production site and unexploited area within the land coverage.

Table 1. Transects georeferencing and distance within the quarry site.

Transect	Distance (Km) total 5½ km	Co-ordinate/geo-reference
1	2	N06°47.609[1] E004° 08.560[1] Elevation 45.1 m
2	1[1]/2	N06° 47.148[1] E004° 08.459[1] Elevation 44.42 m
3	2	N06° 47.148[1] E004° 08.459[1] Elevation 44.2 m
4	1	N06° 47.454[1] E004° 08.519[1] Elevation 33.8 m

METHODOLOGY

The unexploited area that was subjected to assessment is estimated to about 450,000km^2. The line transect method (Buckland *et al*. 2001) was used for the study. The area was sub-divided into 4 transects, with a kilometer interval in-between each transect and parallel to one another. The distance of transects and their geo-reference points are as listed in the Table 1.

In each transect, two methods were used for collecting data; method used for fauna survey is both direct and indirect methods, Direct method required actual sighting and recording of the species into data sheet along the predetermined transects, while indirect method is the recording of the significant signs along the same transect lines. Two research individuals and one native indigene were involved in the collection of data, while analysis of Mueller-Dombois and Ellenberg was adopted for vegetation. This requires accurate spatial databases as well as reliable knowledge of the habitat requirement of the species concerned (Homer *et al.* 1993). Every species and sub-species recorded at the site were evaluated according to International Union for Conservation of Nature for flora and fauna species red list data (IUCN, 2009). Diversity Index was calculated using Shannon Weaver's Index with the formula H**= - E** Pi In Pi where **S** is the number of species, P is the proportion of individuals or abundance of the ith and In is the log base n. This index combines species richness with relative abundance. Shannon's equitability or evenness was calculated using the formula E_H = H / In S. The major growth forms (Cain and De Oliveria Castro, 1959) were noted.

Questionnaires were administered to provide adequate information on the socio-economic status of the species utilization by the inhabitants at the surrounding villages.

Materials used for the research work are recording sheet, compass, binocular, pencils, zoom lens .35 Camera, Global Positioning System (GPS), 300 meters tape rule, areas map, structured questionnaire and a field assistant.

RESULTS

Reptile diversity

The species mostly abundant at the site are the reptiles (Table 2), this range from families like Veranidae: black cobra Naja melanloeuca, Elaphidae, Agama agama and Python with density of 1.8/km each. Rocky environment at the site provide prevailing conducive niche for the herpetology species to thrive at this unexploited area.

Avi-fauna diversity

A total number of thirty two species of avi-fauna (Table 3) were sampled at the site, ranging from different families. Birds were sparsely distributed and species mostly found are the clusters of village-weavers *Ploceus cucullatus* with density 1.81/km and swam-palm-bulbul *Thescelocichla leupleurus (0*.9/km). Other species took the advantage of the vast adjacent farm land to the unexploited site that is presently under investigation. The specific tree species that is mostly used as nesting point by the birds is *Hildegardia barteri.* These might due to the flowering of the tree at the period of sampling even though the industrial activity of quarrying was pronounced and acted as major limiting factors for the species thriving and abundance. Most of the species are presently classified as locally extinct or not available (*Merops suercilliosus, Tauraco persa and Hirundo peucosoma*) or lower risk (*Trenron australis* 0.9/km*, Streptopelia vinacea 1.8/km and Melvus migrans* 0.9/km), but might be at the verge of endangered or vulnerable due to intensive destruction of their habitats and loss of feeding fruits because of quarrying.

Mammal diversity

Five orders and fourteen families were recorded using both direct and indirect sampling methods. Most of them are not resident species due to precarious habitat condition (quarrying activities) that are not conducive for their thriving. However, most species preferred the adjacent

Table 2. Reptile and amphibian population density at the quarry site in Ogbere village.

Taxon				No. available/ km(density)	Transects				IUCN status (2009)
Order	Family	Common name	Scientific name		1	2	3	4	
Reptile	Veranidae	Monitor lizard	*Veranus niloticus*	1.8	+	+	+	+	Lr
		Black cobra	*Naja melanloeuca*	1.8	+	+	+	+	E
		Tree snake	*Bioga blandingii*	0.36	-	-	-	-	Le
		Red headed lizard	*Agama lizard*	1.8	+	+	+	+	Lr
		Tree frogs	*Hypercolius puctuntus*	0.54	+	-	-	+	Lr
		Dwarf crocodile	*Osteolaemus tetruspis*	0.54	+	+	-	-	E
	Pelomedusdae	West African black forest turtle	*Pelusios niger*	0.9	+	+	+	+	E
		Red headed lizard	*Agam agama*	1.8	+	+	-	+	Lr
	Testudinidae	Sarrata hinge back tortoise	*Kinixys erosa*	0.36	-	-	-	+	E
	Python	Rock python	*Python sebae*	1.8	-	-		+	E
	Elaphidae	Green mamba	*Dendrospis viridis*	1.8	+	+	+	+	V

Threatened (T), endangered (E), vulnerable (V), locally extinct (Le) and lower-risk (Lr). Present = +; absent = -

farm areas that exist for roosting. Footprints and activity sites of *Cephalophus nigrifons* and Viverridae family were pronounced within transects. Quantitative analysis and population viability of the species (Table 4) indicated restricted distribution and also total absence of some from the expected niches (along transects), such as Syncerus caffer and Cephalophus Maxweli that are locally extinct. While *Rattus rattus and Malacomys edwadsi* in the family Rodentia are most abundant with density 1.81/km

Flora resources

The study area is naturally a rainforest vegetation but human activities, most importantly farming have reduced most part to a secondary forest (transects 1and 4), forest re-growth (transects 2 and 3), or mere farmlands (transects 2 and 3). The secondary forest is a rather complex community of plants in which disturbance has occurred over a long period. The upper canopy formed by *Hildegardia barteri* reaches about 40m high. This species forms about 60 % of the trees in the site. Herbs are restricted in distribution while weeds are quite common. In some parts, vegetation is usually dense with young trees and shrubs such as *Alchornea cordifolia* and *A. laxiflora* and covered with scramblers and climbers such as *Combretum* spp, *Adenia lobata* and *Smilax kraussiana.* The Diversity Index ranged from1.6 in S3 and 4 to 2.2 in S1 while the Equitability or Evenness Index ranged from 0.12 in S1 to 0.40 in S4. There are approximately 200 trees per Km^2 with *Hildegardia barteri* dominating. The high diversity indices of the entire area ranging from 1.6 to 2.2 indicate the heterogenous-diverse nature of the project site and the fact that there have been recent disturbances. Such effects may not be unconnected with the clearing of major parts for farming. Moreover, the presence of plants like *Manihot esculenta, Carica papaya, Musa spp, Dioscorea spp, Musanga cecropioides,* and *Alchornea spp* provides evidence of recent or previous land use. The most diverse of the four transects is S 1 with an index of 2.2.

The non timber forest resources (NTFR) include *Xanthosoma sagittifolia(cocoyam)*, *Ananas comosus*(pineapple), *M. esculenta*(cassava), *Musa sapientum*(banana), *Musa paradisiaca*(plantain), *Elaeis guineensis* (palm oil and palm wine), *Thaumatococcus daniellii* and *Cola spp*(cola nuts) among others. The timber forest resources (TFR) include *Hallea ledermanii, Terminalia superba* and *Nauclea diderrichii* among others.

GENERAL DISCUSSION

Impact of quarry on fauna

The forest ecosystem of unexploited plot of quarry at Ogbere is seriously a disturbed site due to scanty natural resources (wildlife species) that have been impacted by industrial activity. The animals especially the *Cercopithedae* and *Carnivora* species are the most vulnerable when compared their abundance with similar ecosystem in the same area; likewise the forest vegetation are at the verge of being displaced. The listed resources are awaiting environmental signals such as configuration of the land, disturbance of the relic forest

Table 3. Bird population density at the quarry site in Ogbere village.

Taxon				No. available / km(density)	Transects				IUCN
	Family	Common name	Scientific name		1	2	3	4	
Order	Phassiannidae	African black kite	*Melvus migrans*	0.9	+	+	+	+	Lr
		Lizard buzzard	*Kanpifalco monogramniscus*	0.9	+	+	-	+	V
		Red-necked kestera	*Falco chiquera*	5.4	-	-	+	-	T
		Senega double Spurred francolin	*F. bicalcaratus*	0.9	+	+	+	+	Lr
	Columbidae	Vinaceous dove	*Streptopelia vinacea*	1.8	+	+	+	+	Lr
		Green fruit pigeon	*Trenron australis*	0.9	+	-	+	-	Lr
		Tambourine dove	*T. tympanistria*	1.8	+	+	+	+	Lr
	Musophagidae	Green-crested touraco	*T. persa*	-	-	-	-	-	Le
		Grey plantain eater	*Criniger poscator*	0.9	+	+	-	-	V
	Cuculidae	Senegal coucal	*Centropus senegalenis*	0.9	+	+	-	+	V
		Black throated coucal	*Centropus grillii*	1.09	-	+	-	+	V
	Tytonidae	African barn owl	*Tylo alba*	0.9	+	+	-	+	E
	Apodidae	Little African swift	*Apus affinis*	1.8	+	+	+	+	Lr
	Alcedinidae	Pied kingfisher	*Cerlerudis*	0.72	+	-	-	-	Lr
		Senegal kingfisher	*Halcyon senegalensis*	1.64	+	+	+	+	Lr
	Meropidae	White throat bee eater	*Merops albicollis*	0.9	+	-	+	-	V
		Blue checked bee eater	*Merops suercilliosus*	-	-	-	-	-	Le
	Upupidae	Senegal wood hoopoe	*Phoeniculus purpureleus*	1.45	-	-	+	+	T
		Hoopoe	*Upupa epops*	0.18	-	-	+	-	Le
	Capitonidiae	Naked-faced barbet	*Gymnobucco calvus*	0.9	-	+	+	+	T
	Hirundinidae	Pire-winged swallow	*H. peucosoma*	-	-	+	-	+	Le
		Mosque swallow	*Hirundo senegalensis*	0.9	-	-	-	-	T
	Dictruridae	Glossy-backed drongo	*Dictrurus adsimilis*	1.09	+		+	+	T
	Oriolidae	African golden oriole	*Oriolus auranthus*	1.09	+	+	+	+	E
	Pycnonotidae	Common garden bulbul	*Pycnonotus barbatus*	1.8	+	+	+	+	Lr
		Swamp palm bulbul	*T. leupleurus*	1.8	-		-	-	Lr
	Turdidae	West African thrush	*Turdus pelios*	0.9	+	+	-	+	T
	Nectarinidae	Splendid sunbird	*Nectarinia cuprea*	0.9	+	+	+	+	Lr
		Cupper sunbird	*Mecarinia curpea*	0.9	-	+	+	+	Lr
	Fringilidae	Bronze manikin	*Lancaura cucullatus*	0.9	+	+	+	+	T
		Yellow fronted canary	*Serinus mozambicus*	-	-	-	-	-	Le
		Negro finch	*Nignia canicapilla*	-	-	-	-	-	Le
	Polceidae	Village weaver	*P. cucullatus*	1.81	+	+	+	+	Lr

Threatened (T), endangered (E), vulnerable (V), locally extinct (Le) and lower-risk (Lr). Present = +; absent = -.

Table 4. Mammal population density at the quarry site in Ogbere village.

Taxon			No. available/km	Transects				IUCN status
Order	**Family**	**Scientific name**		**1**	**2**	**3**	**4**	
Artiodactyla	Bovidae	*Syncerus caffer*	-	-	-	-	-	Le
		Cephalophus maxweli	-	-	-	-	-	Le
		Cephalophus nigrifons	0.9	-	+	-	-	V
		Cephalophus monticola	-	-	-	-	-	Le
		Kobus ellipsiprymnus	-	-	-	-	-	Le
		Tragelaphus scriptus	1.27	-	-	-	+	V
Carnivora	Viverridae	*Viveria civet*	0.72	-	+	-	+	E
		Genetta cristata	0.36	+	-	-	-	E
		Genetta pardina rubiginosa	0.18	-	+	-	-	Le
	Carnidae	*Vulpes palluda*	-	-	-	-	-	E
	Mustelidae	*Lutra Tramaculicolis*	-	-	-	-	-	Le
		Phacechoerus aethiepus	-	+	-	-	-	Le
	Thryonomidae	*Thryonomys swinderianus*	1.81	+	+	+	+	Lr
Rodentia	Herpestidae	*Alex paludiousus*	0.72	+	+	+	-	E
		Rattus rattus	1.81	+	+	+	+	Lr
		Hylomiscus stella	0.54	-	-	-	-	Le
	Aciuridae	*Funisciurus angrythrus*	0.72	+	+	-	-	Le
		Xerus erythropus	0.9	-	+		-	Lr
	Cricetidae	*Criceteomys gambianus*	0.55	-	+	-	-	Lr
	Muridae	*Malacomys edwadsi*	1.81	+	+	+	+	Lr
		Hybomys vittatus	-	-	-	-	-	Le
		Rattus rattus	0.72	-	+	-	-	Lr
		Dasymys incomtus	-	-	-	-	-	Le
	Sciuridae	*Protoxerus stangeri*	-	-	-	-	-	Le
Insectivora	Sorricidae	*Crocidura insitania*	-	-	-	-	-	Le
		Crocidura odorata	-	-	-	-	-	Le
	Tenrecidae	*Crocidura Nigeria*	-	+	-	-	-	Le
Hyracoidea	Procavidae	*Dendrohyrax dorsalis*	-	-	-	-	-	Le
Pholidota	Manidae	*Manis tricuspis*	-	-	-	-	-	Le

Threatened (T), endangered (E), vulnerable (V), locally extinct (Le) and lower-risk (Lr); present = +; absent = -.

ecosystem and interruption in the supply of their food from the forest due to quarry activity before they embark on migration.

Adeola (1991) asserted that nature has provided wildlife and biodiversity with certain form of habitat and not as adaptable as man to the surrounding. Thus the expansion of human population and the unfolding of human's horizon to exploit resources for economic and other purposes tend to displace such indigenous resources and can even put some species into extinction, if not addressed with caution. The capacity of wildlife to be adaptive to changing environmental conditions varies within species; Rare and endangered species are non adaptive, such as primate *Cercopithecus* spp. and the avi-fauna, such species will be displaced by migrate or hunted by inhabitants of the area. Less threatened and high productive species with high fecundity are more adaptive, examples of such species are the reptiles like black cobra *Naja melanloeuca,* monitor lizard *Veranus niloticus, Agama agama* and tree snake *Bioga blaningii.*

Okafor (1998) noted that rural and urban development programmes of its nature shared a multiplicity of objectives geared towards improving the living standard of the whole population and their operation invariably involved not only the tapping of the renewable and non-renewable resources (soil), but also the transformation of the natural environment.

Environmental impact prediction of the quarry activities on the vegetation

The major environmental hazard from the quarry is the effect of dust and this will be dependent on:

a) The concentration of the dust particles in the ambient air and its rate of deposition.
b) The type of vegetation.
c) The leaf surface type of the vegetation.
d) degree of penetration of the dust particles into the vegetation.
e) The size distribution of dust particles
f) The chemistry of the dust such as the active dusts from laterite.

Most of the effects of dust particles on plants include the potential to block and damage the stomata such that photosynthesis and respiration are affected. Other effects are shading (which may lead to a reduction in photosynthetic capacity) wearing down on the leaf surfaces and cuticle (Igbal and Shafig, 2001).
The chances of air pollution are high. Pollutants such as dust, gaseous emissions and air- borne particulates will be produced and get deposited on the plants. This will no doubt affect the physiological activities of the plants most especially those around the quarry site such as in photosynthesis and respiration. The implication of these is that some of the plants may have retarded growth while others may be eliminated.

Social cost and social responsibility of quarrying at Ogbere site

The shift in environmental management and modernization for purely economic gain is how to make the people understand and accept the new rule of the economic growth, which include the expansion of educational facilities, improvement in environment quality with attention paid to alternative cost on natural resources (fauna and flora) that would be affected (Mabogunje, 1980). The need to tap the natural resources (quarrying) at BJ quarry site in Ogbere will bring about resulting economic growth and technological progress, but this has been aimed at the expense of environment (social cost), to improve the quality of the materials and human resources (social responsibility) in term of employment opportunity, road construction and other raw materials that are derivable from quarry.
The reason why there have been many environmental problems associated with resource extraction as in the case of quarrying in Quarry might be lack of environmental considerations in the planning and building of the major project (Oyaigheviven, 1998). Thus, projects are usually sited for and embarked upon to satisfy the social and economic needs of the company without the need and aspiration of the people that are directly concerned at the nearest neighbouring communities such as Aba-Kale, Ogbere communities as well as the impact on the primary environment. In open cast mining and quarrying environment, vast area of land are usually existing, leaving behind stagnant ponds or open pits. Consequently, most surface mining environment bears scars of environmental degradation. During mining, materials such as sand, clay, gravel and red earth turn to devastate useful agricultural land and affect other biodiversity (flora and fauna) resources that are indigenous and endemic to the area (social cost). Depending upon the relative toxicity of the material, leakage from the disturbed mineral mining or quarry site into ground water, this could pose quite a serious health matter for both humans and other animals (either domesticated or wild animals) in proximity to the quarry.

Fauna species status: Endangered and endemic species

All the species recorded at the site (transects 1 to 4) are of conservation importance (last column of the Tables 3 to 4). They were rated according to the IUCN 2009 classification and the species were grouped into taxon (reptiles, mammals, and birds). Classification rates are as follow: threatened (t), endangered (e), vulnerable (v), locally extinct (le) and lower-risk (lr) and the rating of their presence were based on simple percentage frequencies (Figures 2 to 5).

From Figures 2 to 5, all the species and sub-species are categorized and each of them served valuable function in the ecosystem, likewise they were utilized in various ways by the surrounding inhabitants. Majority of the species are at threatened and vulnerable rates, which indicated that they are at critical points of survival and also subject to the activity of quarrying. Three options would determine the faith of those species; Most of them might migrate to the adjacent farms' ecosystem within the area, secondly, the local inhabitants as well as staff of the quarry industries will also turn to become predators/ hunters. Thirdly, apart from those aforementioned, sub-critical species will continue to persist and reprocreate despite industrial activities and human influences, example of such are reptiles: *Agama agama*, *Dendrospis viridis;* avifauna: *Streptopelia vinacea, P. cucullatus* and few mammals: *Rattus rattus, Thryonomidae* and *Cricetidae.*

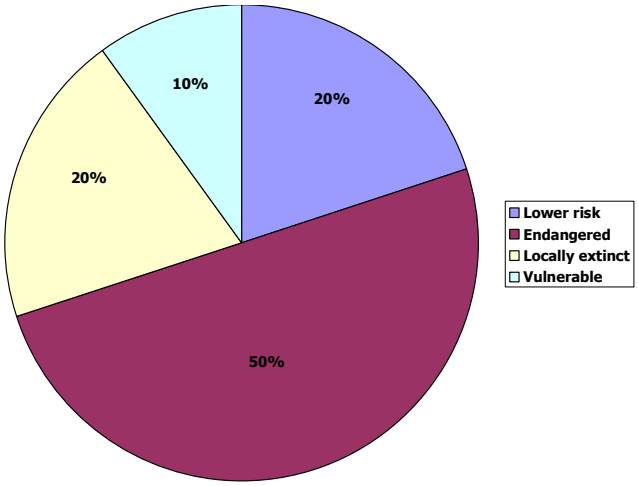

Figure 3. Species status of reptiles.

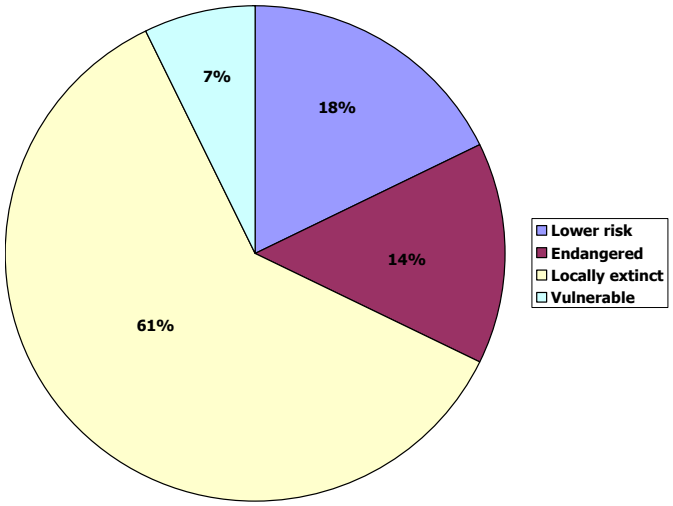

Figure 4. Species status of mammals.

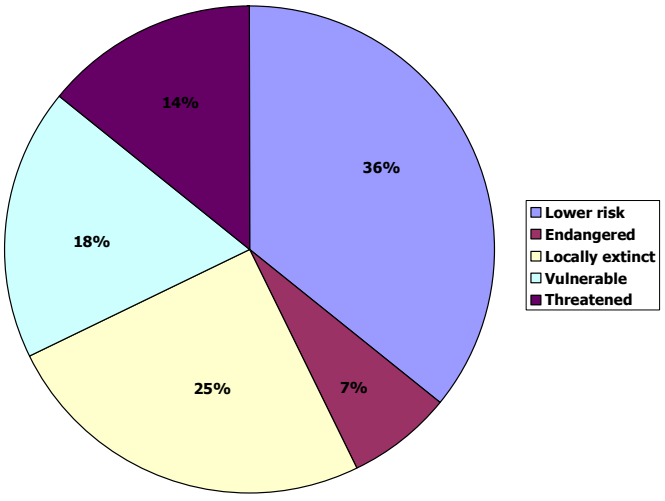

Figure 5. Species status of birds/avifauna.

These species have capacity to exist within the succession of environmental condition. Therefore such species presence in the ecosystem is an indicator of degraded or overexploited community (Webster and Fittipaldi, 2007).

CONCLUSION AND RECOMMENDATIONS

All developmental programmes or projects that could affect natural ecosystem in the tropics are said to be conservation dependents, the proposed and on-going activity at Ogbere Quarry site is not an exception. Many species that are present at the unexploited site are climax types because a slight change in their environmental need that occur due to minning or quarrying activity will result to complete loss. This is because such climax species are more specialized in their environmental needs and less adaptable. The activity of quarrying is a complete removal of the vegetation, which serve as the abode and niches for the wild animals. Only few serial or successional species that are more adaptable will take advantage of transitory and unstable situations.

However, sophisticated manipulation of environment in quarrying project either directly or indirectly (habitat modification) will result to serious implication where by rare and endangered species will become non-adaptive, while more adaptive species that are fewer in number will persist due to pollution (Osha, 2006).

The following are some recommendations that are feasible for quarrying activities which are necessary for regular assessments of environmental impact that can mitigate the effects of problems through technology initiatives. Mandatory environmental impact assessment reports for establishing new quarry unit require the following:

1. Establishment of dust control mechanisms at the unit level.
2. Formulation of a code of conduct for the industry as a self-regulation mechanism.
3. Strengthening of the owner associations to regulate the sector - establishment, operations, licensing, marketing, taxation, etc. Strengthening of labour in the management of the units. Having stakeholder meetings involving the relevant government departments, industry representatives, NGOs, and other interests groups.
4. Extension of Public Liability Insurance Act to the quarrying and crushing units.
5. Efficiency in energy consumption. Alternative power sources (like solar energy, thermal radiation from rocks as source of fuel) have the potential to reduce the input costs, thus increasing the profit margin, leading to the healthy growth of the industry.
6. Options for restoration of abandoned quarry sites by infilling with quarry waste, and/or inert waste from Hyderabad and elsewhere and/or infilling with other non-inert or putrescible waste. Since contamination of nearby resources can be a distinct possibility, especially when the waste is not segregated, any land fill programme has to follow the logical steps involved in establishing a landfill for the waste, including the selection and assessment of the site and the environmental impact of locating such a site in the identified place.
7. Introduction of Controlled blasting operations, to minimize hazards from flying missiles depending on its reliability and feasibility factors, this can affect both the animals and human inhabitants in the area.
8. Protection of rare rock structures through fencing and zoning.
9. Safety procedures for workers, and application of Employees Safety Insurance, and other provisions.
10. Extension of education and training facilities to the traditional stone cutting and quarrying communities.
11. Specialized training for officials of traditional communities, officials of the regulating departments, entrepreneurs, technicians and workers. Undertake research and development activities.

ACKNOWLEDGEMENTS

We acknowledged the support received from JAWURA Environmental Consultancy Ltd, for given us the privilege to be members of EIA consultant team at Ogbere Quarry site, to carry out this research work. Special appreciation goes to Professor O. Osibanjo, for his trust, advice and financial support during the research. Finally, we acknowledge the cooperation received from the staff of all the Quarry companies at Ogbere community.

REFERENCES

Adeola ML (1991). Wildlife Conservation in Nigeria to projected Trend in Human Population. Land use Desertification and the Quality/Quantity of Tropical Rain Forest in FAN Conf. Proc. Oni I. (edit), pp. 326-330.

Anand PB (2006). Waste management in Madras revisited. Environ. Urbanization, 11(20): 161-176.

Buckland ST, Anderson DR, Burnham KP, Laake JL, Borchers DL, Thomas L (2001). Introduction to distance sampling: estimating abundance of biological populations, Oxford University Press, Oxford.

Cain SA, De Oliveria CGM (1959). Manuals of Vegetation Analysis. New York, p. 325.

Fedra K, Winkelbauer L, Pantulu VR (2005). Systems for Environmental Screening. An Application in the Lower Mekong Basin. International Institute for Applied Systems Analysis. A-236l Laxenburg, Austria, p. 169.

Gbile ZO (1992). Status of forest conservation for maintenance of Biodiversity in Nigeria. In “Conservation of Plant genes. Academic press, London, pp. 293-310.

Gauch HG (2001). Multivanate Analysis in Community Ecology Cambridge University Press, p. 85.

Homer CG, Edwards TC, Ramsey RD, Price KP (1993). Use of Remote Sensing Methods in Modelling sage grouse winter habitat. J. Wildlife Manage. 57:78-84.

IUCN (2009). International Union for Conservation of Natural Resources. Both Flora and Fauna Red Data Book. Ladder Presentation U.K.

Mabogunje AL (1980). The Debt to Posterity: Reflection on a National Policy on environmental Management N.P.O. Sada and T. Odemerho (ed). Environmental Issues and Management in Nigerian

Development, p. 6669
Osha OL (2006). Information Booklet on Industrial Hygiene. Revised Edition. U.S. Department of Labor OSHA/OICA Publications, Occupational Safety and Health Administration, Washington, USA, pp. 23-35.
Okafor FC (2006). Rural Development and the Environmental Degradation versus Protection: In P. O. Sada and T. Odemerho (ed.). Environmental Issues and Management in Nigerian Development,. pp. 150-163.
Onochie CFA (1975). The vegetation types of Nigeria. Paper presented at the symposium on Variation and Breeding systems of *Triplochiton scleroxylon* K. Schum. Fed. Dept. For. Res., Ibadan, 21st -28th April.
Oyaigheviven VO (1998). A conceptual frame work for An Environmental Management Policy in P.O. Sada and F.O. Odemerho. Environmental Issues and Management in Nigerian Development 1st Edit. 1988, pp. 38-41.
Iqbal MZ, Shafig M (2001). Periodical effect of cement dust pollution on the growth of some plants. Turk. J. Botany, 25: 19-24.
Keay RWJ (1959). An outline of Nigerian Vegetation. 3rd ed., Federal Government Printer, Lagos, Nigeria. Keay, R. W. J., Onochie, C .F.A. and Stanfield, D.P. (1960-64). Nigerian Trees. Vols. 1&2. Federal Department of Forest Research, Ibadan, Nigeria.
Tanko A (2007). "Environmental concerns, assessment and protection procedures for Nigeria's oil industry"Centre for Development studies and the school of Geography, Geol. Environ. Sci., BUK, Nigeria, p. 1.
Wang A (2007). Principle of Environmental Impact Assessment Best Practice." International Association for Impact Assessment. "Environ. Prot. China: The role of law" pp. 120-128.
Webster RD, Fittipaldi F (2007) The Interest in Impact Assessment Methods: Environmental Methods Review: Retooling impact assessment for the new century published by Fargo, North Dakota, USA, p. 24.
Whittaker RH (1975**).** Communities and ecosystems**.** Macmillan Publishing co; Inc., New York, pp. 56-69.