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World Journal of Biological Research
Revue Mondiale de la Recherche Biologique

World Journal of Biological Research **001**: 1

Environmental Impact Assessment of Cement Factory Production on Biodiversity: A Case Study of UNICEM, Calabar Nigeria.

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Received 04 august 2007 /Accepted 20 September 2007/ published 28 February 2008

Summary

The natural forest at the segment of Southeastern state (Cross River State) is losing its primary status due to various types of human development and industrial activities. This is more envisaged with dry process Kiln method that United Cement Company of Nigeria (UNICEM) intend to use for manufacturing of Cement, which will leave the particulate emission rate of cement as high as 20.8Kg / bbl on the atmosphere. Other environmental pollution problems associated with this activity are bad odour, noise, dust and fumes, aesthetic nuisance, smoke, vibration, effluent and glare.

A total of eighty-two tree species among which are some economic species were recorded during the assessment. Diversity Indices of between 0.03 and 1.33 were recorded for the vegetations. Many of the trees are medicinal with the barks and roots used for the treatment of diseases such as malaria, diarrhea, High blood pressure, and skin diseases. Others are cultivated for food, and as ornaments.

No disease symptoms were found on the plants within the factory site except that most of the lower plants were dehydrated due to lack of rain. Some of the Rhizophora leaves along the coastline showed some leaf spots, yellowing of leaves and the presence of downy meadews. In conclusion, the industrial activity of UNICEM will in no doubt have impact on habitat vegetation of wildlife species; such species will be compelled to migrate or face mortality. And greater concern must be given to endangered and endemic species such as Pan troglodytes (Chimpanzee), Gorilla gorilla, and Pandrillus leucophaeus that can only be found in this rain forest zone of Cross River National Park.

Key words: *UNICEM, Environment, Wildlife, Cement, Industry.*

Introduction

The Southeastern Nigeria contributes to the economic development and environmental security of Nigeria and Cameroon. It is noted to contain some virgin forests in the country with its abundant resources (Diskson, 2006; Fasola, 2006). The effects of technological development and urbanization are gradually negatively affecting forests and forest resources available in the area. The developmental efforts of the government and entrepreneurs in opening up the rural areas for access to basic necessities of life and attempts to industrialize have resulted in the removal of vegetation and the degradation of the environment.

Consequently there is urgent need to address the depletion of the Nigerian biodiversity to avoid the impact on the survival of man especially the coming generations in order to enhance the sustainable utilization of the forest resources. Conservation as noted by the World Conservation Strategy (Cunningham, 2001) is not opposed to development and rational use of natural resources. The most serious risks from industrial production process (like in UNICEM) in Nigeria today come from water and air pollution. All the industries discharge their effluent, without prior treatment, into rivers, estuaries, lagoons, or the sea. Many of these effluents are toxic because they contain heavy metals such as mercury, aluminum and bromide among others. This is of course a great concern to the general environment (terrestrial and coastal) due to discharge of industrial waste in mostly untreated forms. The danger of these heavy metals into the environment stems from the facts that not only are they toxic, but some have cumulative or synergistic effects when combined.

The activities of cement producing industries such as in Ewekoro, Nkalagu, Gboko and others are particularly notorious, although they are few and their physical impact is restricted to a maximum radius of about three kilometers (Iqbl and Shafig, 2001). Within this space, however, natural vegetation and crops are damaged, wildlife species is destroyed or compelled to emigrate, streams are extensively polluted, the soil is overcharged with chemicals and both man and livestock are inconvenienced, by a dense and continuing coating of cement dust. This is astonishing, with dry process kiln method that cement manufacturing industries are employing in Nigeria. This leaves the particulate emission rate as high as 20.8kg/bbl of cement (Iqbl and Shafig, 2001).

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In the case of open cast mining noticed in some cements factories within the country, such as Okpella in Edo State, Nkalagu factory in Anambra and Ewekoro in Ogun State, their primary and secondary activities have generated industrial waste products which have degraded the environment. However in Calabar, the formerly government owned cement industry, revealed that transportation involving the use of motor vehicles and power plant equipment have emitted considerable pollutants into the air. But because of the relative singleness of the industry in the area as compared with other cities in the country, the intensity or the gravity of the problems was much less than in any of the major industrial-belt states.

Though we cannot stop environmental pollution and damage in the path to economic development, but this can be minimized through adequate environmental management and sustained conservation practices. Environmental Impact Assessment (EIA) is an answer to these activities, designed to identify, interpret and communicate information about the well being of ecosystems on which man's survival depends. The on-going activities of refurbishing old cement industry (formerly owned by the Cross River State), to become productive entity (UNICEM), require thorough EIA process. This is necessary at both pre-and post-operational states and the blue print of environmental impact statement is necessary to carry out a plan leading to responsible growth by reducing the conflicts between development (industrial growth) and environmental quality.

For these purposes, it is necessary to document base line information on biodiversity (flora and fauna) within and outside (quarry site) of the area. Mitigation measures towards environmental amelioration due to industrial activities are highlighted in this work. Such industrial development process should be monitored and its negative externalities and environmental impact assessed to avoid wrong attitude to industrial growth no matter the environmental cost.

Study area and methodology

The company (UNICEM) is situated in Calabar Municipal Local Government Area of Cross River State. Calabar generally falls within the Rain Forest zone (Fasola, 2006; Dickson, 2006) with its characteristic high density of trees and a highly stratified structure. Tropical rainforest is the most complex type of vegetation in the world. It has a characteristic general appearance that is easily recognizable though there may be different grades of complexity depending on communities, age and influence of man.

The site was formerly owned by the state cement factory, but abandoned for years without production activities. It is bounded by the Cross River toward the northern part, and various establishments have their activities dominated the beach area. Such as ADDES or Inland water way belong to Federal Ministry of water resources, with coordinate 04.97393^{0}N, 008.33235^{0}E, the Naval beach 04.96979^{0}N, 008.32178^{0}E, the Nigeria Port Authority (NPA) Jetty workshop 06.34529^{0}N, 005.312056^{0}E, the NNPC Jetty site 04.98436^{0}N, 008.32111^{0}E and lastly the Navy Headquarter 04.98528^{0}N, 008.31837^{0}E.

The quarry site is a large expanse acre of land, with characteristics mountain outcrop which is said to be ninety five percent (95%) dominated by limestone. The site is closer to Akampa town, with a number of communities that comprise the whole area. These include the Mburi village at coordinate 05.04493^{0}N, 008.298995^{0}E, Abifan community, which is also the main quarry workshop site 05.07591^{0}N, 008.52192^{0}E and lastly the Nfamosign community that is the main quarry work site 05.06993^{0}N, 008.53908^{0}E. Presently the worksite is full of pool of water that was artificially created by the former company activities. The vegetation at the site is predominantly oil palm plantation, which was reportedly planted by a German Engineer in the 1950's.

Table A: STUDY SITE DESCRIPTION BY COORDINATE (UNICEM. AREA)

DESCRIPTION	COORDINATE
NPA Jetty Workshop	06.34529^{0}N 005.312056^{0}E
Marine beach	04.96305^{0}N 008.31537^{0}E
Naval beach	04.96979^{0}N 008.32178^{0}E
ADDES/Inland water way Fed. Min. of Water Resources.	04.97393^{0}N 008.32235^{0}E
UNICEM Parking Plan	04.98042^{0}N 008.32408^{0}E
UNICEM Main effluent Discharge site to river cross	04.98102^{0}N 008.32396^{0}E
Upway (Northern part) from NNPC Jetty.	04.98436^{0}N 008.32111^{0}E
Navy H.Q. Water side	04.98528^{0}N 008.31837^{0}E
1.5km away from UNICEM	04.98544^{0}N 008.31470^{0}E
2km away from UNICEM	04.98466^{0}N 008.31021^{0}E

Table B: DESCRIPTION OF LIME STONE WORKSHOP COORDINATE (QUARRY SITES VIA AKAMPA)

DESCRIPTION	COORDINATE
B_1 – Mburi Village	05.044993^{0}N 008.29895^{0}E
B_2 – Abifan Community	05.07591^{0}N 008.52192^{0}E
Quarry Workshop	05.06874^{0}N 008.53730^{0}E
Quarry work site (out crop and pool of water) Mfamosign Community.	05.06993^{0}N 008.53908^{0}E

The method adopted for wildlife diversity study is called Analytical Habitat Associations (AHS), as described by MANLY *et al* (1993) and profoundly used by ADEOLA (1998), POWEL (1994), and HUNT (1997). This method is based on some work originally aimed at species habitat studies and is of course more general and often interesting to discover which part of the habitat is prefentially used by a species of animal. Once these relationships are known it may be possible to predict how particular habitat changes have affected such species. This type of study is variously known as:

1) Habitat utilization study.
2) Habitat association study.
3) Resource / human activities selection study.

The methods of vegetation survey and analysis of Morris and Therivel (1995) were used. A visual inspection was done to gain an overall impression of the habitats and communities present in the area under study. Along the vegetation, ten transects of 500m each were taken randomly covering the study area and the plant species on either side enumerated using floristic and structural attributes. Diversity Index was calculated using the Shannon's formula- $H^1 = \sum^{s}_{ith} Pi\ l_n\ Pi$, where **s** is the number of species, **Pi** is the proportion of individuals or the abundance of the **ith** and **ln** is the log base **n.** This index combines species richness with relative abundance. Observations were also made at random points along the coastline, south of the factory. The major growth forms were noted.

Understanding the habitat requirements (habitat utilization) of a species at the study sites of UNICEM and Quarry drilling site, is important for prediction of environmental impact and any mitigation measure that can be predicted for aspect of conservation of such endemic species. This method will provide a thorough model to quantify the relationships between species composition and their habitats. It is capable of detecting the appropriate gradients and patterns. Interpreting and explaining the patterns is capable of first predicting distributions of species in the area, predicting the consequences of future land use changes and thirdly, providing an understanding of the nature of the relationship between the species composition and their habitat.

It is necessary to adopt a range of these methods to achieve all the set aims and also bear in mind the main purpose of the study, the Environmental Impact Assessment (EIA) and provide base line list of species composition. Materials used for this study are Global Positioning System (GPS) Sport Track programme MAGELLAN version; Binocular 185 x 40mm range; Minolta 135 metre zoom lens camera; Recording sheets; Questionnaire for socio-economic information and one experienced local (indigene) hunter. The fieldwork was done during dry season (March).

RESULTS

From the results obtained, (Tables I -1II) it was found that the area harbour an impressive array of mammalian species in spite of its highly perturbed nature. The order chiroptera, rodentia, canivora, and avifauna formed the bulk of the animals. Examination of the habitat, where this animals occurred shown that the relic forests (riparian vegetation) around Cross River and all its tributaries harbored more species just like quarry sites that are dominated by bush fallows and grassland (cultivated areas) while the factory site is dominated by the avi-fauna.

The forests within these segments of southeastern state (Cross River) are losing their original primary ecotone due to various human developmental activities. Though a comprehensive inventory of species or absolute density survey of species were not determined, the fast rate at which species are losing their natural territories call for a great concern. Information from local hunters through questionnaire obtained showed a sharp drop in the number of game animals they were able to kill recently as compared to the past. From the checklist of species composition and conservation status at the study sites (Tables 1-3), riparian forest along beaches and the quarry site composed of diversity of species ranges from reptile, canivora, pholidota and cheroptera. But the main UNICEM factory site is a relic of abandoned building, which have suffered long years of unkept condition, except for the presence of species of rodentia such as giant rat *Cricetomys gambianus*, and reptilian such as *Agama agama*, *Dendrospis viridis* and Cheroptera – *Tadarida pumila*; The former industrial activities which have generated pollution such as noise and dust had kept or drives away important species representative from the site. Although the presence of specific habitat within such ecosystem does not imply their species availability [BIGNAL, 1988], a variety of intra and inter-specific processes have made the habitat unavailable to specific animal species.

The human activities such as farming have encroached into the vegetation reducing most part of the factory site to a regrowth forest. This is more of a semi natural community, which due to a past influence of man has unconsciously encouraged the growth of particular species at the expense of others as it does to crops. A total of eighty two species among which are some economic species were recorded during the assessment and these are indicated in the table III. Diversity Indices of between 0.03 and 1.33 were recorded for the vegetations. Different Diversity Indices have been reported for tropical rainforest vegetation (Hall and Okali, 1979).

Many of the trees are medicinal with the barks and roots used for the treatment of diseases such as malaria, diarrhea, High blood pressure, skin diseases etc. Others are cultivated for food, and as ornaments. The grasses are fodder to animals. *Terminalia* and *Khaya* are good timber species

The vegetation from Mburi village to the Quarry at Mfamosign is a secondary forest with the upper canopy reaching about 38meters. Herbs are restricted in distribution while trees form discontinuous canopies. Epiphytes are quite common. However the small oil palm plantation at Mfamosign created a shade for the survival of bryophytes and ferns. Grasses dominated the fringe of this forest. This is a consequence of the bush burning activity prior to the planting season. This vegetation is the most diverse of all the vegetations studied with a Diversity Index of 1.33. The least index of 0.03 was obtained for the north of the factory. The vegetation composition of the factory site (south, west, north, east) and the quarry site at Mburi, Abifam, and Mfamosign towards Mkampa are listed in table III.

Table 1. CHECKLIST OF WILD ANIMAL SPECIES COMPOSITION AND CONSERVATION STATUS AT THE SITES

Order/Species	*Common Name*	*Along Beaches*	*Factory Site*	*Quarry Site*	*Conservation Status*
INSECTIVORA	Otter shrew				
Potamogale velox		✓	-	-	T
CHEROPTERA					
Micropteropus pusillus	Lesserepanlet – bat	-	-	✓	T
Hypsignathus monstosus	Hammer headed bat	✓	-	-	T
Tadarida condylura	Angola free tailed bat	-	-	✓	T
T. Pumila	Little free tailed bat	✓	✓	✓	T
Nycteris arge	Slit – faced bat	✓	-	✓	T
PHOLIDOTA					
Manis tricuspis	Tree Pangolin	✓	-	✓	E
RODENTIA					
Xerus erythropus	Ground squirrel	✓	-	✓	T
Anomalurus beecrofti	Flying squirrel	✓	-	✓	T
Cricotomys gambianus	Giant rat	✓	✓	✓	LR
Thryonomys swinderianus	Cane rat	✓	-	✓	LR
Atherurus africanas	Brush – tail porcupine	✓	-	✓	T
CANIVORA					
Viverra ciretta	African civet	✓	-	✓	
Nandimia obscurus	Cusimanse mongoose	✓	-	-	E
Anonyx capensis	Cape clawless otter	✓	-	-	T
ARTIODACTYLA					
Tragelerphus scriptus	Bushbuck	✓	-	✓	T
Phacochoerus aethiopicus	Warthog	✓	-	✓	T
PRIMATE					
Galago alleni	Bush baby	✓	-	✓	E
Cercopithecus mona	Mona monkey	✓	-	-	T
REPTILE					
Dendrospis viridis	Green mamba	✓	✓	✓	T
Naja melanoleuca	Black cobia	✓	-	✓	E
Agama agama	Red headed lizard	-	✓	✓	LR
Varanus hiloticus	Monitor lizard	✓	✓	✓	LR
Bioga blandingii	Tree snake	✓	-	✓	E

Source: Field Survey, 2004

KEY: T = Threatened
E = Endangered
LR = Lower Risk
} IUCN (1996) categories

Table II. CHECKLIST OF BIRDS AT THE STUDY SITES

Order/Species	*Common Name*	*Beaches*	*Factory Site*	*Quarry Site*	*Conservation Status*
ACCIPTERIDAE					
Milvos nigrans	Black kite	✓	✓	✓	LR
Neophron	Hooded vulture	✓	-	✓	LR
monachus	Palmnut	✓	-	✓	E
Cypohielax angolensis	vulture				
PSITTACIDAE					
Psittacus erithacus	Grey parrot				E
ARDEIDAE					
Egretta	Little Egret	✓	✓	✓	LR
garzetta	Great while	✓	-	-	E
Egretta alba	egret	✓	-	-	LR
Scopus	Hammer kop	✓	-	-	E
umbretta	Grey heron	✓	-	-	E
Ardea cinerea	Reef heron				
Egretta gularis					
NECTARIDAE					
Anthepies	Mouse brown	✓	✓	✓	LR
gabonicus	sunbird	✓	-	✓	LR
Nectarinia caccinigester	Splendid sunbird				
COLUMBLDAE					
Streptopelia	Vinaceous dove	✓	✓	✓	LR
vinacea	Greenfruit	✓	-	✓	LR
Treron australis	pigeon	✓	-	✓	LR
Turtur tympanistria	Tambourine dove				
CAPITONIDAE					
Gymbobucco calvus	Naked – faced barbet	✓	-	✓	
FRINGILLIDAE					
Lonchura	Bronze manikin	-	-	✓	
cucullatus	Yellow fronted	✓	-	✓	
Serinus mozabicus	canary Grey –	✓	-	✓	
Nigrita cacicapilla	crowned negro Finch				
CICONIDAE					
Ciconia episcopus	White necked stock	✓	-	-	E
FALCONIDAE					
Mulvus migrans	AfricanBlackkite	✓	✓	✓	LR
Kaupifalco	Lizard buzzard	✓	-	✓	
monogramnicus	River eagle	✓	-	-	
Haliaetus	Red-necked	-	-	✓	
vocifera	kesterd	✓		✓	
Falco chiquera	Little sparrow				
Accipeter erigathropus					
ALCEDINIDAE					
Ceryle rudis	Pied kingfisher	✓	-	✓	T
Halcyon	Senegal	✓	✓	✓	LR
senegalensis	kingfisher	✓		✓	LR
Ccyx picta	Pypmy kingfisher				
PLOCEIDAE					
Ploceus	Village weaver	✓	✓	✓	LR
cucullatus	Crested	✓	-	✓	T
Malimbus malimbus	mallimbe				

Source: Field Survey, 2004

KEY: T = Threatened
E = Endangered
LR = Lower Risk
} IUCN (1996) categories

INDUSTRIAL CONSEQUENCES ON BIO – DIVERSITY

Although the level of industrialization in Nigeria is still at the hemp of improvement, its growth rate in the recent past has been significant. In spite of the current economic recession, industrial growth is not likely to diminish because of the growing awareness of the need to produce most essential commodities locally among which cement from UNICEM industry is paramount. Consequently, industrial expansion is likely to continue in spite of, or even because of the present economic depression [OZO, 1998].

One consequence of the trend is the growing intolerability of the urban environment. It is important that in finding solutions to this problem, better understanding of the perception of people and bio – diversity (environment) that are directly concerned is important. The view is widely held that a major concern and preoccupation in most developing countries is with economic growth and that people are indifferent to, and place low premium on environmental quality. This attitude arises from a perception that economic growth and environmental quality are mutually exclusive (Adeniyi, 1983). But economic growth from industrialization is a major perpetrator of environmental pollution [Barkley and Seckler, 1972]. And indeed, industrialization of this kind [UNICEM] to produce cement has been specifically singled out as a major contributor to environmental pollution.

This is more envisaged with dry process kiln method that this cement industry intends to use for manufacturing. This method leaves the particulate emission rate as high as 20.8kg/bbl of cement on the atmosphere (Iqbl and Shafig, 2001). Other environmental pollution problems that are associated with these activities are odour, noise, durst and fumes, aesthetic nuisance, smoke, vibration, effluent and glare. The cement producing activities is even more serious, because the natural vegetation at the quarry site of Akampa (communities such as Mburi, Abifan and Mbamosign) will face threat of damage, wildlife species listed in tables 1 and 2 will be destroyed or compelled to migrate, the stream, river calabar and soil will be polluted and overcharged with sewage (effluent) chemicals and lastly there will be continuing coating of cement durst on vegetation which will block or slow photosynthesis processes.

No disease symptoms were found on the plants within the factory site except that most of the lower plants were dehydrated due to lack of rain. However some of the *Rhizophora* leaves along the coast line particularly at about 1000metres from the NNPC jetty (CC7) (04.98544Nand008.31470E) showed some leaf spots, yellowing of leaves and the presence of downy meadews.

With the onset of cement production by the company, the chances of air and water pollution are high. Pollutants such as gaseous emissions, air borne particulates, a wide range of effluents containing toxins such as heavy metals and harmful organic compounds and oil will be produced and get deposited on the plants and also get discharged in the surrounding water in the river. This will no doubt affect the physiological activities of the plants most especially those around the factory site such as in photosynthesis and respiration. There will be loss of lower green plants. The implication of these is that some of the plants will have retarded growth while others will be eliminated. In the same vein the aquatic life may be threatened.

Conclusion and mitigating measures

Attention has been called to changes in Nigerian land use as an inevitable facet of man-environment relationships in the country (NEST, 1992). The changes occur as the country attempt to adjust endless wants and desires for food, shelter, recreation and other industrial product of this kind (CEMENT). While making good contribution to the overall industrial development, different land use activities have equally produced negative impact on the general environment. The impact is collectively referred to as environmental degradation and implying the abuse of the environment through improper resource management. Thus, the expansion of human want through establishment of this cement industry (UNICEM) and unfolding of horizon to exploit resources for economic and social purposes will generate environmental pollution, death of endemic wildlife species and of those that are rare or endangered or indeed put certain vulnerable species into extinction

Table III. FLORA SPECIES COMPOSITION AND ABUNDANCE IN CEMENT INDUSRTIAL AREA

s/N	Species	Fac. Site	South Site	West Site	North Site	East Site	Quarry site
1.	*Musanga cecropioides*	✓	-	✓	-	✓	✓
2.	*Gimelina arborea*	✓	-	-	✓	✓	✓
3.	*Ficus exasperata*	✓	-	-	-	✓	
4.	*Terminalia catappa*	✓	-	-	-	-	
5.	*Elaeia guineensis*	✓	✓	✓	-	✓	✓
6.	*Cassia siamea*	✓	-	-	-	✓	
7.	*Mangifera indica*	✓	-	-	✓	-	
8.	*Pinus caribea*	✓	-	-	✓	-	
9.	*Azadiracta indica*	✓	-	-	-	-	
10.	*Psidium guajava*	✓	-	-	✓	-	
11.	*Cola acuminata*	✓	-	-	-	-	
12.	*Ficus polita*	✓	-	-	-	-	
13.	*Newbouldia laevis*	✓	-	-	-	-	✓
14.	*Alstonia booneii*	-	-	✓	-	-	
15.	*Anthocleista vogelii*	-	-	-	-	-	✓
16	*Cola gigantean*	-	-	-	-	-	✓
17	*Nauclea diderrichii*	-	-	-	-	-	✓
18	*Symphonia globulifera*	-	-	-	-	-	✓
19	*Terminalia suoerba*	-	-	-	-	-	✓
20	*Khaya senegalensis*	-	-	-	-	-	✓
21	*Acasia seyal*	-	-	-	-	-	
22	*Leucaenia leucocephala*	-	-	-	-	✓	
23	*Rhizophora harrisanii*	-	-	-	-	-	
24	*Rhizophora mangle*	-	-	-	-	-	
25	*Tecoma stans*	-	-	-	✓	-	
26	*Cleistopholis patens*	-	-	-	-	-	✓
27	*Casuarina equisatiifolia*	✓	-	-	-	-	
28	*Cola nitida*	✓	-	✓	✓	-	
29	*Bambusa vulgaris*	✓	✓	✓	-	✓	
30	*Dacryyodes edulis*	✓	-	-	✓	-	
31	*Cocos micifera*	✓	-	-	✓	-	
32	*Spondias mombin*	✓	-	-	-	-	-
33	*Carica papaya*	✓	-	-	-	-	-
34	*Musa parasidiaca*	✓	-	✓	✓	-	✓
35.	*Musa sapientum*	✓	-	✓	✓	-	✓
36.	*Nypa fruticans*	-	✓	-	-	-	-
37.	*Vossia cuspidate*	-	-	✓	-	✓	-
38.	*Costus lucanusianus*	-	✓	✓	-	-	✓
39.	*Alternanthera sessilis*	✓	-	-	-	-	-
40.	*Euphorbia heterophylla*	✓	-	-	-	-	-
41.	*Euphorbia hirta*	✓	-	-	-	-	-
42.	*Euphorbia gossipifolia*	✓	-	-	-	-	-
43.	*Physalis angulata*	✓	-	-	-	-	-
44.	*Heliotropium indicum*	✓	-	-	-	-	-
45.	*Spigelia anthelmia*	✓	-	-	-	-	-
46.	*Cleome rutidosperma*	✓	-	-	-	-	-
47.	*Tridax procumbens*	✓	-	-	-	-	-
48.	*Commelia benghalensis*	✓	-	-	✓	-	-
49.	*Asystasia gangetica*	✓	-	-	-	-	-
50.	*Emilia praetermissa*	✓	-	-	-	-	-
51.	*Crotolaria retusa*	✓	-	-	-	✓	-
52.	*Phyllanthus amarus*	-	-	-	-	-	-
53.	*Sida acuta*	✓	-	-	-	-	-
54.	*Calopogonium mucunoides*	✓	-	-	-	✓	✓
55.	*Chromolaena odorata*	✓	-	-	-	✓	✓
56.	*Colocasia esculenta*	-	-	-	-	-	-
57.	*Manihot esculenta*	✓	-	✓	-	-	-
58.	*Solanum wrightii*	✓	-	-	-	-	-
59.	*Cassia alata*	-	-	-	-	✓	✓
60.	*Alchornea cordifolia*	-	-	✓	-	✓	✓
61.	*Acalypha godserffiana*	-	-	-	✓	-	-
62.	*Ixora cocinea*	-	-	-	✓	-	-
63.	*Hibiscus rosa-sinensis*	-	-	-	✓	-	-
64.	*Piliostigma reticulata*	-	-	-	✓	-	-
65.	*Glyphaea brevis*	✓	-	-	-	-	-
66.	*Panicum maximum*	✓	-	-	-	✓	✓
67.	*Dactyloctenium aegyptium*	✓	-	-	-	-	-
68.	*Sporobolus pyramidalis*	✓	-	-	-	-	-
69.	*Eleusine indica*	✓	-	-	-	-	-
70.	*Cyperus dilatalus*	✓	-	-	-	-	-
71.	*Mariscus alternifolius*	✓	-	-	-	-	-
72.	*Luffa aegyptiaca*	-	-	-	✓	-	-
73.	*Lagenaria breviflora*	-	-	-	✓	-	-
74.	*Ipomoea pers-caprae*	-	✓	-	-	✓	-
75.	*Nymphaea lotus*	-	-	-	-	-	✓
76.	*Cyclosorus striatus*	✓	-	-	-	-	✓
77.	*Cyclosorus afer*	✓	-	-	-	-	✓
78.	*Platycerium angolense*	✓	-	-	-	-	✓
79.	*Stereophyllum radiculosum*	✓	-	-	-	-	✓
80.	*Calymperes erosum*	✓	-	-	-	-	✓
81.	*Fissidens platybriodes*	✓	-	-	-	-	✓
82.	*Racopilum africana*	✓	-	-	-	-	✓

Source: Field Survey, 2004.

The operation of quarrying at Akampa area for limestone dredging on massive scale involves not only tapping of the resources, but also the transformation of the natural environment. According to Hacher (1963), the only responsibility of a corporate industry is to make profits, thus contributing to a prosperous economic system. There is only one social responsibility of industrial business and that is to use all resources available and stay at profit margin. This view point ignores or repudiates its responsibility for the social or natural consequences of any aggressive industrial activities in general.

In the case of UNICEM, the high precipitation condition due to the heavy rainfall belt of the area may reduce the direct effect on man and vegetation by the washing down of the phyloplane. Efforts should be made to control the discharge of the cement particles in the atmosphere and into the river. It might be necessary to create a green belt zone where dust tolerating plants and which add to the natural and aesthetic value of the environment are cultivated. It is hereby suggested that the few trees of *Pinus caribea, Cassia siamea, Mangifera indica, Elaeis guineensis, Cocos nucifera, Azadirachta indica, Musanga cecropioides* and *Terminalia catappa* at the factory site are not allowed to give way to further construction. More of these could also be planted in and around the factory.

At the Quarry, the above-mentioned communities should be educated on the danger to health of exposure to particles emanating from limestone excavation in the area. This will enable them keep the necessary distance from the site for farming activities. Those that are quite close may be resettled. More importantly, the company needs to be conscious of the environmental purifying effect of the vegetation and thus ensure minimal removal of plant cover. However, contrary to this legalistic argument is the viewpoint in favour of social responsibility, that this industry (UNICEM) must exhibit a clear and lively sense of obligation to the public and the natural environment (bio-diversity), more so to the social cost of their economic activity.

The industry must have a control laboratory to perform up to date test on the sewage, waste and effluent passed into the environment, either into the air, river or soil. And prompt action must be taken to correct hazard lethal effect. The environmental tax that are paid to the government (either state or federal), should be accommodated in a special environmental fund to be disbursed exclusively for tackling environmental problems within the active industrial area.

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