

ENVIRONMENT AND OPERATION AUDIT RATING OF QUARRIES IN EVBONOGBON TOWN, EDO STATE, NIGERIA

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ABSTRACT

Quarry Audit Rating (QAR) is a mathematical model developed for the purpose of investigating and assessing the level of environmental and operation compliance of quarries. It has become imperative to have ready tool that will be at the disposal of internal health, safety and environmental officers in extractive industry, and also available to regulatory and supervisory bodies like the Ministry of Mines and Steel Development and Ministry of Environment at the State and Federal levels, to enable on the spot assessment of the level of compliance with extant environmental regulations. Environmental Audit rating mechanism is important to meet the current global advocacy for sustainability in the extractive industry. In this paper the quantitative investigation of, health, safety and environmental checklists that are described as best internationally acceptable practices in the extractive industry was performed, this was administered as questionnaire to six (6) person per quarry, drawn from categories of quarry employee from quarry A, B and C . The response from the administered research tool is subjected to the QAR model to determine the environmental and operation compliance level for

each of the quarries in Evbonogbon town, The result is presented as a ratio of the computed value to a perfect quarry value; the result is described as the quarries QAR., The QAR rating for quarry A, B and C are described as, Excellent (85.778%), Excellent (86.661%) and Very Strong (71.056%) respectively, as QAR increases sustainability is improved in the quarry site.

Key Words: Quarry, Pollution, Environmental Audit, Compliance and Sustainability.

INTRODUCTION

As man interact with its environment on daily basis, by the process of extraction of important agricultural materials and mineral products needed to satisfy the ever increasing yearnings for the basic necessity of life, food, clothing and shelter; the environment is constantly been modified in ways that may adversely affect the life sustaining potential, of the impacted environment. In order to minimize these challenges and improve environmental sustainability, Environmental Management System (EMS) was developed as a tool for environmental management, administration and control.

This buttresses the new philosophy in the extractive industry, which is sustainability, which means the process of meeting economic and environmental needs of the present and also enhancing the ability of generations yet unborn to do same. In the words of Wangari Maathai, the 2004, Nobel Peace Prize winner, “You cannot protect the environment unless you empower people, inform them and help them understand that these resources are theirs and that they must protect them” [1].

STATEMENT OF THE PROBLEM

The Koko port incidence in 1988, in present Warri North Local Government Area of Delta State, was the watershed that triggered an awakening in the area of environmental laws, regulations and enforcement in Nigeria, [2]. The major fallout of that event was the creation of

several laws, act, regulation and policies, monitored by designated agencies, charged with the mandate of ensuring safe and healthy working conditions, reduction and elimination of environmental pollution and the granting of working permit and licences based on internationally best practices, [3]. Environmental Audit (EA) has been described as a continuum of EIA, the design of standards environmental audit policy in quarries and other extractive industry have become imperative considering its negative footprint.

AIM AND OBJECTIVE OF THE STUDY

The aim of this work is to apply a model as a template that will guide environmental audit practices in quarry industry. The specific objective is to: evaluate the level of compliance to the extant environmental regulations and policies via audit checklist.

LOCATION OF STUDY AREA

The quarry sites were selected from Edo South senatorial district in Evbonogbon town formerly called Ohosu along Benin-Ore express road, this community is located in Ovia South West Local government Area of Edo State, the town host three large quarries, namely Reynold Construction Company (RCC) or quarry A on coordinate (06° 44' 22"N, 05° 09' 19"E), Georgoi Rock or quarry B on coordinate (06° 45' 15"N, 05° 09' 45"E) and, Harvey Quarry Limited or quarry C on coordinate (06° 45' 15"N, 05° 10' 30"E)

QUARRY

Quarry refers to any open excavation from which any useful stone is extracted for building and engineering. The two main branches of the quarry industry are the dimension-stone

and crushed-stone quarrying. In dimension-stone quarry, blocks of stone, such as marble, are extracted in different shapes and sizes for different industrial purpose and domestic usage. While in crushed-stone industry, granite, limestone, sandstone, or basaltic rock are crushed for use majorly as concrete aggregate and road stone, a third class of quarry is the sand quarry.

METHODS OF ENFORCEMENT

The Agency charged with the enforcement of environmental law and regulation normally adopts pre-emptive measures to secure compliance within the regulatory system. Failure to comply voluntarily with relevant legislative requirements and licensing provisions will compel the agency to use its enforcement powers; some of the methods of enforcements which the agency has adopted are:

issuance of permits and licences;

issuance of prohibition and enforcement notices;

variation of licence conditions;

implementing the polluter-pays-principle; and

suspension and/or revocation of permits and licences;

ENVIRONMENTAL PROTECTION IN THE EXTRACTIVE INDUSTRY

According to [4] all processes associated with the extractive industry have negative impact on the environment. The continued development and exploitation of the earth's natural and mineral resources, has revealed a need to plan, protect, and facilitate prudence during exploration and exploitation of the environmental resources for a better environment for man [5]. Reference [6] posited that the demand for the product of the extractive industry will continue to

be on the rise considering the present demand trend and current world population estimated at over 7.8 billion and has been projected to 9 billion in 2040, by the United State Census Bureau [7], so the demand for the various quarry product will continue to be on the rise, leading to further environmental degradation if extraction processes of mining and quarrying are not undertaking in an eco-friendly or sustainable way.

MINING AND QUARRY OF SOLID MINERALS RESOURCES

The growing profile of natural resources extraction within the economy dictates that, attention be focused on its intrinsic tendency to cause environmental degradation during blasting and other operations [8]; mineral exploration and production operations should, therefore, be done in an environmentally sustainable manner. In order to achieve this objective, the permit to initiate mineral exploration and production must of necessity be preceded by an environmental impact assessment (EIA) that is finally rounded off with Environmental Audit (EA). The final approval should be tied to the consent of operator to permit regular collection of samples and conduct of Environmental audit, given one or two week notice to operator of any site. Accordingly, sustainable exploration and exploitation strategy needs to be implemented nationally.

ORIGIN OF ENVIRONMENTAL AUDIT

Mining and quarry activity is known to be a nonpoint source of pollution that contributes to air, water and land pollution, it pollutes water by adding dissolved solid, suspended solid and toxic heavy metals to hydrologic cycle this is one of the reasons for the creation of environmental audit. Reference [9] asserted that Environmental audit is still at a relatively early stage even in western countries, leading to the creation of internal environmental audit

department; the internal environmental auditors' responsibility involves checking the organizations operation to ensure compliance to extant environmental rule and legislations. Environmental audit is a proactive measure to safeguard the environment by facilitating management control of environmental practices and also assessing compliance with company policies, which would include meeting regulatory requirements.

METHODOLOGY

This study relied majorly on primary documents created during the course of the research, by careful observation of the quarry environment and adjoining community, oral interview and administered questionnaire, quantitative methods was adopted for this study. The adoption of this method will allow the research to be comprehensive.

ISSUANCE OF SCALED QUALITATIVE QUESTIONNAIRE

A strategic sampling technique was adopted in the issuance of questionnaire, to identify persons that are connected to the quarry directly for a period of not less than three years, these individuals were interviewed and questionnaire were administered separately, about eighteen (18) persons were involved.

Structure of Questionnaire to be used for the Environmental Audit

The instrument that was used for this study was made up of about seventy five (75) questions per questionnaire, that were subdivided into eight (8) sub-groups with heading described in Table I. The questionnaire is scaled on a four (4) point rating and basic features of the questionnaire are revealed in Table II. The Standard Quarry Operation (SQO) is expected to

be $75 \times 4 = 300$ points per questionnaire, while Audited Quarry Operation (AQO) is expected to be equal or in reality lesser than the Standard Quarry Operation (SQO).

Table I

S/N	Sub topic of Questionnaire (Parameters)	Number of Question	Expected Maximum Point
1	Quarry Management System (QMS)	18	72
2	Quarry Explosive Storage (QES)	9	36
3	Quarry Blasting Practices (QBP)	15	60
4	Quarry Isolation and Tagging (QIT)	5	20
5	Quarry Tipping on Stockpiles (QTS)	4	16
6	Quarry Emergency Plans (QEP)	8	32
7	Quarry Occupational Health (QOH)	6	24
8	Quarry Workshop Facilities (QWF)	10	40
	TOTAL	75 questions	300 points

Features of the research Questionnaire

Table II.

S/N		Strongly Agree (SA)	Agree (A)	Disagree (D)	Strongly Disagree (SD)
	Quarry Management System (QMS)	4	3	2	1
1					
2					
3					

Structure of scaled questionnaire for environmental audit.

Quarry Audit Rating (QAR)

Quarry Audit Rating (QAR) is a function of the eight (8) parameters described in Table I. Of the eight (8), the Quarry Management System (QMS) have the strongest influence on the other seven parameters.

$$QAR = \sum_{i=1}^8 (QMS + QES + QBP + QIT + QTS + QEP + QOH + QWS) / \sum SQO \quad (1)$$

MODEL DEVELOPMENT

A model was developed, with the objective to aid in predicting the level of environmental compliance in the operation of quarry, and to facilitate the principle of sustainable development. The model was developed from, data acquisition from questionnaire analyses. This was done as shown in (2).

$$QAR = \frac{\Sigma(AQO)}{\Sigma(SQO)} \leq 1 \quad (2)$$

Where, QAR is the quarry audit rating; SQO is standard quarry operation and AQO is audited quarry operation. Hence, AQO will always be lesser than SQO, resulting in the validation of the expression below;

$$AQO \leq SQO$$

As QAR tends towards unity in (2) the environmental standard in the quarry is approaching perfect condition, zero pollution and zero accident and good health and safety condition and practices.

CHARTS FOR AUDIT RATING

The computed Quarry Audit Rating (QAR) was described based on the graded percentage chart described in Table III. It is suggested that incentive such as tax reduction should be given to any quarry that its QAR falls within the boundary of Perfect compliance; this measure can improve environmental compliance sustainability in the extractive industry.

Table III

S/N	Percentage Compliance (%)	Description
1	90 – 100	Perfect Compliance
2	80 – 89	Excellent Compliance
3	70 – 79	Very Strong Compliance

4	60 – 69	Strong Compliance
5	50 – 59	Partial Compliance
6	40 – 49	Weak Compliance
7	20 – 39	Very Weak Compliance
8	0 – 19	No or Zero Compliance

Graded Audit Chart

RESULT

The QAR for quarry A, based on the computation from the six (6) questionnaires, using the model, in equation (2), the total QAR equals, 0.858 or 85.778%, and this lies within the boundaries of excellent compliance as indicate in Table 3 and Table 4. Quarry Explosives Storage (QES) have a compliance level of 99.074%, while the lowest compliance was obtained from the Quarry Management Systems (QMS) with a compliance of 75.231%.

Table IV

	Description of Checklist	Audited Quantity	Perfect Quantity	Compliance Percentage (%)	Description of Rating
1	Quarry Management Systems (QMS)	325	432	75.231	Very Strong
2	Quarry Explosives Storage (QES)	214	216	99.074	Perfect Compliance
3	Quarry Blasting Practices (QBP)	285	360	79.167	Very Strong
4	Quarry Isolation and Tagging (QIT)	111	120	92.500	Very Strong
5	Quarries Tipping on Stockpile (QTS)	93	96	96.875	Very Strong
6	Quarry Emergency Plans (QEP)	159	192	82.813	Excellent Compliance
7	Quarries Occupational Health (QOH)	126	144	87.500	Excellent Compliance
8	Quarry Workshops (QWS)	231	240	96.250	Very Strong

TOTAL	1544	1800	85.778	Excellent Compliance
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Summary for Site A

For quarry B, the computation from the six (6) questionnaires, using the mathematical model, equation (2), we have the QAR as 0.866 or 86.611%, and this lies within the boundaries of excellent compliance as recommended in Table 3 and Table 5. The Quarry Explosives Storage (QES) obtained was perfect with a value of 100% while the lowest obtained was 70.833 from the Quarry Emergency Plans (QEP).

Table V

	Description of Checklist	Audited Quantity	Perfect Quantity	Compliance Percentage (%)
1	Quarry Management Systems (QMS)	366	432	84.722
2	Quarry Explosives Storage (QES)	216	216	100.000
3	Quarry Blasting Practices (QBP)	299	360	83.056
4	Quarry Isolation and Tagging (QIT)	103	120	85.833
5	Quarries Tipping on Stockpile (QTS)	95	96	98.958
6	Quarry Emergency Plans (QEP)	136	192	70.833
7	Quarries Occupational Health (QOH)	113	144	78.472
8	Quarry Workshops (QWS)	231	240	96.250
	TOTAL	1,559	1800	86.611

Summary for Site B

The QAR for quarry C, based on the computation from the six (6) questionnaires, using the mathematical model, equation (2), we have the QAR as 0.711 or 71.056%, and this lies within the boundaries of very strong compliance as described in Table 3 and 5. The highest

compliance was obtained from the Quarry Management Systems (QMS) while the lowest of 49.479 was obtained from the Quarry Emergency Plans (QEP).

Table VI

	Description of Checklist	Audited Quantity	Perfect Quantity	Compliance Percentage (%)	Description of Rating
1	Quarry Management Systems (QMS)	256	432	59.259	Partial Compliance
2	Quarry Explosives Storage (QES)	210	216	97.222	Perfect Compliance
3	Quarry Blasting Practices (QBP)	272	360	75.556	Very Strong Compliance
4	Quarry Isolation and Tagging (QIT)	96	120	80.000	Excellent Compliance
5	Quarries Tipping on Stockpile (QTS)	71	96	73.958	Very Strong Compliance
6	Quarry Emergency Plans (QEP)	95	192	49.479	Weak Compliance
7	Quarries Occupational Health (QOH)	75	144	52.083	Partial Compliance
8	Quarry Workshops (QWS)	204	240	85.000	Excellent Compliance
	TOTAL	1,279	1800	71.056	

Summary for Site C

The mean QAR for the three quarries studied, based on the computation from the eighteen (18) questionnaires, using the mathematical model described in equation (2), we have the QAR as 0.811 or 81.148%, which lies within the boundaries of very strong compliance as indicated in Table 5. The strongest level of compliance from the computation is the Quarry Explosives Storage (QES) having a rating of 96.296% while the lowest compliance was observed

in the Quarry Emergency Plans (QEP) having a compliance of 57.083%, described as Partial compliance.

Table VII

	Name of Quarry	Audit Summation	Perfect Quarry Summation	QAR in Fraction	QAR in Percentage	Description of Rating
1	QAR for A	1544	1800	0.85777	85.778%	Excellent
2	QAR for B	1559	1800	0.86611	86.611%	Excellent
3	QAR for C	1279	1800	0.71055	71.056%	Very Strong
	MEAN			0.81148	81.148%	Excellent

Summary for the three quarries investigated

CONCLUSION AND RECOMMENDATION

CONCLUSION

From the plethora of existing researches and this research it has been established that quarry activities like all other form of extractive industries operations, most times leaves a negative footprint on the environment, and a way of controlling and mitigating this fallout, is by enactment and establishment of policy, and regular assessment of this policy, as part of a holistic Environmental Management System (EMS), for each operation that impact on the environment based on the initial EIA report, Environmental audit must be undertaken and regarded as a continuum of the EIA on already established schedule recommended by the Federal Ministry of Environment and Nigerian Mineral and Mining Act of 2011.

This research established the fact that the three quarries studied in Evbonogbon town in Edo State have an average Quarry Audit Rating (QAR) of 81.148%, which is described as an excellent compliance to extant operational standards and policy. From the eight operational task

assessed the highest compliance was observed in the Quarry Explosives Storage (QES) having a rating of 96.2962% while the lowest compliance is observed in the Quarry Emergency Plans (QEP) described as partial compliance. On individual basis quarry B has the highest level of compliance, while quarry C has the lowest level of compliance. From Table 4, Table 5 and Table 6 as the Quarry Management System (QMS) increases the QAR which is an indication of perfect environmental, safety and occupational health in the quarries sites being studied also increases.

RECOMMENDATION

Sequel to the observations and findings obtained in the course of this research the following recommendations are proposed;

- (a) the issuance of Environmental Audit (EA) certificate should be presented to any quarry that has undergone an EA;
- (b) at the point of renewal of quarry lease, previous EA certificate should be presented as a prerequisite for issuance of renewal;
- (c) it is suggested that any quarry, whose Quarry Audit Rating (QAR) is below the boundary for strong compliance should be sanction, by giving a fourteen (14) days notice to the quarry, of another environmental audit process, and if after the second audit process no appreciable improvement, at the expiration of the current quarry licence, a renewal will have to go through the process of a fresh application.
- (d) It is recommended that the cost for an Environmental Audit should be borne by the operator and regulatory agencies in a ratio of 30% to 70% respectively, but a second audit process due to sanction of first low compliance will be totally borne by the operator.

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