Original Research Article

Evaluation of environmental and social impacts of extraction quarry of rawmaterials : case of the ETOA clayquarry, Yaounde 3

Abstract

This research work is based on the evaluation of environmental and social impacts on the extraction quarry of raw materials at the Etoa clay quarry in Yaounde III and to propose measures envisage at reducing the different negative impacts.

This work was carried out during the period of June 2015 to February 2016 using the following methodology which consisted of a documentary research, visit to the clay quarry, using the matrix of Leopold and Martin fecteau for the identification and evaluation of impacts, cartography of study zone using ERDAS and QGIS, analyses and interpretation of collected data.

The results show that, extraction of clay from this area has negative impacts of 76.2 % with the most significant on the environment being soil degradation, loss of biodiversity and farmland. Globally, most of the negative impacts are irreversible. The positive impacts are of 23.8 % and the most important are, construction of acces road to the clay quarry, protection of the entire clay quarry, creation of job opportunities and increase in economic activities. As a measure to mitigate the negative impacts, shrubs will be planted round the site and exploitation will follow an exploitation plan to create acces in to the quarry. At the end of the extraction of clay this area will be transformed in to fish farming and those whose crops will be touched will be compensated.

The different mitigation measures proposed are to reduce or if possible repair all the negative impacts (all the residual negative impacts will all have a minor importance) and this will lead to the acceptance of this project in the area on an environmental point of view and will contribute to the promotion of the sustainable development of Etoa and its environs.

Key words : Evaluation, environnemental impact, social, clayquarry, Etoa.

Introduction

As the world's population grew, the need for more resources also increased. In order to meet the increasing demand for these resources, more industrial activities also grew around the world both in developed and developing countries. These increased industrial activities over the years did not consider the resulting environmental degradation such as water, air and land pollution. The degradation was not considered along with the intended industrial growth, thus, the value proposition of much economic activity ignored these "costs".

Typically, the enterprises that produced these negative effects on the environment were not held accountable for them. They externalized these costs and the society suffered the impacts. Many ecosystems have been adversely affected to the point where they can no longer withstand or recover from natural disasters resulting from human activities and such disasters include global warming, flooding and extreme weather conditions, land degradations etc. These negative consequences on our environment have drawn a lot of attention on a global scale. (Nkechinyere, 2010).

Quarrying activities are crucial components of socioeconomic development, as they provide the key material required for building and infrastructure, as well as decent incomes through numerous job opportunities. However, although these activities constitute an important pillar of economic sustainability, quarrying is a short-term action with long term impacts affecting soil, water, and other natural resources, not to mention the negative effects on human health. (Carla K *et al*., 2014).

The Local Materials Promotion Authority (MIPROMALO) was created by decree n° 90/1353 of September 1990 and is a public establishment with juridical or legal and financial autonomy under the technical supervisory of the Ministry of Scientific Research and Innovation. MIPROMALOisincharge of the present extraction of claymaterial at the Etoaclayquarry in Yaounde III sub-division and extraction of clay in this area has been going on since the discovery of claymaterial in this area. (Ngon N., 2007).

In Cameroon, and especially in Yaounde, studiescarried out so far by researchers in the domain of geology has led to the increase in awareness in the miningindustry. The rawmaterialsuch as clayisextracted in clayquarries and used as local materials in the construction of houses, ceramics, pottery, etc. This has broughtconcern to the MINEPDED, MINRESI, MINEE and Yaoundeurbancouncil as of how eachquarry must berestored and rehabilitatedduring and after exploitation. The presence of abandonedquarrieswith an increase in size of claypits leads to a change in the aesthetics of the area, environmentaldegradation and otherenvironmental impacts on man as well.

The city of Yaoundecannotreallyboast of a well-defined land use by 2035 if all the exploitation quarries are abandoned and no rehabilitation and restorationworks are done. This may lead to severalnegatives impacts on the environment.

This studyis to contribute to the restoration and rehabilitation of the quarry for better management of rawmaterials in the capital city of Yaounde, and itisbased on the evaluation of environmental and social impacts on extraction quarries of rawmaterials in the Etoaclayquarry of Yaounde III sub-division. This extraction of rawmaterialsiscarried out by the enterprise MIPROMALO. The extraction of rawmaterial can beassociated to positive and negative impacts of man and the environment.

The general objective of this study is to bring out the environmental and social impacts resulting from the exploitation of clay material in the Etoa clay quarry of the Yaounde III sub division.

This general objective will be realized through the following specific objectives:

- to identify impacts of the project on the environment;
- to characterise and evaluate impacts of the project and land use on the environment;
- to elaborate an environmental management plan.

Material and methodology

Identification of project impact

The mapswerecollected and the study area delineatedbased on limits. Visual interpretationled to false colour composition and assigning the zone of interest leads to training site identification. Maximum likelihood classification wasdonewhichgivessupervised classification and post classification process. Separability test wasalsodone in conformity to the GPS readingcollectedfromfieldwork and groundverificationwasdone. Maps of required zones wereobtainedfrom 1989 and 2015 whichgives the great change for over 26 years in this area.

Identification of impacts wasdoneusingLeopold'sgridbased on the potential interaction (positive and negative) thatcouldexistbetween the activities of the project and environmental components. Impact receptors, valorisedelements of the environmentthatcouldbeaffected by the construction work.

Thesevalorisedelements are groupedintothree components:

- physical milieu;
- biological milieu;
- human milieu (economicactivities, employment, health and security).

The sources of impacts are the differentactivities of the projectthat can affect valorisedelements. The descriptions of impacts consist in presenting for eachidentified impact the cause, manifestation and eventually the effect. Identification of impacts wasalsodoneduring the excavation of claymaterial in this zone.

Characterization and evaluation of impacts

Characterisation of impacts involves the description of impacts usingwelldefinedcriteria to evaluatethem in a way to determinetheir magnitude and order of priority in whichthese impacts couldbeavoided, mitigated or compensated. To this, the criteriaused for characterisation of impacts are:

- the nature of impact whichcouldbe positive or negative;
- interaction of impacts whichcouldbe direct (D) or indirect (ID);
- the extension of impact, linked to spatial dimension such as the surface area affected. The threelevels to measurethisindicator are: a)regional extension (R), characterise an impact that can touch 100 % of the zone of project site or above; b) local extension; describe an impact thatislimited on the site and c) punctual extension; characterise impact localized on a precise point;

- the intensity of impact is relative to the degree of disturbance in the milieu, sensibility, vulnerability and scarcity of the affected components, itcouldbelow, average, or high;
- the occurrence of impact determines the probability in which an impact can beproduce, itcouldbe certain or probable;
- the reversibility of an impact indicateswhether an impact isreversible (RE) or irreversible(Irr).

The gravity of an impact whichisdetermined by the superposition of theseindicatorsbelowpermits the evaluation of each impact of the project. Thesethreelevels are used to describe an impact; major (M), average (Av) and minor (Mi); major impacts are thosethatcannotbeneglected. There is an obligation to provide mitigation and /or compensatorymeasures, average impacts are noticedthus mitigation measures are provided, and minor impacts are not very important but thereisneed for compensation. Impacts are classedintosignificant (Sig) and insignificant (insig). This classification is a result of a strict way of identification and evaluation. Thus, significant impacts are thosethat have major effect on the environment and for which mitigation measures are to beprovided. The following table illustratesparameters for impact characterization.

Table 1. Parameters for impact characterization.

Criteria for characterization	Value of characterization
Nature	Positive
	Negative
Duration	Short term
	Medium term
	Long term
Intensity	High
	Average
	Low
Reversibility	Reversible
	Irreversible
Interaction	Direct
	Indirect
Extension	Regional
	Local
	Punctual
Gravity	Major
	Average
	Minor
Occurrence	Certain
	Probable

The evaluation of each impact wasdone by crossingthree of the abovecriteria (intensity, extension and duration) using the evaluationgridadopted by Martin Fecteau because of itssimplicity (Table 2). The aim of thisevaluationis to giveabsolute importance to an impact, thus impact evaluationpermits the attribution of a relative value to an impact whichcouldbe major, average or minor whichoccurduring the exploitation and construction phases.

Table 2. Evaluation matrix of impacts (Martin Fecteau, 1997).

Intensity	Extent	Duration	Significance of impact		
			Major	Average	Minor
High	Regional	Permanent	+		
		Temporary		+	
	Local	Permanent	+		
		Temporary		+	

Intensity	Extent	Duration	Significance of impact		
			Major	Average	Minor
	Punctual	Permanent		+	
		Temporary			+
Average	Regional	Permanent	+		
		Temporary		+	
	Local	Permanent		+	
		Temporary			+
	Punctual	Permanent		+	
		Temporary			+
Low	Regional	Permanent		+	
		Temporary			+
	Local	Permanent		+	
		Temporary			+
	Punctual	Permanent			+
		Temporary			+

The proposed environmental measures regroup actions, corrective dispositive, alternative management modes and alternative measures to correct, mitigate, compensate, eliminate every negative impact or enhance positive impacts. Efficiency, cost, adaptation to the Cameroonian context and feasibility are among the development of these criteria measures.

Indicators and monitoring of auditors/supervisory**.** The indicators and verifiers have been defined. An indicator is a quantitative variable for measuring the disturbance caused by an activity in a location and during a given period. An auditor is a source that provides the information necessary for obtaining objectively verifiable indicators.

Environmental and Social Management Plan

This is a set of specifications that lists all environmental measures and practices that the company responsible for carrying out the work must observe scrupulously. These measures aredeveloped in consultation withstakeholders(public consultation).

DATA ANALYSIS

In thisstudy, information gatheredthrough interviews, observations, questionnaires and from the maps of 1989 and 2015 wasanalysedusing spread sheet program such as Microsoft word 2010, Excel 2010, QGIS 2.8.1 and ERDAS to come out withmaps, averages, percentages, tables and others.The mapping ofthe study areais madeusingQGIS 2.8.1 and ERDAS software.The analysis of the data will be to bring the resultson:Identification anddescriptionof impacts,characterizationandevaluation their importance,propose mitigation measure and finally the elaboration of the environmentalandsocialmanagement plan

Results

Identification of impacts of the extraction quarry of rawmaterials.

The analysis of questionnaire shows that**t**most of the inhabitants of Etoa and its environs are origins of the center region, the Yandas (about 70 % of respondent) and are owners of land and houses. The present land of the clayquarryisowned by the natives of this zone. The analysis of the 1989 and 2015 maps of this zone shows thatsince the start of the exploitation of clay in this zone, there has been someenvironmentaldegradation.

Before the exploitation of clayquarry in this area, this zone wasconsidered a natural area with the presence of high cover of vegetation, lowbuild up houses and hydrological network intact in this area. After the analyses of the map of 1989 whichwasbefore the start of project in this zone (using the remotelysensedmethod) itwasdiscoveredthat, out of the 288.81

hecters of total surface area of study zone, vegetation cover was 400 hecters, build up area was 200 hecters and hydrologywas 80hecters. This couldbeseen in the fig.1. below.

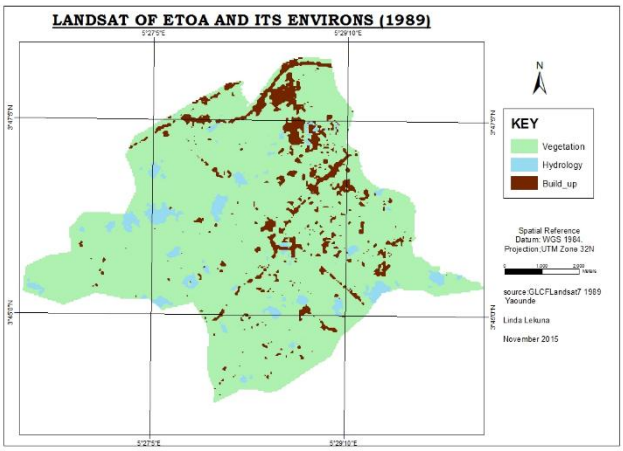

Fig.1. Landsat image of Etoa and its environs of 1989.

The histogram below in Fig.2.shows the results from the evaluation of the landuse pattern in the Etoa and its environs on various components of the environments (vegetation, buildup and hydrology).

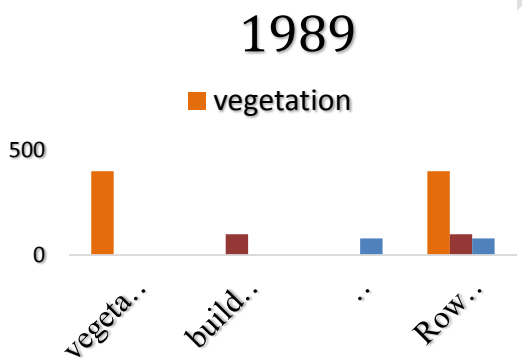

Fig.2. Evaluation of vegetation cover, build up area and hydrology of Etoa and its environs of 1989.

The analyses of the area with the present exploitation of clay material permits to bring out all the possible impacts that are generated by the project to its immediate environment. The environmental component analysed is the physical, biological and the socio-economic milieu. The study area is analysed using the remotely sensed method of analysing the map of 2015. Vegetation cover shows that it covers 200 hecters of land, buildup area covers 240 hecters of land and hydrology covers 185 hecters of land. Fig.3. below gives a clear view of the present situation.

Land use of the urban growth is estimated by time series analysis of satellite Landsat images. Spectral indices calculated from the images are used to evaluate change in buildup area, vegetation and hydrology. Due to rapid urban growth in developing countries (Cameroon) buildup areas have been dramatically expanded to suburban area. From the comparison between the time series Landsat images of 1989 and 2015, many vegetated areas and bare ground area of the 1989 images are changed to buildup areas in the 2015 newer images.

Vegetation cover has reducefrom 69 % to 32 % causing a greatloss of biodiversity, hydrologyincreasefrom 14 % to 30 % as excavation of claymaterialsincreaseseveryyearleavingbehindmanyclaypitsfilledwith water. Build up area increasesfrom 17 % up to 38 % as the population alsoincrease and thisis a factor thatshould not beneglected in the analysis of socio-economic. The inhabitants of this zone (the Yandas) practice subsistence agriculture, based on the production of foodcrops (cassava, plantain, maize, banana, okro,...) for local consumption and not for exportation. Agriculture constitute the principal source of revenue, henceexpropriating people on a land of 5hectares willbe a handicap to the population of thislocality if appropriatemeasures are not taken.

The presence of thisclaypits are just about 5m awayfrom the river Mefouwhich joins to the River Mfoundi and goes round to Mbalmayo whereitiscaptured and treated as source of drinking water to the population of Yaoundetown.

Exploitation of clayhereisdone in a disorderlywaymaking the zone a risk zone. Heavy woods are destroyedincluding the destruction of raphial palm found in the area. (Fig.3below shows landsat image of Etoa and its environs of 2015).

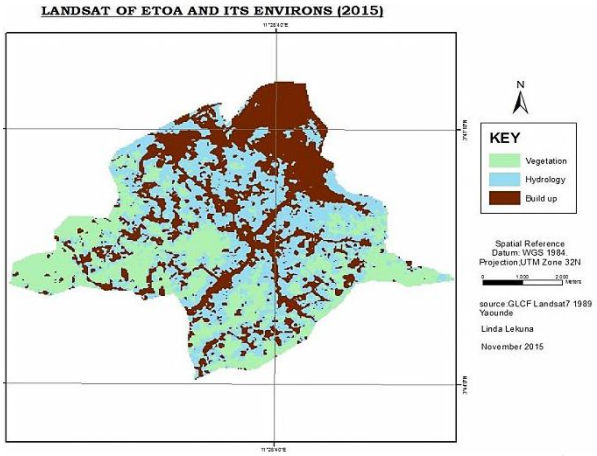

Fig.3. Landsat image of Etoa and its environ of 2015.

The histogram below in Fig.4.shows the results from the evaluation of the landuse pattern in the Etoa and its environs on various components of the environments (vegetation, buildup and hydrology) on the present situation.

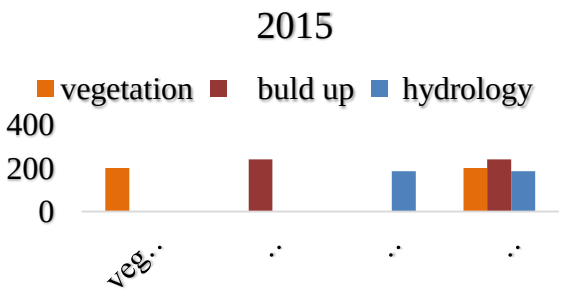

Fig.4.The evaluation of vegetation cover, build up area and hydrology of Etoa and its environs in 2015.

The evaluation of the landuse pattern (vegetation,buidup and hydrology) of this area shows a great change in the different environmental components. Vegetation in this area has drastically reduced due to deforestation and mans activities in the area. Buidup area (houses,roads,schools,…) has increase while the high demand for clay material for burnt bricks has also lead to the increase in excavation of clay and consequently an increase in the water surface in this area.The table below shows the various percentage change in the different environmental components from 1989 to 2015.(table 3.)

Table. 3.percentages of landuse of 1989 and 2015 in Etoa and its environs

component / Year	vegetation	Build up	hydrology
1989	69%	17%	14%
2015	32%	38%	30%
1989-2015(% change)	37%	21%	16%

Spectral indices calculated from the combination of multi-bands images have been widely used to calculate vegetated and bare ground area in remote sensing technology. The normalized difference vegetation index (NDVI) which is one of the powerful indices to evaluate vegetated areas in satellite images is used. Below is Fig.5. that shows the landuse in Etoa and its environs of 2015.

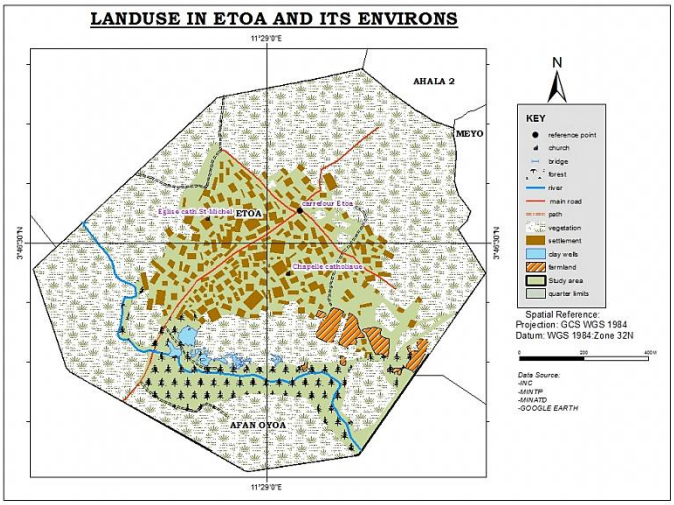

Fig.5. Land use pattern of Etoa and its environs (2015).

Characterisation and evaluation of impacts

Table 4. Characterization of impacts

Components of the milieu		Source	Impacts	Nature	Interaction	Duration	Extent	Intensity	Occurrence	Reversibility	cumulative Effect	relative Importance
PHYSICAL MILIEU	Air	-Production of gas, smoke and other polluting substance (co, co_2, pb...)	Air Pollution	-	ID	Lt	I	lo	Cer	Rev	No	Mi
	Soil	Ground works	-Soil erosion -Loss of soil fertility	-	ID	Lt	I	lo	Cer	Rev	No	Mi
	Surface water	-Use of fuel from excavators -fuel washed by water in to the clay pits and river -Maintenance of machines(vehicles)	-Pollution of surface water	-	ID	Lt	I	Av	Cer	Rev	Yes	Mi
	Underground water	-Use of fuel -Maintenance of machines	-Pollution of underground water	-	D	Lt	I	lo	Cer	Rev	Yes	Mi
	Acousticenvironment	-Excavation of clay	-Noise duringworkinghours	-	D	S	I	lo	Cer	Rev	No	Mi

	Landscape	-Use of fuel -Maintenance of engines, presence of workers clearing the site -Removal of wood from the clay pits	-Loss of natural beauty of area (Aesthetic)	-	D	Lt	I	lo	Cer	Rev	No	Mi
BIOLOGICAL MILIEU	Flora	-Presence of workers clearing the site -Exploitation of clay and deforestation	-Destruction of crops, vegetation and biodiversity	-	D	Lt	I	Av	Cer	Rev	No	Ma
	Fauna	-Presence of workers Exploitation of land	-Destruction of habitat and biodiversiy	-	D	Lt	I	lo	Cer	Irr	No	Av

Table 5. Characterization of impacts.

Components of the milieu		Source	Impacts	Nature	Interaction	Duration	Extent	Intensity	Occurrence	Reversibility	cumulative Effect	relative Importance
SOCIO-ECONOMIC MILIEU	Job opportunities	-Recruitment of workers from different domains	Job creation	+	D	Lt	Re	lo	Cer	Rev	No	Av
	EconomicActivities	-Workersfromother areas	Increase in economic activities and revenues	+	D	Lt	Pro	lo	Cer	Rev	Yes	Av
	Health and Security	-Circulation of heavy vehicles and the excavators	Risk of accident	-	D	Lt	L	Lo	Cer	Irr	Yes	Mi
		- Presence of workers from other areas	respiratory infection during the dry seasons	-	I	Lt	L	Av	Cer	Irr	Yes	Av
		Source of water	Pollution of underground water	-	D	S	L	lo	Cer	Rev	Yes	Mi
	Social security and conflict	-Recruitment of workers from other areas	Risk of conflict between the population, workers and land owner	-	I	Lt	L	lo	Cer	Rev	No	Mi
		-Liberation of farm land	Conflictlink to compensation	-	D	Lt	L	Av	Cer	Rev	No	Mi

	Livelihood	-Transportation of clay material to enterprise	Improvement of Livelihood	+	D	Lt	L	Av	Cer	Rev	No	Av
	Education	-Exploitation of claymaterials	Scientific Research	+	ID	Lt	Re	Hi	Cer	Rev	No	Ma

Key: D: Direct, ID: indirect, L: local, lo: low, Av: average, Pro: probable, Cer: certain, Mi: minor, Ma: major, Rev: reversible, Irr: irreversible, Re: Regional, Lt: long time, Hi: High.

Environmental management plan

The objective of an EMP is to describe the measures, actions and meansthatwillberequiredduring the construction and exploitation phases of a project. It alsoconsiders the worries or preoccupation of the population during public consultations.

An EMP is a toolthataims at preventingenvironmentalrisk, respect of norms, regulations, realization of projectsfollowing the principles of good management and implementmeasures of survey and control of environmentalrisk. Preventive and or corrective measures are alsoprovided for potential impact thatmaytouchhealth or environment. The table 6belowpresent the principal elements in the implementation of an EMP and the responsibility of the different participants on the project and the cost of all the recommendedenvironmentalmeasures.

Table 6: Environmental management plan(EMP)

Mitigation Measure	Impacts	Objective	Activities	Measurable Indicators	Means of verification	Person or enterprise in charge	Period	Cost (FCFA)
Sensitization of workers and nearby population	N°:1,2,3,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20.21.	-Awaken the conscience of the population on environmental issues; -sensitize workers and local population on the mitigation measures of negative impacts.	-Evaluate the sensitization campaigns and provide a reliable exploitation plan for the clay quarry; -elaborate with competent administration and local population on the protection of the clay quarry; -elaborate a plan of sensitization	-Number of sensitization campaigns organized with workers and the population; -attendance list and conformation from sensitization persons; -reports from meetings; -Presence of danger signs at dangerous points in the quarry	-Consultation of results on sensitization; -observations; -written documents	-Recruit a consultant or a competent sub - contractor	-Before the exploitation of clay material and till the end of exploitation	5.000.000

Mitigation Measure	impacts	Objective	Activities	Measurable Indicators	Means of verification	Person or enterprise in charge	Period	Cost (FCFA)
Protection of workers, local population, and the clay quarry	N°:1,9,10, 11,12,15,1 6,17,20	Reduce risk encountered during working hours and seasons of exploitation; -ensure the protection of workers, local population and raw materials	-Provision of PPE to workers; -register workers under the social insurance; -technical control of heavy duty vehicles and excavators; -follow a well design exploitation plan to extract raw material; -creation of acces roads for workers and heavy duty vehicles; -scientific research on aquaculture.	-Number of PPE given to workers; -presence of an exploitation plan on site; -a report on the quantity of clay extracted per season and per year.	-Direct observations; -consultation of company's documents	Enterprise -MINSANTE	From the beginning of extraction of clay up to the end of project.	8.000.000

Mitigation Measure	impacts	Objective	Activities	Measurable Indicators	Means of verification	Person or enterprise in charge	Period	Cost (FCFA)
Management of quarry	N°:8,2,3,4, 7,9,13,17, 20.	-Keep the quarry clean and protected from the population; -prevent soil and underground water pollution from oil leakages from heavy duty vehicles; -	-Extraction of sufficient quantity of clay material per season; -employ periodic workers to keep site clean; -fencing of the exploited site to prevent accidents; -construction of acces roads in the quarry	-List of persons in charge of the clearing site; -number of clearing done per year; -presence of accessible roads in the quarry.	-Consultation of documents from the enterprise	-Quarry contractor; -enterprise	-Throughout the existence of the project	18.000.000.
Rehabilitatio n and Restorate the area	N°:1, 2,3,4,8,9,1 7.	-Limit the loss of biodiversity; -limit the cause of climate change and soil erosion in the area	-Rehabilitate the already exploited zone of the quarry; -planting of trees along the river bangs	-Contract signed for further research on fish farming	-Number of trees planted at the river sides.	Enterprise; -NGO; -MINEPDED	- Throughout the existence of the project	6.000.000.

Discussion

The presentstudyrequired for thisprojectis a detailedenvironmental and social impact assessment. This issobecauseitdoes not onlyinvolve the execution of the projectalone but alsoinvolves public consultation in the project. The differentresultswereobtainedfrom the initial state of the environmentduring the exploitation of claymaterial and the identification of potential impacts.

The most important aspect thatislinked to environmentaldegradation in this area is the disorderly exploitation of clay in this zone and the absence of an exploitation plan. The land use pattern in this area has greatly change leading to an increases in the surface of water bodies from 14% to 30% giving a change of 16 % increase in the surface area of water body and in the number and size of claypockets over the years. The vegetation cover has reducedfrom 69% to 32% (from 1989 to 2015) thusgiving a change of 37% vegetation cover. Rehabilitation and restorationworks must bedoneinorder to avoidcomplete land degradation by 2035.The mitigation measures must befollowed to avoid the great change detection of the evaluated zone by 2035(Fen F *et al.*, 2014). The degradation of this area has led to numerous accidents in this area and at times the zone isflooded by water from the nearby river which can lead to loss of valuableclaymaterial in the near future, loss of exploitation land and evenloss of job opportunities.

Considering the situation of the study zone with the presence of the new project of fishfarming, the positive impacts willbeimplemented. Some of the positive and most important impact are; job opportunities, increase in state fund, and source of scientificresearch. The sameresultswereobtained by Delphine (2013) working on urbancontrolledlandfill of hospital and industrialwastewhoconfirm the positive socioeconomic impacts on the construction of a landfill in Ngomba. Alsofrom Anonymous (2014) similarresultswereobtainedwhoevaluated the evolution of the forest cover in the Douala reserveusing the remotelysensedmethod. In the report, for an area to bedeterminedwhetheritisdegraded or not, it has to beanalyzed over a period of more thanten (10) years.

During the exploitation of clay in this area, the negative impacts include the following; air pollution by smokefromheavydutyvehicles, noise and dustparticles', water pollution, Pollution of soil, loss of vegetation and crops (loss of biodiversity),Change of naturallandscape, Migration of birds and reptiles in this area, Risk of accident, flooding, migration of birds, pollution of surface and underground water ,risk of conflict, risk of proliferation of mosquito parasites, risk of degradation of transportation pathways and poor management of resources. The presence of all the above

correspond to thework of Rebel (2014) realized in Lom Pangar. All the negative impacts wereevaluated to 76.2 % while the positive impacts wereevaluated to 23.8 %.

The environmental management plan will enable stakeholders of projects, notably the MINTP, MINEPDED, MINRESI, MINSANTE and YUC to take into consideration all the necessary measures needed to manage the environment during the exploitation and construction phase. This was also mentioned by NANA (2014) on the project of environmental and social impact on the abduction of portable water supply in Jikejem-oku.

The loss of biodiversity in this area can also be compensated through the rehabilitation and restoration of this area .The construction of fish farming will help improve on the aesthetics of the area. The consequence is the destruction of biodiversity, loss of animal habitat and farm land which is already partly covered by water and clay pits. The clayquarry show that the site ispartlyoccupiedwithcrops and cocoa plantation of about 5% and part of the quarrycoveredwithnaturalvegetation to about 50 % of its surface area. The farmerswillbedeprived of their source of subsistence.

The real impactsare thosewhose manifestationis already visible while potential impacts are those impacts which arelikely to occurover time. Twenty-one (21)impactswere identifiedand evaluated. Fromthis work onlyfive (5)were positiveimpactsand of which we had four average positive impacts and one major positive impact.Thesixteen (16)other impactsare all negative impacts with two major negative impacts**.**

Conclusion

This studywasbased on the evaluation of environmental and social impacts on extraction quarry of rawmaterials and the case of the Etoaclayquarry in Yaounde III sub-division. To attainthis objective, itwasnecessary to identifyeach impact, characterized the impacts and proposed mitigation measures, compensation measures or bonifications measures. As the exploitation of claymaterialis on-going, itisobservedthat the biophysical and human components of the environment in this area isalreadybeingaffectedbased on the analysis of land use by the remotelysensedmethod. The different components of the environmentsuch as; air, soil, water, flora, fauna and population isalreadyaffected and willbeaffected at different rate if the mitigation measures are not employed at the appropriate moment.

This studybrings out somenegative impacts on the biophysical milieu whichincludeessentially air pollution by dustfrom the transportation pathways, emission of gasfromheavydutyvehicles, contamination of water in claypits and the nearbystream by spillage of oilfromheavyvehicles, destruction of habitats of someanimals, soil pollution and the disappearance of certain plant species. Workersdriving the heavydutyvehiclesmightdevelopoccupationaldiseases over a long period of time; conflictbetween land owner and the enterprise.The project also have positive impacts like the creation of jobs to newer worker and researcher and the increase in economic activities of the enterprise.

The projectcouldbeaccepted in this area because of the followingenvironmental justifications:

- the presence of an underground water source from the open claypits .
- thereis the possibility of rehabilitating the area by transformingitintofishfarming.
- the topographical and morphologicallayout of this area is a guaranteethat pollution of surface water willbeminimised .

However, the differentproposed mitigation measureswill permit to solve or reduce the damages causedduring the exploitation of rawmaterials. If all the mitigation measures are applied and within the givenperiod of time and that the EMP isusedproperly, then the impacts will have negligibleeffects as the claymaterials and the environmentwillbeprotected.

Integrating the local population and the land owner in to the newerproject of fishfarmingis a means of integrating the project in itsownenvironment and most importantly the use of an exploitation plan during exploitation. We can conclude thatthe project islargelyinteresting forthe people of this area, whoalsoeagerly wait.

References

Anonymous, 2014a. Health and Environmental effects of abandoned quarry used for Municipal waste dump in associated granite industry quarry Abeokuta Ogun State Nigeria. University of Nigeria. pp. 48-57.

Anonymous, 2014b. National institute of cartography Yaounde. Landsat images of 1989 and of 2015.Yaounde.

Carla K., Christine M., Rita E., and Souha T., 2014. Mediterranean Quarry Rehabilitation Manual: Learning from the Holcim Experience.p.8

Delphine N., 2013. Evaluation of environmental and social impacts on the construction of a controlled landfill for industrial and hospital waste at Ngomba (Douala V). A dissertation of a Professional Master's in Environmental Sciences. University of Yaounde I. pp.20-51.

Fen F.,Ojuku T., Pierre N., 2014. A report on the role of geographic information system in Land use dynamics in the city of Bamenda from 2002 to 2014.pp.28-30.

Ngon N., 2007. Morphological, mineralogical, geochemical and crystallographicstudy of lateriticclays and hydromorphicclays of the Yaoundé region in the humid tropical zone. Industrial tests and evaluation of theirpotential as building materials. Doctoral thesis / PHD in earth science, University of Yaoundé I. pp 77-80.

Nana., 2014. The environmental and social impact study of the drinking water supplyproject in my city Jikejem-Oku. Dissertation for the Professional Master'sdegree in Environmental Sciences University of Yaoundé P.31.

Nanor J., 2011. Assessment of the effects of quarrying activities on some selected communities in the lower Manya krobo district. Thesis in environmental science, university of Ghana. P.16.

Nkechinyere V., 2010. Environmental sustainability and sustainable growth: A global outlook. Thesis in Organizational Dynamics at the University of Pennsylvania. P.1.

Rebel B., Vanclay F., 2014. Social impact assessment: contribution to the state of the art series. p. 59.