Report on a Feasibility Study: A Case Study of Ratcon Quarry Limited.

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ABSTRACT

A feasibility study was conducted at Ratcon Quarry, Limited, located at Sokuro Village, 15km away from Ibadan, Nigeria, along the Lagos-Ibadan expressway, with an area of 150 acres. The area is covered by the southwestern basement complex. The rocks are pinkish granite gneiss and gray granite gneiss. Evaluation shows a tonnage of 75Mt; annual average production of 0.65Mt; economic life span of 115 years. The value and viability of quarry business is lucrative in a third world country like Nigeria, where there is available market for consumption in civil engineering works; with an initial investment cost of US$18 million, total cash out flow of US $5.55 million, total cash inflow of US $9.85 million, annual net profit of US $ 3.91 million, the payback period of six (6) years.

(Keywords: feasibility, Sokuro, cashflow, Ratcon)

INTRODUCTION

A feasibility study is carried out with the aim of evaluating a proposed or ongoing project to ascertain its economic value and viability with some level of assurance and accuracy. This involves geological, technical, and economic evaluation (Herefordshire and Worcestershire, 2012; Bowers et al., 2012). These three factors if properly measured with a degree of assurance decide whether or not a project is viable.

In the case of this feasibility report was carried out at RATCON Quarry, which is a medium scale quarry site in Nigeria. This report attempts to evaluate the quarry, this involves geological, technical, and economic evaluation, from this report if it is viable, suggestion can be made for an investor who is interested in the establishment of quarry site.

Location and Accessibility

RATCON Quarry is situated at Sokuro Village, Oluyele L.G.A, along Lagos- Ibadan express way, about 15km away from Ibadan City. It is bounded by longitude 7′28′14° N and 7′25′83^0 N; and latitude 3′84′36^0 E and 3′76′24^0 E. It is at the right-side along the express way, and is linked to the main road by a motorable minor road (Figure 1).

The quarry site occupies about 150 Acres, with an undulating relief, the southern portion has the highest relief of 220-270m above sea level, and is the location where blasting is taking place. The lowest relief is at the northwestern part, nearly flat, where the administration and electrical workshop is situated, with an average relief of 170m above sea level. Generally the quarry site is an undulating area.

The quarry site has a good drainage pattern, luckily enough it is bounded by two streams, and one cross cuts the site at north while the latter is at the boundary edge at the south. Which give the site advantage to easily connect the drainages into the trellis stream.

Geological Setting

Nigeria lies approximately between latitudes 4^{0}N and 15^{0}N and Longitudes 3^{0}E and 14^{0}E, within the Pan African mobile belt in between the West African and Congo cratons. The geology of Nigeria is dominated by crystalline and sedimentary rocks both occurring approximately in equal proportions (Woakes et al., 1987). The crystalline rocks are made up of Precambrian basement complex and the Phanerozoic rocks which occur in the eastern region of the country and in the north central part of Nigeria.

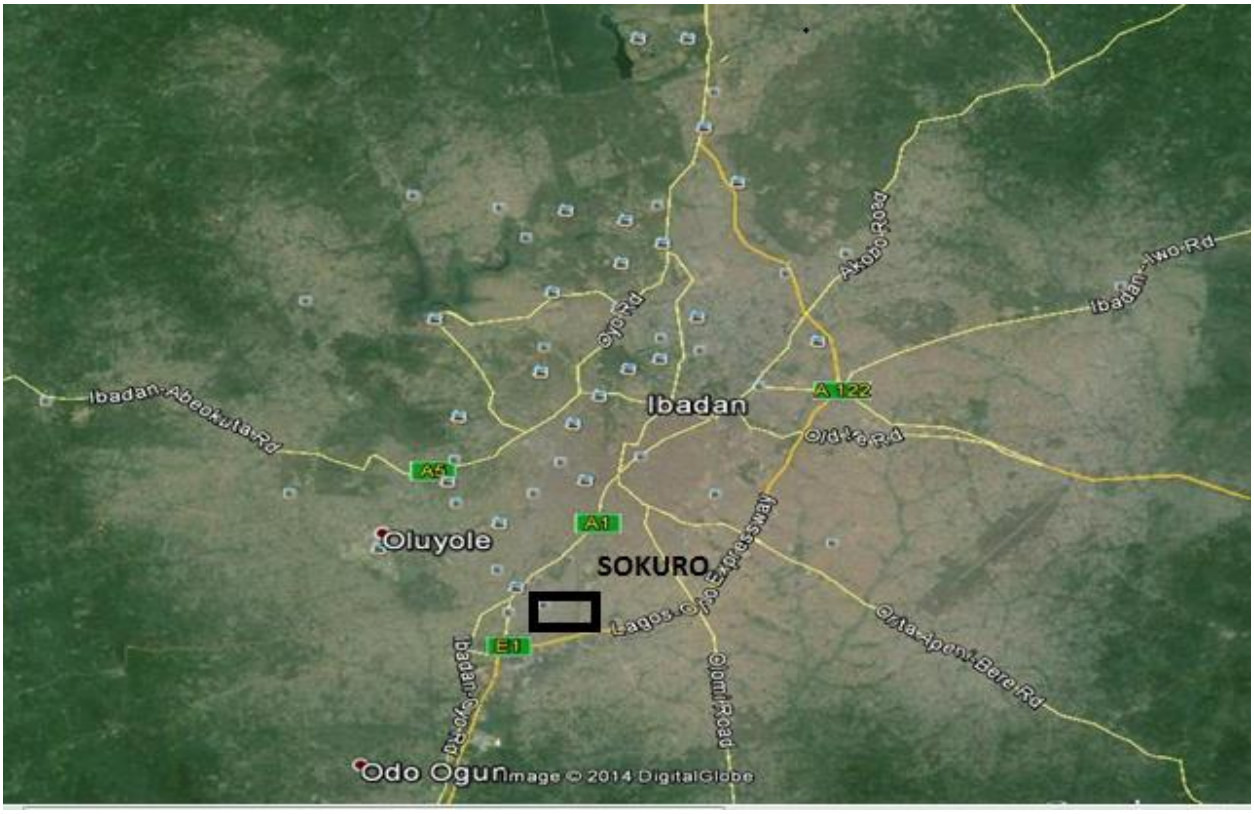

Figure 1: A Satellite Image Showing the Study Area (Extracted from Google Earth, 2014).

The Precambrian basement rocks in Nigeria consist of the migmatite gneissic–quartzite complex dated Archean to Early Proterozoic (2700-2000 Ma). Other units include the NE-SW trending schist belts mostly developed in the western half of the country and the granitoid plutons of the older granite suite dated Late Proterozoic to Early Phanerozoic (750-450Ma) (Figure 2).

The area covered by the southwestern Nigeria basement complex lies between latitudes 7°N and 10°N and longitudes 3°E and 6°E right in the equatorial rain forest region of Africa. The main lithologies include the amphibolites, migmatite gneisses, granites, and pegmatites. Other important rock units are the schists, made up of biotite schist, quartzite schist talk-tremolite schist, and the muscovite schists. The crystalline rocks intruded into these schistose rocks.

The Migmatite-Gnessic Complex

This geotectonic complex which constitutes over 75% of the surface area of the southwestern Nigerian basement complex is said to have evolved through 3 major geotectonic events:

1. Initiation of crust forming process during the Early Proterozoic (2000Ma) typified by the Ibadan (Southwestern Nigeria) grey gneisses considered by Woakes et al.; (1987) as to have been derived directly from the mantle.

2. Emplacement of granites in Early Proterozoic (2000Ma) and

3. The Pan African events (450Ma-750Ma). Rahaman and Ocan (1978) on the basis of geological field mapping reported over ten evolutionary events within the basement complex with the emplacement of dolerite dykes as the youngest. On the basis of wide geochemical analyses and interpretation, geotectonic studies, field mapping and plumbotectonics, Oyinloye (1998 and 2011) had suggested a modified Burke et al; (1976) sequence of evolutionary events in the Southwestern Nigeria basement complex.

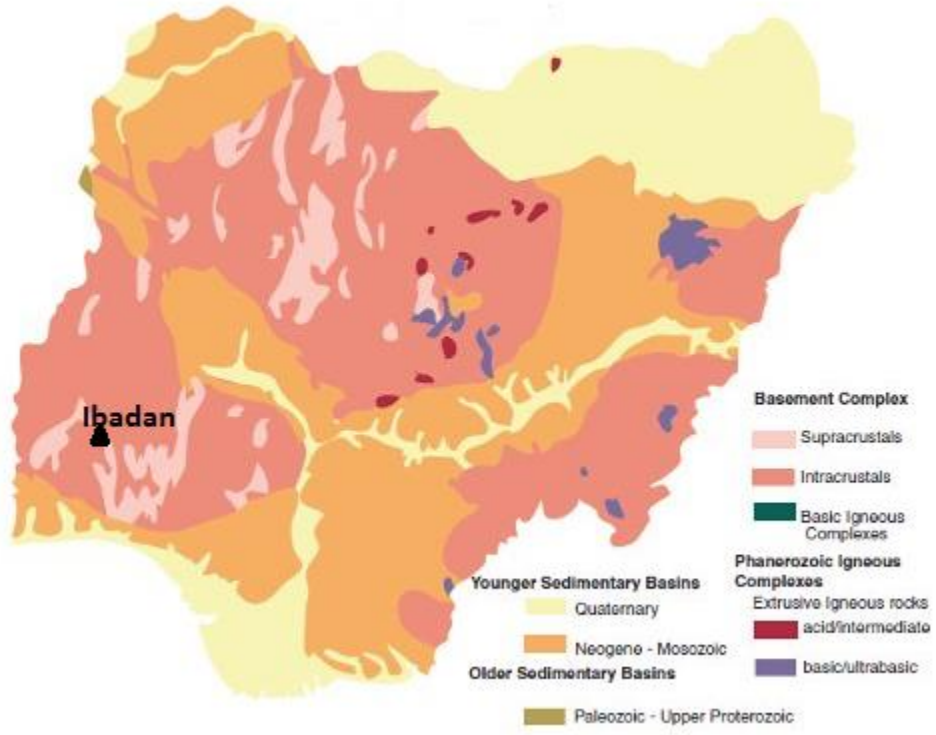

Figure 2: A Simplified Geologic Map of Nigeria showing the Area of Study.

Local Geology

During the course of field mapping of the quarry site, two varieties of granite gneiss were encountered with varying color and textural composition on hand specimen. These are the grey granite gneiss and pinkish granite gneiss.

The Gray Granite Gneiss

The greyish granite gneiss occupies about 65% of the areal extend. The overall color is grey-dark. The texture of this variety of granite gneiss is fine to medium, medium grade metamorphism with well-developed foliation defined by preferred orientation of the dark and light bands minerals. This variety is composed majorly of quartz, biotite, plagioclase and k-feldspars as shown in Figure 3.

Looking at its textural composition of fine-medium grained, highly fractured and metamorphosed makes is much easier to be blasted along zones of weakness compared to pinkish variety.

Figure 3: The Gray Granite Gneiss at the Quarry.

The Pink Granite Gneisses

The pinkish granite gneiss makes an inferred contact with the gray-type. Generally is pinkish with large phenocrysts of k-feldspars and quartz. The texture varies from medium to coarse grained, becoming more of pegmatite in some areas. The grain size ranges from <0.5cm-3cm depending on the location. This variety of granite gneiss is also fractured but not well pronounced as the grayish variety (Figure 4).

This variety of granite gneiss is made-up of higher percentage of k-feldspars phenocryst which is susceptible to weathering, hence it has effect on the overall strength and carrying capacity of the rock in geotechnics and civil engineering works. Moreover, in general terms the granite gneiss of the quarry, which is used as the raw material in production of crushed stones of various sizes are highly fractured, thus creates more plane of weakness it is not suitable as dimension stones.

Figure 4: The Pink Granite Gneisses showing the Larger Crystals of K-Feldspars.

Stages of Production and Plant Machinery

There are five (5) principal stages in the extraction and processing in quarrying at RATCON, which are as follows:

I. *Soil and overburden removal*: the thickness of topsoil and overburden varies with location on the site, the overburden are mostly lateritic with a thickness range between 1-6m thick, which mostly requires digging and haulage, excavators and trucks are used for such duties.

II. *Fragmentation:* this is a stage where rocks are disintegrated into required sized from the outcrop to the processing plant. Two basic stages are employed:

   a. *Primary fragmentation*: this involves drilling, blasting and mechanical breaking. The degree of fragmentation produced during blasting is determined by two factors: explosive energy creating new fracture surfaces in the rock mass, and exploitation of existing zones of weakness such as, faults and joint, which depends solemnly on the choice and amount of explosives used, the arrangement of blast holes and the sequencing of the detonation. The machines used here are: excavators, wagon drill.

   b. *Secondary fragmentation*: if the primary fragmentation is insufficient and may not produce a well graded rock pile suitable for immediate loading and crushing, pecker and power drill is used.

III. *Loading and conveying*: once broken rocks have been created in piles, the material is loaded to the haulage. Loading by using excavators and wheel loading shovels and conveying to the crushing plant by pay loaders and dumpers.

IV. *Crushing/processing:* this involves crushing the broken rocks into required sizes for different purposes. The crusher consists of feeders for irregular crushing of stones and then conveyed to the cone by feed conveyor belt. The cone crushes the stone into smaller sizes, after that it is been conveyed to screen which separates the crushed stones into the various desire able sizes.

   a. *Asphalt plant:* this plant process the crushed stone particles into asphalt for road construction, for other civil

engineering works this processing is not need. Asphalt plant has four chambers, the first two is filled with crushed stone dust and the latter is filled with 3/8 chippings, this content is been conveyed into the drier to the screen, then the screened particles are then conveyed to the mixer, to mix the dust with bitumen. This finished product are used in road construction, this product is majorly consumed by the companies road construction section (Table 1).

Table 1: The Products from the Quarry.

Product	Uses
Stone dust	Asphalt
3/8 inch	Block industry/asphalt
½ inch	Concrete/road constructions
¾ inch	Concrete
7/8 inch	Concrete
Stone base	Road construction before laying asphalt

ENVIRONMENTAL EFFECT

Generally quarrying activities has an adverse effect on the environment these are:

a. Noise, vibration and dust which has effect on the host community

b. Air and water pollution, the emission of carbon mono oxide by plant machinery pollutes the environment on the other hand, the drainage of the quarry is been channeled to the streams which might be contaminated even though the management claimed is free from pollution.

The company has tried to minimize such destruction made by their activities through the following:

a. Reclamation is going on to level the excavated area for farming, and some of the excavated area has been converted into fish ponds.

b. The machines on ground are mostly CAT C3-C9 engines which are compatible with global standard, less noise and emission of harmful gases.

GOVERNMENT REGULATION

Any company that engaged in mining in Nigeria must abide by the Nigeria minerals and mining act 2007 in which RATCON Quarry is no of exception. The regulatory bodies under the *Ministry of Mines and Steel Development (MMSD)*, *Mining Cadastre Office (MCO)* that lease/license and regulates mining activities, *Mines Inspectorate Department (MID)* supervise mining activities, and *Mines Environmental Compliance Department (MECD)* which regulates environmental issue.

Some of the Regulations of Quarrying under Minerals and Mining Act, 2007, Regulatory Obligation

1. A lease shall:
   a. A quarry not to be granted in respect of any area of land exceeding 5Km^2.
   b. Unless previously revoked or otherwise determined, remain in force for a period of 5yrs, or any lesser period for which the lease has been granted, from the date of the grant of the lease and shall then expire unless renewed.

2. Must compensate and pay the surface rents within the area of lease.

3. Shall not take any protected tree except with the consent of the proper forestry officer.

4. A quarry lease shall not, except under water license granted, under this part convey any exclusive right or privilege to any lake, river, spring, stream or any other water body passing through or adjacent to the land within the area of the lease.

Right of the Holder of a Quarry Lease

1. Enter on the land within the area of the lease or license granted.

2. Carry out quarrying operation on the land within the area of the lease and shown on the plan supplied (if required).

3. Remove and dispose of any quarriable mine specified in the lease.

(Nigerian minerals and mining act, 2007)

ECONOMIC EVALUATION

Tonnage

Tonnage= volume x specific gravity

Volume= area x height
= 607030.89m^2 x 45m
= 273,16390m^3

Specific gravity of granite gneiss= 2.75 average
Therefore tonnage will be, 75,120073 metric tons of granite-gneiss (approx. 75million tons)

Production Rate

Average Daily production= 2500 tons

The quarry operates five (5) days in week

Annual average production (A.A.P) = 2500 tons x 5 x 52 (Moon et al., 2007)
= *0.65 million metric tons*

Economic Life Span

The life span of the quarry = total estimated reserve/average annual production
(Moon et al, 2007)
= 75 million tons/0.65 million tons

Therefore the quarry life span is approximately, one hundred and fifteen years (115 yrs)

The has been on production for the past twenty three (23) years,

Total reserve= *75 million tons*

Explored reserve= *15 million tons*

Current estimated reserve= *60 million tons*

Possible Cash Flow

I. Cash inflow

Total cash inflow= average annual production x price rate per ton (stone and dunne, 2002)
= 0.65 million tons x US$ 15.152
= ***US$ 9,848800***

II. Cash outflow

This is been presented in Table 2.

Table 2: Annual Operating Cost.

Items	US$M
Diesel consumption Diesel per day:7500 ltrs	2.12
Premium and engine oil	0.6
Blasting materials	0.3
Maintenance and repairs	0.6
Administration, marketing and logistics	0.6
Staff salaries, wages and allowances: Staff strength of 350; Skilled laborers, 80; Unskilled laborers, 270	1.15
Depreciation	0.3
Insurance	0.15
Tax VAT(5% gross profit)	0.49
Royalty	0.196
Total cost	***5.33***

Total Cash Outflow= US$ 5331691.3

Net profit = Total cash inflow – Total cash out flow (Moon et al., 2007)
= US$ 9,848800 **–** US $ 5,331691.3

Net profit = US$ 3,911048.13 (US$3.91 million)

Value and Viability

The value and viability of quarry business is lucrative from the possible cash flow above, the initial investment is about *US$ 18 million* and the total annual outflow is *US$ 5.33 million* and inflow of *US$ 9.85 million*, with an annual profit of *US$3.91 million*, the payback period is about six (years).

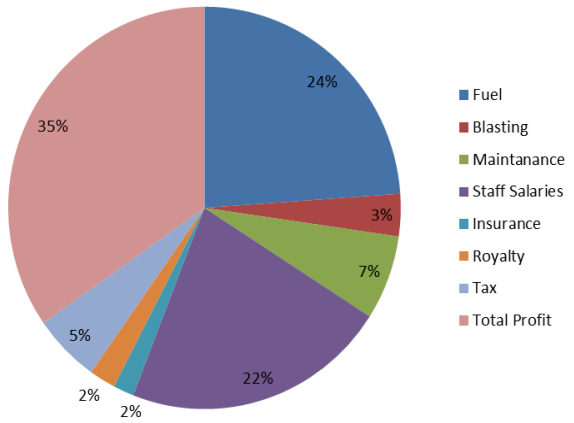

Figure 5: Total Cash Flow of Ratcon Quarry.

Quarrying has a shorter gestation period compared to mineral mining, though it is associated with following challenges which affects the production rate. The challenges include:

1. In the raining seasons the production is lower, the efficiency of machines are low.

2. Lack of spare parts and lubricant in the country, it has to be imported with takes a longer time.

3. Machine break down, in some instances foreign engineer has to come and repair.

4. The largest consumption of quarry products is in the road construction, as such political situation in the country controls the market.

CONCLUSION

Quarrying has a shorter gestation period compared to mineral mining, value and viability of quarry business is lucrative from the possible cash flow above, the initial investment is about *US$ 18 million*, and the total annual outflow is *US$ 5.33 million* and inflow of *US$ 9.85 million*, with an annual profit of *US $3.91 million*, the payback period is about six (years).

The major problem in quarry business is lack of adequate power supply, looking at the cash out flow, *22.9%* (US $2.12 million) is been spent on diesel (Figure 5), even the price of the diesel in Nigerian market is not stable. As such it affects drastically on the overall profit of the business.

REFERENCES

1. Bowers, P., B. Fahram, S. Hutchins, R. Rose, D. Sadtler, and S. Underwood. 2012. “Acquisition Proposal and Visibility Study of Bev Quarry, Nevada USA”. www.smenet.org. Date accessed: 10/10/2013.

2. Burke, K.C., S.J. Freeth, and N.K. Grant. 1976. “The Structure and Sequence of Geological Events in the Basement Complex of Ibadan Area Western Nigeria”. *Precamb. Res*. 3:537-45.

3. Herefordshire and Worcestershire Earth Heritage, 2012. “Feasibility Study into the Future Use and Management of Broadway Quarry, Cotswold Hills, England”. www.earthheritagetrust.org. Accessed on 10/10/2013.

4. MMSD. 2010. “Gold Deposits: Exploration Opportunities in Nigeria”. Ministry of Mines and Steel Development. www.mmsd.gov.ng. Accessed on 11/09/2013.

5. Moon, C., M. Whateley, and A.M. Evans. 2009. *Introduction to Mineral Exploration*. John Wiley and Sons: New York, NY. 496p.

6. Nigerian Minerals and Mining Act. 2007. Ministry of Mines and Steel Development: Abuja, Nigeria. 33pp. www.mmsd.gov.ng. Accessed on 10/10/2013.

7. Oyinloye, A.O. 2011. “Geology and Geotectonic Setting of the Basement Complex Rocks in SW Nigeria: Implication on Provenance and Evolution”. *Journal of Earth and Environmental Science*. cdn.intechopen.com/pdfs-wm/24552.pdf. accessed on 11/12/2013.

8. Oyinloye, A.O. 1998. “Geology, Geochemistry and Origin of the Banded Gneises in the Basement Complex of the Ilesha area, SW Nigeria”. *Journal African Earth Sci. London*. 264:633-41.

9. Rahaman, M.A. and O.O. Ocan. 1978. “On Relationship in the Precambrian Migmatitic Gneiss of Nigeria”. *Journal of Mining and Geol.* 15(1).

10. Stone, J.G. and P.G. Dunn. 2002. *Ore Reserve Estimates in the Real World*. Society of Economic Geologist Inc. Special Publication, 3rd Ed., p. 01-06.

11. Value Added Tax (Amendment) Act No. 12. 2007. *Laws of the Federation, Lagos Judiciary Library*. 5pp, www.lagosjudiciarylibrary.com. Date accessed: 10/10/2013

12. Woakes, M., C.A. Ajibade, and M.A. Rahaman. 1987. “Some Metallogenic Features of the

Nigerian Basement". *Journal of Africa Science*. 5:655-664.

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