MARKET AND PROFITABILITY FACTORS FOR ARTISANALLY QUARRIED STONE: POTENTIAL CONSTRAINTS TO ENVIRONMENTAL AND OPERATIONAL IMPROVEMENTS?

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JUNE 1999
TABLE OF CONTENTS

INTRODUCTION................................................................................................................................. I

SECTION ONE: THE SMALL-SCALE ARTISANAL QUARRYING INDUSTRY .............................................. I

1.1 INTRODUCTION TO BUILDING STONE IN KENYA ........................................................................ 1
1.2 INSTITUTIONAL AND OPERATIONAL FEATURES OF SMALL-SCALE ARTISANAL QUARRIES ........ 2
1.3 MARKET FACTORS FOR ARTISANALLY QUARRIED STONE ........................................................... 2

Box One: Stone usage in the Umoja II housing unit scheme ................................................................. 2
1.4 BUILDING STONE PURCHASERS .................................................................................................. 3
1.5 OTHER QUARRY PRODUCTS ......................................................................................................... 3
1.6 SUPPLY CHAIN RELATIONSHIPS .................................................................................................. 3
1.7 PRICE FACTORS FOR BUILDING STONE IN KENYA ................................................................... 4

1.7.1 Stone quarrying prices ............................................................................................................... 4
1.7.2 Transportation prices ............................................................................................................... 4
1.7.3 Building stone dressing prices .................................................................................................. 5

SECTION TWO: LINKAGES BETWEEN IMPROVED OPERATIONAL PERFORMANCE AND IMPROVED ENVIRONMENTAL PERFORMANCE ................................................................. 5

2.1 ARTISANAL QUARRYING AND THE ENVIRONMENT .................................................................... 5
2.2 MECHANISATION ............................................................................................................................. 6
2.3 BENCHING ....................................................................................................................................... 7
2.4 PLANNING AND IMPROVED MANAGEMENT TECHNIQUES ......................................................... 7
2.5 INSTITUTIONAL CHANGES ............................................................................................................. 7

SECTION THREE: CONSTRAINTS TO INCREASED PRODUCTIVITY AND ENVIRONMENTAL IMPROVEMENTS .............................................................................................................. 7

3.1 STRUCTURAL CONSTRAINTS ........................................................................................................... 7
3.2 MARKET CONSTRAINTS ................................................................................................................... 8
3.3 LABOUR CONSTRAINTS ................................................................................................................... 9
3.4 CREDIT CONSTRAINTS .................................................................................................................... 9

SECTION FOUR: RECOMMENDATIONS ................................................................................................. 10

4.1 STRUCTURAL CONSTRAINTS ........................................................................................................... 10
4.2 MARKET CONSTRAINTS ................................................................................................................... 10
4.3 LABOUR CONSTRAINTS ................................................................................................................... 11
4.4 CREDIT CONSTRAINTS .................................................................................................................... 12

SECTION FIVE: CONCLUSION ............................................................................................................... 12

REFERENCES ......................................................................................................................................... 13
INTRODUCTION

This paper assesses the extent to which the implementation of environmental improvements and better operating practices within the Kenyan small-scale quarrying industry are constrained by the way in which the market for the artisanally produced stone operates. As its main example, the paper relates to the situation in the region surrounding Nairobi, Kenya, as reflected in the case study research undertaken in this ITDG project and, subsequently, described in other associated papers (Wells, 1996 & 1998, Savery, 1997 and Mjaria, 1997). This paper also draws on the findings of the comparative study conducted in Goa, India (Noronha, 1998).

The paper begins by outlining the market for stone and explains how the strong demand for building stone drives the current proliferation of small-scale quarrying operations in Kenya. This section of the paper outlines who the users of the stone are and how they relate to the quarry operators. It also examines the price determinants for building stone in Kenya and analyses the environmental threat to the sector. The second section of the paper attempts to illustrate any linkages shown to exist between the increased viability and profitability of small-scale quarrying through improved operational practices and their subsequent benefit on the environment. Of particular concern, is the use of planning before quarrying, the limited use of mechanisation, and the reduction in the use of blasting as a quarrying technique.

The paper, in section three, then identifies the constraints to quarry owners achieving a sufficiently stable and viable price for their product for them to be able to implement improved operational and environmental procedures. These factors are described to relate both to demand factors, such as markets and prices, and supply factors, such as productivity, employer and employee skill levels, and worker migrations. The paper then analyses the assumption that improved operational and environmental practice is totally contingent on artisanal quarrying becoming more secure and financially viable. In its penultimate section, the paper analyses the conclusions made in the project documentation and suggests action that needs to be taken to improve the marketability and viability of artisanally quarried stone. The paper integrates this with recommendations of the steps that need to be taken to implement plans to overcome these constraints and concludes in section five.

SECTION ONE: THE SMALL-SCALE ARTISANAL QUARRYING INDUSTRY

1.1 INTRODUCTION TO BUILDING STONE IN KENYA

The use of building (or dimension) stone for construction purposes in Kenya is extensive, particularly where suitable rock deposits occur. One such deposit occurs around Nairobi and is remarkable for its availability over a wide area and for its variations in colour and hardness. The building stone quarried from these deposits is institutionally accepted as a permanent walling material that meets Government standards for structural use. Building stone also has a social status within the community and may be transported over long distances for the construction of houses in both rural and urban areas. Its different varieties have long been used to produce aesthetically and structurally appealing buildings. In Nairobi, the majority of the residential boundary walls are constructed with building stone and it continues to be used extensively in the construction of housing for all levels of income.

Within Kenya, the construction industry is booming, although it has been tempered in recent years by central government fiscal constraints. Nevertheless, demand for building materials is strong and increasing. Within the industry, the stone quarrying sector represents a significant economic activity. The building stone deposits within the Nairobi area have a conchoidal fracture and a tendency to develop columnar joints that facilitates their easy extraction by Jua Kali (informal) operators. Consequently, within the quarrying sector, small-scale artisanal quarries currently produce 95 percent of the building stone. The production of this stone is a labour intensive activity that has not benefited from any significant technological advances in many years. This manual process generates employment and income for a large number of people. It is currently estimated to directly employ
between 40,000 and 200,000 people within the country. The linkages that Jua Kali quarries have with other sectors, such as blacksmiths and transporters, creates significant additional dependent employment.

1.2 Institutional and Operational Features of Small-Scale Artisanal Quarries

The institutional structure of stone quarries within the Nairobi area is complex. By comparison, the quarrying process is simple and largely similar in most quarries. Stone quarrying in Kenya falls outside the Mining Act of 1940 and, consequently, has virtually no regulatory control. The only environmental regulation applies to quarries on forestry land and concerns minimal land restoration after quarry closure. Stone quarrying is conducted on land which is either privately held or, in the case of forestry land, belonging to the Ministry of the Environment. On privately held land, the owner operates the quarry himself or herself, or, leases it to a third party. On government land, quarrying leases are granted to a third party. Occasionally, the government or a private individual leases the quarrying land to a co-operative. The length of a quarrying lease is normally one year although leases are sometimes granted on a monthly basis. Leases for quarries on Government of Kenya forestry land state that the owners must pay royalties on the stone that they quarry. This is at a fixed rate per metre of stone produced and the level is dependent on the stone size. By-products also attract royalties on a cubic metre or per tonne produced basis. Quarry operators on private land often have similar leases and royalty payment structures. Wells (1998) argues that lease lengths and royalty structures compel quarry owners to operate on very short time horizons.

Quarrying leases tend to be given for plots of approximately 100 feet by 50 feet. They are worked with a 50 foot face that, when fully developed, is generally about 20 to 30 foot in depth. Quarries generally employ 10 to 15 men per site. The quarry managers/owners or their foreman oversee their quarry workers. These, mostly, men use a variety of hand-held tools in combination with explosive blasting to remove the overburden (2 men); drill holes for blasting (2 men); place the blast (1 man who operates in several quarries); break and cut the stone (2 men); and move, stack and load the stone (at least 2 men). Payment for much of this work is on a piece-rate basis.

1.3 Market Factors for Artisanally Quarried Stone

In 1990, Agevi and Ogero (1990) found that the official price of dressed building stone was the same as that of concrete blocks, although stone could normally be purchased at below the official price. In 1992, when cement prices were decontrolled, there was a resulting sharp increase in the price of cement, aggregates and sand. Consequently, building stone became, and continues to be, the cheapest permanent building material available around Nairobi. With the current construction boom, demand for building stone has been increasing. Evidence of this demand is witnessed in the increasing number of artisanal quarries around Nairobi. Indeed, demand for building materials has been so strong that quarry operators have been unable match supply with demand. They are hampered by poor extraction techniques and limited accumulated capital to hold significant stocks of stone. Consequently, for large construction projects it is difficult to specify and obtain stone requirements. This is evident by the fact that the construction industry has continued to use the currently more expensive machine-cut stones and concrete blocks (see Box 1 for an example). Looking to the future, projected demand for building stone will depend on the level of Government fiscal reform, the success of crop production and tourism, and the strength of the Kenyan shilling. While these factors may fluctuate with time, the backdrop of a population predicted to double before 2025 will ensure that growth in the housing sector, with its building material requirements, is inevitable.

Box One. Stone Usage in the Umoja 11 Housing Unit Scheme

Constraints on the ability of the small-scale quarry sector to provide large quantities of stone were apparent on the 4000 plus housing unit scheme of Umoja 11, in Nairobi. There, the designers and builders had initially
planned to use hand-cut dimension stone. However, the supply of stone was inadequate and designers, therefore, had to resort to the use of concrete blocks (Agevi and Ogero, 1990).

1.4 BUILDING STONE PURCHASERS

As indicated above, the main purchaser and end user of building stone is the construction industry. Within Kenya, three major users of the building stone can be identified. They are:

- One-off house builders;
- Estate developers, building large rooming houses;
- Contractors, for the construction of houses and non-residential buildings.

These categories can then be further subdivided into those operating in the formal and informal sectors. With only minimal numbers of buildings being officially completed each year, this suggests that the majority of buildings are constructed by the informal sector and have no planning permission. In her study, Wells (1996) found that artisanal quarries supply both the informal and formal sectors of the building industry and that the greatest demand for building stone is from the informal sector. Thus, artisanal quarry operators have complete access to the building stone market. However, they do not have the exclusive access to the informal building sector as informal builders procure their supplies from both the formal and informal sectors.

1.5 OTHER QUARRY PRODUCTS

The market for other quarry products includes hand-cut hardcore from the Njiru quarries, which is sold to contractors for road construction and maintenance in Nairobi. Hardcore from the softer stone of the Njiru and Ngong quarries is sold at a lower price to contractors, estate developers and individual builders who, for example, use it for the foundations of buildings. There is also a market for machine crushed aggregates but this requires access to a crushing facility. In the Nairobi region, two mechanised quarries currently produce machine-cut building stone. They produce facing stones and one produces floor tiles. All categories of builders buy these products. Some contractors also have their own stone-cutting machines for producing facing stone.

1.6 SUPPLY CHAIN RELATIONSHIPS

An important aspect of any analysis of the market for a product or service relates to the way in which the buyers and sellers interact. Economic theory suggests that where a monopoly or oligopoly exists, the seller is better able to dictate the price of the product. In a free market, where the product is homogenous, where there is perfect knowledge, and where there are no barriers to entry, the seller becomes a price taker. The price is then dictated by supply and demand. In the case of Kenyan small-scale quarrying, attempts to control building stone prices have largely failed and leases appear relatively easy to secure suggesting that there are few barriers to entry. Furthermore, due to poor market knowledge, most quarry owners have been unable to differentiate their product in the market place. Consequently, small-scale quarry owners have become price takers.

The ability of small-scale quarry operators to influence the price of their building stone is further harmed by the fact that most quarry owners do not have access to any transport. They are, therefore, dependent on selling their stone at the price that they can achieve at the quarry gate. In the Kenyan case, the majority of stone is sold directly to the customer or their fierdi, who arrive at the quarry site with a lorry to purchase their stone requirements. Some contractors in the building/construction industry have their own transport but it would appear that other buyers, who are the majority, are restricted to making use of transportation provided by private lorry/truck operators.
Building stone is also transacted from the quarry to the construction site through intermediaries or brokers. The brokers generally operate on a commission basis but they are also believed to operate other less scrupulous practices. They have traditionally been largely unpopular with quarry owners. However, brokers do have the potential to be beneficial to the marketing process as they can respond to and reduce market imperfections. For example, buyers frequently make use of intermediaries when they do not have sufficient information about certain quarries. Quarry owners also sometimes approach the brokers if they have stone that they cannot sell. The action of individuals, groups or brokers purchasing stone speculatively for later resale is rare.

The market for hand-cut building stone can be characterised as one of many producers and many sellers both operating largely independently of each other with prices being determined largely by market forces. The Kenyan market for stone, thus, appears to be very similar in format to that of Goa, India. There, Noronha (1998) finds that the building stone arrives at the construction site in one of three ways. Firstly, some quarry owners have their own lorries. Secondly, there are truck operators who buy the stone from the quarry owners and deliver it to the builders; they may or may not be dedicated stone transporters. Thirdly, some contractors and builders buy direct from the quarry owners through a contract or transport the stone themselves. However, in contrast to the situation in Kenya, the quarry owners, in most cases, do not cut the stone unless they have a firm order.

1.7 PRICE FACTORS FOR BUILDING STONE IN KENYA

The price of building stone has three components. Firstly, there is the cost of quarrying the stone. Secondly, there is the cost of transporting the stone from the quarry to the construction site. Thirdly, there is the cost of dressing the stone to the required standard, dependent on building type.

1.7.1 STONE QUARRYING PRICES

Agevi and Ogero (1990) note that there are no deliberate efforts by quarry owners to look for customers. Consequently, as most quarry owners do not have any means of transporting their stone to the market, most transactions are conducted at the quarry gate. Sellers in a group of quarries do try to agree and hold a minimum price. However, they are largely unsuccessful and the quarry gate price for building stone in Kenya appears to be determined primarily by market forces. The three most important factors determining the price of building stone at the quarry gate are:

1. The quality of the stone, with the shape of the blocks and the calibre of the cutting being the key determinants of this quality.

2. The regularity of demand by buyers and the quantities that they demand. Those who buy bulk quantities and purchase on a regular basis are able to secure lower prices.

3. The time of purchase. Although some quarry owners can stockpile stone, other sellers reduce their prices when this begins to happen. Sellers may also drop their prices on Saturday evenings when they are desperate to sell stone to be able to pay their staff. The time of year can also influence prices with months such as December (Christmas) and April (when rain makes the roads impassable) making demand for building stone low. Stone prices fluctuations create hardship for quarry owners and employees alike.

1.7.2 TRANSPORTATION PRICES

The cost of building stone at the construction site includes a charge for transportation from the quarry to the site. In the Kenyan case study, it was found that 40 percent of the cost of delivered building stone is consumed in transportation costs. By comparison, Noronha (1998), in the Goan case finds that, although transport costs
were dependent on the distance of the quarry from the construction site, the average transport component of
delivered stone price equated to between 20 and 25 percent of its selling price.

The Kenyan case study also found sufficient evidence to suggest that transport costs are artificially inflated by
lorry drivers who collude to keep prices high. For example, transportation charges have risen four-fold since
1990. This is double the expected level given the increases in fuel and other associated costs over that period.
Agevi and Ogero (1990) found in the Njiru quarries that, on average, 75 lorry loads of stone were sold from that
quarrying area, yet, at any one time, 20 or 30 lorries could be found waiting for customers. Furthermore, other
lorries roamed the various construction sites looking for customers. This apparent over capacity would suggest
that the returns achieved from transporting stone were lucrative at the time of this survey. Using the Indian case
as a comparison, it is noted that quarry owners who have their own transportation tend to benefit most from
their quarrying operations.

1.7.3 BUILDING STONE DRESSING PRICES

Although dependent on the building under construction, builders generally require both dressed and undressed
stone. Traditionally, stone was dressed at the quarry site. However, as much of the demand for the stone is now
derived from low cost housing development, where only rough or partially dressed stone is required, building
stone is now mostly dressed at the construction site. The expense of this process is dependent on the amount of
dressing required and equivalent to between 40 and 70 percent of the quarry gate stone price (Agevi and Ogero
1990).

SECTION TWO: LINKAGES BETWEEN IMPROVED OPERATIONAL PERFORMANCE AND IMPROVED ENVIRONMENTAL PERFORMANCE

2.1 ARTISANAL QUARRYING AND THE ENVIRONMENT

Wells (1998) identifies environmental concerns as one of the major threats to the continuing viability of small-
scale quarries in Kenya. With respect to the environmental impact of the small-scale quarries, Savery (1997) finds
that there is ‘a blatant disregard for the environment’ in the Kenyan stone quarries. The main environmental
effects of small-scale artisanal mining, as outlined more fully in other areas of the project documentation, are:

1. Degradation of land and stone reserves through uncontrolled and inefficient quarrying. For
example, estimates of the waste produced range from 50 percent (Agevi and Ogero 1990) to 95
percent (Mjaria, 1997) of the stone quarried

2. Denudation of tree cover and vegetation and associated damage to vulnerable flora and fauna where
land restoration is not undertaken. For example, Savery (1997) describes some of the areas of
abandoned quarry sites as being lunar in appearance. Likewise, a 1989 government report on the
quarrying activity in the Nyeri Forest cited that quarrying practices had led to the rapid destruction
of indigenous forests and rapid soil erosion

3. Increased risk of flooding, soil erosion and land subsidence

4. Water pollution can be an issue in certain areas (for example, where water courses or artesian water
is subsequently used for drinking). Regulations usually specify a minimum distance for operations
from watercourses

5. Ground vibration and associated noise from explosive blasting is disturbing to nearby communities
SECTION TWO: LINKAGES BETWEEN IMPROVED OPERATIONAL PERFORMANCE AND IMPROVED ENVIRONMENTAL PERFORMANCE

6. Air pollution from explosives and machinery, and quarry or road dust can affect near nearby communities

7. Derelict quarries can fill with water and increase the risk of malaria affected mosquito infestation

Currently, there is little effective pressure on small-scale quarry operators to preserve the environment and refrain from blasting, to replace topsoil or to replant trees. Despite this, some quarry owners have had their quarries closed down on environmental grounds. If current operational practices continue, and there is a continued expansion of quarrying activities into new areas, these pressures are likely to increase. More generally, concerns about the extent to which small-scale mining is damaging the environment are likely to lead to tighter restrictions on the operation of quarries. Such regulatory restrictions might increase the costs of production or force the closure of certain quarries. However, given that the relevant government departments are weak institutionally and, consequently, have poor regulatory enforcement powers, any increase in the regulatory control of small-scale quarrying would likely, at present, result in a proliferation of illegal quarrying activity.

As has been highlighted above and elsewhere in the project documentation (e.g. Savery, 1997), small-scale artisanal quarrying degrades the natural environment. Minimising this degradation is a priority if small-scale quarry operators are to survive into the future. The main processes in stone quarrying are the clearance of overburden, drilling, blasting, splitting and, finally, dressing the stone. Opportunities to either increase productivity or improve environmental performance are limited by among other factors: poor knowledge of reserves; poor planning; poor mining practices; sub-standard tools; inefficient management of personnel and resources; poor working conditions; high degrees of mobility among quarry workers; and a lack of marketing strategies. If appropriate techniques can be developed that improve the operational efficiency of the quarrying process whilst at the same time improving the environmental performance then these avenues should explored. Identified methods include: improved tools and extraction techniques (limited mechanisation and benching); the introduction of better quarrying methods; more selective and skilful use of explosives; marketing and sizing of blocks to maximise the number of building stones extracted; stronger quarrying institutions; and the production of a wider range of stone products. These techniques are explicitly explored and laid out in other areas of the project documentation (e.g. Savery, 1997 & Wells, 1998) but for the purposes of this paper a few of the methods are briefly described here.

2.2 MECHANISATION

The Indian case study highlighted the use of simple machines that improve the efficiency, productivity and environmental performance of many small-scale mines. This has improved the incomes of both the quarry owners and their employees. Following this example, the argument proceeds that through the appropriate mechanisation of Kenyan quarry operations, it is likely that environmental improvements will follow. Firstly, selected mechanisation will lead to an improvement in productivity and less wastage of stone at the quarry and construction site (machine-cutting tools reduce wasted stone and machine cut stone requires less dressing). This will increase the profitability of the quarry and in turn increase opportunities for other environmental improvements. However, the process of mechanisation invariably leads to a substitution of capital for labour often resulting in a reduced labour requirement. In the case of small-scale quarrying unless productivity increases are matched by increases in overall building stone production, job losses would seem inevitable in any form of mechanisation process. However, Savery (1997) argues that certain selected mechanisation would improve productivity without reducing the employment within the mine. Examples are the introduction of augur-based manual drills to replace manual driven drilling rods and the introduction of motorised wheelbarrows to remove the overburden. A critical factor in any reduction of the labour force from any move to mechanisation is that many of the job loses would be among the least skilled and lowest paid workers. Thus, a move to full mechanisation may promote potentially serious social impacts.
2.3 BENCHING

The use of explosives in the quarrying process has many detrimental environmental effects. Excessive amounts of waste rock, suitable only for chippings; noise; explosive fumes; and flying rock are all associated hazards. Intermediate Technology Kenya (IT-K) has experimented with a quarrying process known as benching. This process involves cutting out the stone layer by layer rather than the random blasting with explosives. Preliminary results from this study suggest that it may reduce waste by 50 percent and five quarries in the Ngong area have taken on the technique, independent of the IT-K project.

2.4 PLANNING AND IMPROVED MANAGEMENT TECHNIQUES

Currently, large amounts of stone are wasted, as the planning of quarries is not carried out in any systematic way. For example, waste and overburden are placed on uncovered reserves and stone is left unutilised in between the worked out quarry cells. Recommendations from the case studies are that planning should be undertaken for the careful removal of topsoil so that full extraction can be undertaken. Topsoil can then be replaced at site restoration. Likewise, planning and co-operative arrangements between quarry owners can reduce the waste stone left between quarries. Alternatively, the operation of larger quarries could reduce the number of boundary walls. As an example of the success of such measures, in a larger quarry, where improved management practices are undertaken, workers are paid a premium of 10 percent and employment has increased.

2.5 INSTITUTIONAL CHANGES

The whole of the Kenyan small-scale quarrying industry appears to lack any formal institutional framework. Such institutions should be the driving force behind changes to the sector to improve its productivity, viability and environmental performance. For example, small-scale quarry operators do not have any formal institution for conveying their representation to other stakeholders, such as, the government and the construction industry. Likewise, there are no formal training mechanisms for quarry workers. It has been recommended that some form of formal training should be established to train both quarry owners and employees in the skills of quarry management and the technical requirements of the job, respectively. Savery (1997), citing an example of a UK quarrying association10, recommends that a quarrying association should be formed to represent the interests of quarry owners. A parallel body should also represent the interests of quarry workers. These bodies could then become the forum for the presentation, discussion, promotion and dissemination of information on new quarrying tools and techniques, and how to care for the environment.

The improved quarrying techniques and institutional changes appear to offer quarry owners the win-win scenario with enhanced productivity and improved environmental performance. The assumption is that this will then lead to an improved viability for the sector, increased health and safety, and improved wages for the workers. However, are these productivity achievements likely to be achieved? Do the market and price constraints faced by the small-scale quarrying sector in achieving a sufficiently viable operation make these improvements in productivity unlikely? The following section focuses on four of the major constraints, operational structure, the market, labour, and capital.

3.1 STRUCTURAL CONSTRAINTS

The operational structure of the small-scale quarry sector contributes to the environmental degradation. As mentioned earlier, quarries operate as a complex process where responsibilities and authority are not easily defined. The loosely associated group known as 'quarry owners' do not normally own the land on which they are quarrying. Rather they have a concession to quarry the land for a set period. With little regulatory enforcement of any restoration commitments, they are, therefore, relatively unconcerned with the future value of the land. Quarry owners are also constrained in their environmental management of the quarry by the length of their
operating lease. Leases generally only last for one year but they may be considerably shorter, for example, as little as one month. In such a situation, the concession holder has an incentive to maximise stone production because their income is dependent on the amount of stone sold from that quarry for the set lease period. She/ he has no direct incentive to conserve stone. At the end of the lease period, they move on to another lease to exploit that concession in a similar manner. Consequently, quarry owners do not maximise stone production per area of deposit.

Likewise, workers within the quarry are paid by the amount of stone produced at the end of the day or week. They, therefore, also have little incentive to conserve stone. Because of this desire to maximise stone output, environmentally unsound practices abound. For instance, the use of blasting to loosen the rock wastes a large percentage of the stone but this method of quarrying is used as it maximises production. Any recommendation to use alternative benching techniques to extract the stone are likely to be resisted not only by blasters who would have to find an alternative livelihood but by all involved if the production rate of building stone falls. Landowners are also likely to benefit from maximising the exploitation of stone as they receive royalties on every foot of stone produced. Wells (1998) argues that relatively small modifications in the organisation of the quarries and the methods used could bring about improvements in the proportion of usable stone extracted. The changes, she argues, are resisted because they imply that that a lower rate of extraction will result with poorer returns for quarry operators in a very competitive market. However, if improvements result in increased yields due to the lower rates of wastage, structural constraints need not impede the use of new quarrying techniques.

3.2 Market Constraints

A critical area with regards to achieving improved profitability and security and the associated environmental improvements within the sector is associated with the quarry gate price for building stone. The price of building stone in a competitive market is about supply and demand. Starting with demand, this is likely to remain strong in Kenya providing hand-cut building stone remains the cheapest building material option.

On the supply side, the recommendations for improved productivity, if successful, should result in an increased supply of hand-cut stone. Alternatively, similar amounts of stone will be produced at a lower overall cost. The quarrying process is labour intensive and, as such, these reduced costs are likely to be labour costs, especially if more capital equipment is used in the quarrying process. In a market of a fixed size, if supply is increased through productivity enhancements, the product price will necessarily fall. It is, therefore, possible that falling stone prices will largely wipe out the gains achieved by enhanced productivity. The market for hand-cut building stone is not at saturation levels and, therefore, increases in supply should not result in a marked price fall. If demand for building stone actually increases, especially if lower building stone prices have a positive substitutional effect, then profits in the quarrying sector may rise without any associated falls in the levels of employment. However, if production remains the same with improved productivity, then some quarry workers are likely to lose their jobs.

The market currently dictates that quarry owners are only able to influence the first stage in the process of getting stone to the building site. Both quarry operators and their intermediaries appear to have taken no serious consideration to the marketing of their stone. While builders are innovating in the way in which they use stone, quarry owners appear unconnected to the market place and have only vague ideas of the market requirements. In response, Wells (1998) recommends that quarry owners should produce better quality stone. For example, they could produce better cut and dressed stone that would reduce on-site dressing requirements and, presumably, lower the transportation costs. Quarry owners may also be able to find a market for higher quality stone but this appears to be a limited option; niche market sales demand is only likely to occur from building contractors. However, at present, the value adding process of transporting and dressing largely occurs after the stone has left the quarry gate. The margins that are taken by those engaged in these processes will affect the competitiveness of hand-cut building stone in the building materials market.
The marketing aspect of hand-cut building stone is an area where quarry owners seem to be particularly constrained. The key factor here would seem to be the role of intermediaries and, in particular, those who transport the stone. As highlighted earlier, transportation is a problem for quarry owners. Any increase in the supply of building stone that may lower quarry gate prices may result in lorry drivers further increasing their margins. Quarry owners, therefore, need to break the stranglehold that the lorry drivers currently hold. Wells (1998) suggests that a reduction in transportation charges is a realistic prospect. She argues that if quarry owners could co-operate and secure their own transport, they would have an improved opportunity to determine their selling price both at the quarry gate and at the building site. This strategy, she then suggests, would bring greater stability to the market for hand-cut stone. This would allow quarry owners the means and opportunity to introduce better quarrying methods that are not only more efficient and increase productivity but also have environmental benefits. This would then counter the threat from increased future environmental pressures. From the Goan case study (Noronha, 1998), we find that those quarry owners who have their own transport are benefiting most from their quarrying operations. Likewise, in Kenya those with their own transport have benefited from this acquisition.

### 3.3 Labour Constraints

In 1990, Agevi and Ogero (1990) found that, in most quarrying areas, the availability of skilled labour to be inadequate. Institutions that provide training in artisanal quarrying are absent in Kenya and the majority of the people working within the quarries have no formal training. Consequently, most of the people working in the Kenyan quarries start as labourers and learn the necessary skills of their trade on the job, gradually graduating to stone cutters and dressers. However, the skills learnt are elementary, inadequate and uncoordinated. Membership of formal associations and the presence of informal networks appears low. There is also a high degree of mobility among quarry workers with many also being migrants making formal training difficult to implement. In this respect, workers within the quarries have similar characteristics to the Indian quarry workers. New operational practices and associated machinery will demand higher a skill level in all areas. Workers will need to be trained to operate new machinery and be educated in new quarrying processes and techniques. This is a particular problem where quarry workers continue to move on at regular intervals, as training can be a costly process even if it is conducted on the job. However, if improved productivity resulted in increased returns to quarry owners who then passed on these improvements to quarry workers in the form of higher wages, then it is likely that the workforce would become more stable.

The quarry owners are also charged as being inefficient managers of their businesses. As with the quarry workers, there are no formal institutions to enhance planning and management skills in quarrying. Prospective operators do not have the skills or access to the necessary skills, to carry out feasibility studies to determine the economic and technical viability of their enterprises. Decisions concerning prospective reserves are made by rule of thumb and often based on the stone structure of neighbouring quarries. Similarly, business plans that consider marketing, financial, personnel and environmental issues are not undertaken. Consequently, quarries are often poorly located and face problems, such as, waterlogging during the rainy season. Poor quarrying practices also abound with the double handling of overburden and inappropriate storage of stone chippings common. Lack of managerial capacity may therefore hinder the successful implementation of new practices and techniques. Furthermore, if quarry owners are to successfully integrate their quarry operations with that of transportation and dressing, this will also require higher levels of managerial skill.

ITDG and other initiatives are currently trying to address some of these labour constraints through appropriate training at a small number of quarrying sites. However, for any significant improvements to be made training initiatives will need to be more comprehensive and engage all parties in the quarrying process.

### 3.4 Credit Constraints

Wells (1998) argues that small-scale quarry owners have very little 'room for manoeuvre'. For example, cash flow difficulties are forcing quarry owners to sell building stone at below market prices. Small quarry operators
conducting their business activities in a highly competitive market with little capital can not afford to operate with the higher costs that improved environmental performance would entail. In particular, quarry owners do not have sufficient credit to invest in new equipment that might increase productivity and minimise some of the current environmental damage. They are also unable to afford the luxury of experimentation. Drawing from the Indian case study, Noronha (1998) finds that the ability to fund the investments that have resulted in improved productivity, returns and better environmental performance was enabled through bank credit. There, credit was made available by a well-developed network of credit and loan facilities. In spite of this, credit has still been difficult to obtain for many first time borrowers due to the illegitimacy of many operations. In Kenya, however, most small-scale quarry owners are unable to access credit as the financial sector is unwilling to lend them money. Consequently, even if limited mechanisation or other practices are shown to work, the quarry owners may not have sufficient capital to implement these improvements.

4.1 Structural Constraints

It is apparent that for large-scale environmental gains to be realised the incentive structures for quarry operators and landowners have to be changed. Innovations that lower the extraction rate of stone, however much they benefit the environment, are likely to be resisted. The present emphasis, upheld by the mining lease and royalty arrangements, on maximising output in a given time period with a largely limitless resource must be changed. Institutional structures should be put in place that regard the stone as a fixed and limited resource at each quarry site. This would have the effect of promoting practices that reduce the amount of waste produced per unit of building stone produced. Consequently, the Kenyan natural resource base would be degraded at a slower rate with the added benefit that other environmental damage caused by quarrying would be lessened. Savery (1997) states that a new “Mining Act”, that includes stone quarries, was to go before parliament in 1997. It is believed that this revised act may herald a new environmental awareness of the impact of mineral extraction. The outcome and any subsequent effects that may have arisen from this act are unknown.

4.2 Market Constraints

The current market for stone, although strong, does not seem favourable to small-scale quarry owners. A lack of trust of brokers, artificially high transportation charges and a lack of knowledge of what the market requires all contribute to unfavourable prices for building stone. Policies that engage brokers constructively with quarry owners, advance quarry owners' ownership of transport, and improve knowledge market requirements should be promoted. Dhar (1997), writing of the Indian experience, states that the creation of mining co-operatives has been one of the most successful ways of stimulating small-scale mining. Co-operatives have two significant advantages over an individual mining activity. Firstly, through their greater financial power and long-term viability, they have improved access to equipment and new technology. Secondly, larger, more stable, operations smooth out price fluctuations. As profits flow they can also be used to develop social services for workers and their families, as well as expanding production capacity. Encouraging the creation of central processing, marketing and transport facilities with the involvement of co-operatives would help informal quarrying operations to become more efficient and productive.


**Section Four: Recommendations**

1. **An investigation of the market for building stone and its by-products to enable production to meet market needs.** It might:

   - Test the market for better cut stone
   - Ascertain the direct and indirect costs involved in meeting market requirements
   - Research the market potential for the 80 – 85 percent of stone that is currently rejected. For example, could further screening provide a range of aggregate or ballast sizes as opposed to the multi-sized single hard-core product currently left in the quarry?
   - Examine the practicality of forming a stone market where potential buyers can view and compare the stone of many quarries before making a purchase. Stone could be graded for colour and specificity and then given a quality assurance standard to bring confidence to the market.

2. **An investigation into the extent to which additional environmental costs might be absorbed through a more integrated quarrying operation.** This would include the incorporation of transportation activities within the quarrying process. It might:

   - look at the facilitation and funding of the initial stages of a quarry-owning co-operative to run their own transportation

3. **Brokers have the potential to fulfil an important market function and efforts to integrate them into sector formally seem sensible if appropriately regulated**

   Wells (1998) recommends that a pilot or demonstration project to achieve many of the above objectives is justified and desirable. Such a project, she suggests, should undertaken in co-operation with a group of quarry owners in an environmentally sensitive area, such as the Ngong Forest, involving a concerned proprietor. The project, if successful, would be subsequently replicated within the area and extended to other areas. However, before the implementation of any such intervention, Wells (ibid.) recommends that a baseline study be undertaken to examine the diversity of quarrying operations.

4. **Labour Constraints**

   An institutional weakness that has resulted in no formal training opportunities for either quarry owners or workers appears a significant obstacle to the implementation of the proposed technical solutions to improved productivity in the small-scale quarrying sector. With poor technical and managerial skills and a highly mobile and transient labour force, the successful implementation of measures that require improved levels of labour skills are likely to prove difficult. The lack of formal and informal networks of alliance and support further hamper these aims. Efforts by ITDG and others in this area would need to cover a larger proportion of the quarries to have any significant overall effect on quarrying techniques and practices. Indeed, a training and development strategy that involves policy makers, researchers, training institutions, donors and quarrying representatives may be required to achieve these aims.

**Recommendations include:**

- A project should be designed to demonstrate better quarrying practices.
SECTION FIVE: CONCLUSION

- To examine the feasibility of conducting management training courses for quarry operators
- To examine the feasibility of providing incentives for the training for quarry workers either formally or through renewed apprenticeships

4.4 Credit Constraints

The inaccessibility to credit appears to be a significant constraint that will prevent many quarry owners implementing better operational practices and techniques. ITDG are working in this area but to gain access to funds, businesses should prove that they have a secure lease and relatively sound management. This may require the preparation of a business plan, for which a certain level of training is again required.

Evidence from the two case studies suggests that the larger small-scale quarries have a greater potential to implement new technologies and operate with higher levels of environmental performance. This may in no small way be due to their ability to overcome the constraints identified within this paper. Support for this argument is enhanced by the fact that larger quarries have also been shown to be able to pay their workers higher wages and operate with higher levels of health and safety (Noronha, 1998). However, before advocating support for this type of quarry it should be cautioned that most Kenyan small-scale stone quarries are not of this size. Hence, efforts to promote these quarries may exclude and distance many smaller quarries from the new technologies. The solution to this problem would seem, as Dhar (1997) suggested, to be in the promotion of co-operative working. For example, Savery (1997) found that at one site where the intervening walls between individual quarries were removed, productivity had increased. Co-operative structures could also facilitate the purchase of new capital equipment through cost sharing. Co-operation in this way may be the solution to allow small-scale artisanal quarry owners to benefit from enhanced quarrying processes that simultaneously reduce the environmental impact and increase productivity. Thus, small-scale quarry owners can realise sustainable livelihoods for themselves and their employees.

1 Intermediate Technology Development Group

2 This paper also draws on an earlier paper by Agevi, E. & Ogero (1990) and write-ups of ITDG project workshops


4 This higher estimate is taken from the Kenya Quarry and Mine Workers Union, 1996.

5 In other areas of Kenya not included in this study, stone quarrying is conducted on land held in trust and on local authority controlled land.

6 An ITDG comparative analysis of the cost of walling found that it is 31 percent cheaper to construct a wall using artisanal quarried stone than concrete blocks.

7 See Uglow (1999), Mitigating the Environmental Impact of Artisanal Quarrying

8 There are no regulations enforcing restoration of land mined on privately held land. There is a requirement for restoration of Government forestland, on which many quarries around Nairobi are located, but in practice, many of the requirements are not met even partially. The Soil Conservation Department of the Ministry of Agriculture, for example, does not seem to have the mandate to prosecute those who leave pits exposed after quarrying. It plays only an advisory role on restoration of the land rendered useless after stone-extraction, if requested by the landowners. (Wells, 1998).
Research by Mjaria (1997) found that approximately half of the quarry owners wished to see some form of mechanisation and 45 percent of quarry workers wanted improved drilling methods. However, almost all quarry workers and owners expressed a fear that motorised tools and new efficient quarrying methods would displace their jobs.

BACMI (British Aggregates Construction Materials Industry).

For example, the ASTA (Artisanal Stone Trade Association).

Seventy-seven percent of quarry workers have been at their current mine for less than one year (Mjaria, 1997).

References


