Strategies For Enhancing The Contribution Of Gemstone Mining In Developing Countries

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Abstract: The principal objective of this study is to suggest strategies for enhancing the contribution of gemstone mining to economies of developing countries (DCs). There are three major reasons for the study, namely, (i) the sub-sector’s apparent significant economic potential, (ii) a conspicuous lack of scientific literature on aspects of mining, processing and marketing, and (iii) the unique position held by gemstone mining in the world’s mining industry. The study focuses on five principal areas. First, the interrelationship between minerals and economic development is discussed. The special role and potential held by small scale mining (SSM) in contributing to the development objectives of DCs, is emphasized. Second, a review of the international gemstone industry is conducted. The high unit value of gemstones, the elevated geological risk, special mining techniques and complex marketing mechanisms, places the industry in a unique position within the world’s mining sector. A strong positive correlation is found to exist between the consumption of gemstones and the GNP per capita. The consumption is also found to set in only above a certain level of GNP per capita which provides an indication of where gemstone markets are. Thirdly, a detailed evaluation of policies and sub-sector constraints is presented. It is established that the sub-sector’s constraints are largely a direct result of an unsupportive policy environment. While aiming at improving the total operational business environment of the economy, policies must emphasize the role of free markets systems, state ownership of mines and control of marketing must be limited to improve the sub-sector’s productivity and efficiency. Effective mineral resource policies as reflected by sound mineral legislation as well as high quality of institutional framework support, is also a pre-condition to the successful development of the sub-sector. Lastly, resulting from the investigation of policies and sub-sector constraints, options for the removal of constraints are identified. The identified options are then combined into a general development strategy model for the sub-sector.

Keywords Small-scale mining; gemstone mining sub-sector; Economic development; mineral policies; institutional framework support.

Role of Small-scale Mining

A universal definition of what constitutes small-scale mining, has always been elusive (Barreto L.M, Hinton J and Hruschka F (2018). Generally, a typical small-scale mining operation in DCs is characterized by the following attributes:

- Often seasonal production of limited quantities of minerals from small deposits with few known reserves;
- Labor intensive with heavy reliance on manual labor;
- Lack of technical, financial and business management skills;
- With a few exceptions, the capital investment in plant and machinery is held to a minimum; and
- May be owned and managed by the individual entrepreneur, a family, cooperative, limited company of the state.

More specifically, based on organizational aspects, three basic types of small-scale mines with special characteristics can be distinguished as illustrated in Figure 1. The first type, artisanal mining (micro-scale mining) encompasses the smallest and simplest operations. It is characterized by the use of simple tools and the absence of a formal enterprise. Artisanal mining ranges from individuals to more commonly family or village groups, mining legally or illegally. The second group comprises the traditional SSM which includes registered and licensed non-mechanized or semi-mechanized mining operations run by organized society members of entrepreneurs with the use of hired labor. The third group is the legally constituted advanced SSM using highly mechanized techniques. The third group is the legally constituted advanced SSM using highly mechanized techniques.

There are a number of clearly identifiable social and economic benefits associated with SSM in DCs with the following advantages:

- Has high employment potential, especially for unskilled labor
- Low investment requirements
- Short gestation periods
- Does not require elaborate infrastructure
- It is an efficient user of scarce capital, and
- Creates opportunities for indigenous entrepreneurial development

One of the major characteristics of SSM is its low barriers to entry in terms of initial capital requirements, infrastructural needs, implementation time and a minimum amount of reserves. Because of these limited barriers to entry, the artisanal and SSM sub-sector has reached significant proportions in a number of DCs largely in
response to growing youth unemployment. Evidence from these countries, however, confirms that SSM activities can generate quite conflicting effects. It is obvious that the sub-sector incorporates both an important positive and a serious destructive potential (Gavin, 2002). This is particularly the case with regard to the artisanal segment of the sub-sector. The constructive potential pertains to employment, income and foreign earnings effects. However, if conducted in an uncontrollable manner, SSM can also be associated with serious negative implications (Hrushka F, Hentschel T, et al., 2009) and (Mihaye, J, 2013). These include:

- Neglect of safety and hygienic conditions
- Vicious exploitation of labor, including child labor
- Non-adherence to environmental protection regulations, and
- Extensive illegal mining and marketing activities, notably in gemstones and precious metals.
- Cultural and traditional conflicts with existing communities.
- Introduction of new diseases and prostitution into local communities.

From a technical and structural perspective, SSM in DCs can be subdivided into artisanal operations on the one hand and small mining enterprises on the other. Small mining enterprises are formally registered legal entities, usually in the form of single proprietorship companies, cooperatives or limited liability companies. These enterprises generally have basic management structures, hired labor-force and a minimum degree of mechanization. By contrast, the main characteristics of artisanal mining is the absence of a formal legal enterprise, although mining activities as such are usually well organized. Artisanal mining is conducted both as an informal spontaneous activity without legal title to the property worked, and as a formal operation on registered claims. The most significant positive aspect of artisanal and SSM in DCs is the employment effect. Being a highly labor intensive activity, it provides substantial employment to people in rural areas where alternative job opportunities are scarce and low paying. As opposed to medium and large-scale mining, artisanal and small operations, moreover, primarily use inexpensive domestic inputs in the form of locally manufactured simple equipment and tools. Demand for local inputs not only promotes the evolution of a domestic manufacturing industry, it also contributes to save scarce foreign exchange. Equally important is the fact that the use of inexpensive local inputs instead of more costly foreign equipment results in a higher national value added per unit output. Considering all aspects, it is apparent that owing to the intimate linkages with the domestic market, small operations are an important force in regional development. Given that small miners primarily target high value minerals such as gold and gemstones for which there is no local market, SSM is an export oriented economic activity, contributing significantly to the foreign exchange earnings which are usually scarce in most DCs. Apart from the significant beneficial effects of the sub-sector discussed, uncontrolled artisanal and SSM operations can, however, also have a serious negative impact. Of particular concern in this context is the poor health and safety record and the widespread use of hazardous mining and processing practices. Moreover, artisanal and SSM activities cause the destruction of vegetation and the degradation of large areas of land, as mined out prospects are usually abandoned without post-mining reclamation. Much of the land worked by the miners is left with a pattern of waste piles and unsecured pits and trenches, which pose a grave safety hazard to people and livestock. The second serious negative aspect of the sub-sector relates to the extent of lawlessness, disruption of local communities way of life, illegal mining and marketing. Gold and gemstones, the main products of the sub-sector, can be easily traded due to their exceptionally high unit value. In addition, controlling the marketing of these commodities is practically impossible in view of the large numbers of miners involved, their frequently remote locations, their mobility and the small individual product quantities traded. The concurrence of these factors greatly facilitates the evolution of a black market. Available information indicates that in many DCs, more than 50 percent of the production of precious minerals is traded illegally. One of the principal economic consequences of illicit trading in the affected countries is the loss of tax revenues. The other effect is that the potential to increase the national value added through further downstream processing, cannot be utilized. While there may be a number of reasons for illicit mining and trading, it primarily results from inadequate government policies. Cumbersome access to mineral rights is one major cause of illegal mining. A black market usually develops, whenever official prices offered by the government buying agencies are fixed well below world market prices. An overvalued currency, together with high rate of inflation also has the effect of underpricing. The traditional strong ties established by illegal buyers through a mechanism of pre-financing the operations of small producers lacking working capital, frequently is another important factor. It is evident from economic theory that the greatest volume of production and sub-sector income, can only be achieved if the market is allowed to operate freely, offering prices close to the world market prices.

Review of the Sub-sector

It must be noted that the world’s gemstone sub-sector comprises of colored gemstones as well as gem diamond. In relation to other minerals, gemstones are characterized by their exceptionally high unit value, which is a reflection of their scarcity or rarity. For example, a good grade of emerald may have a value of US$6,500 per carat while that of copper may be around US$6,500 per tonne. Thus the unit value of emerald is 5 million times that of copper! Gemstone deposits are small with a highly variable and discontinuous mineralization. For this reason, they are extremely difficult to explore, resulting in exceptionally high geological risks, which is another major characteristic of the sub-sector. A heuristic model developed by De Geoffroy and Wignall which relates in a simple manner the probability of detection of any type of mineral resource to the exploration expenditure is indicated in Figure 2 (De Geoffroy and Wignall, 1985).
It can be observed that initially, the probability of detection rises rapidly with increments in exploration expenditures. However at some point, diminishing returns set in resulting in large expenditures with ever decreasing improvements in the probability of detection until it reaches its maximum value of unity. Given the nature of gemstone deposits, budgets for gemstone exploration to ensure a high probability of success can be expected to be considerably higher than with other minerals, a fact which renders detailed exploration of gemstones economically unjustified. Because of this factor, it is usually not possible to establish any significant amount of reserves with a reasonable level of confidence. This leads to inability to develop convincing bankable documents necessary for raising capital from traditional financial banking systems. Gemstone mining is largely concentrated in DCs. The estimation of actual gemstone production remains one of the most difficult areas in the study of the world gemstone sub-sector, since as previously mentioned, significant quantities are mined and traded illegally. Both open-pit and underground mining techniques are used. Where gemstone pockets are close to the surface, open-pit mining methods are used. This is the most commonly applied mode of operation in gemstone mining. In the case where deposits are deep-lying, simple underground mining methods are employed. Mining operations range from the very simple manual labor-intensive methods to highly mechanized methods. In the case of submerged placer deposits, the river may be diverted to drain the bottom. Otherwise dredging is commonly used. Following the mining operation, gemstones may undergo some downstream processing. The most important value added activity in downstream processing is lapidary work involving the cutting and polishing of gemstone materials and jewelry making. With the exception of a few countries such as India, Sri Lanka, Thailand and Brazil, most DCs do not have a developed lapidary sector and export rough stones. The major cutting centers of colored stones of high value are located in Germany, Israel, Thailand, Sri Lanka, USA, India, France and Russia. China and Japan are well known for cutting jade and other non-transparent materials. Marketing channels for colored gemstones are totally different from those of gem diamond or other minerals. Gem diamond has been synonymous with De Beers. For most of the twentieth century, the diamond market was entirely controlled by De Beers. The cartel controlled over 90 percent of world’s supply of diamonds largely from its own sources. Once De Beers had control of global supply, it could keep prices stable by stockholding rough diamonds during a weak market and then releasing them once demand increased. This total control of the industry meant that De Beers set diamond prices. However, with the arrival of new but significant supplies of diamonds from Russia, Canada and others, the monopoly was destroyed (https://www.diamondspot.com). Today diamond prices are driven largely by supply and demand. Current De Beers market shares is estimated to have dropped to about 33 percent through its Diamond Trading Company (DTC). See figure 4.

By contrast, the marketing of colored gemstones is characterized by an absence of any form of organization to influence prices either by producers or intermediaries. Structurally, the colored gemstone market fits the monopolistic competition which is a type of imperfect competition such that many producers sell products that are differentiated from one another and hence are not perfect substitutes. There are no dominant producers, a fact which has made the establishment of a syndicate like the DTC impossible. In the absence of price support mechanisms for colored stones, prices respond purely to the prevailing supply and demand conditions. The basic determinants of demand for gemstones are its own price, the price of substitutes, price of complements, disposable incomes of consumers reflected by the level of the GNP per capita of any given nation, size of population, and other subjective factors such as taste, fashion and cultural traditions. Of these factors, income is the most important one. A study of the USA which is the biggest single market for gemstones followed by Japan during the period between 1970 and 1991, indicates a strong correlation between the GNP per capita and gemstone demand measured by consumption, as illustrated in Figure 3.
In this study, the analysis of policies and the identification of sub-sector constraints, based on their origin, gemstone sub-sector constraints can be segmented into two categories, namely, (i) external constraints that influence the environment in which the sub-sector operates, comprising of economic and mineral resource policies, and (ii) structurally inherent constraints, such as high geological risks, financial, business management and technology constraints. Mineral resource policies (MRP) are part of the overall national economic policies. Constraints are essentially due to their poor design and promotional quality. If for instance, the national economic policy does not recognize the importance of promoting value addition, then significant social and economic benefits, are lost to foreign markets. Major issues associated with MRP are due to poor design and promotional capacity. Access to mineral rights most often are problematic. The major problems associated with mineral rights have included: (i) the difficulty in securing permits; (ii) rights have not been readily transferable; and (iii) licenses have been of unreasonable duration. Small deposits that can be exploited profitably by small scale miners, have been neglected. This is evident from the sub-Saharan mining sector experience which comprises of large-scale mining operations on one end of the scale and numerous unregistered artisanal mining operations on the other. There is the “missing middle” comprising of formal small to medium-scale operations. The other important aspect of the MRP concerns the poor quality of institutional framework support due to lack of adequate operational budgets from the government. Therefore, the burgeoning small-scale mining sector is constrained from making meaningful economic contribution by the lack of appropriate mineral legislations and an inadequately resourced institutional support required to deal with the demanding task of supervising and monitoring many small miners.

Policy and Strategy Options
In view of the apparent economic significance of the gemstone sub-sector in DCS in terms of employment and income, further efforts to improve the environmental, social and economic performance of small-scale miners, are well justified. An effective promotional policy can be structured into four stages. The first stage aims at creating an enabling environment, including a supportive legal framework. This is followed by institutional building and strengthening measures to effectively support and monitor the sector. Given the large numbers of small miners that tend to characterize the sector, the third stage involves the formal organization of sector activities to create organizational mechanisms suitable for channeling assistance and facilitating monitoring and control. With a formally organized sector, the last stage involves the provision of technical and financial assistance aimed at improving labor productivity and gemstone recovery. From the study conducted, it is evident that there are three key elements for improving the operational business environment of the sector. First, free markets policies must be put in place limiting the state ownership and control of business. Markets must be freed of controls, including foreign exchange markets and gemstone marketing. Second, while all these factors are important, no meaningful investment can take place under conditions of political uncertainty, civil strife, poor fiscal and monetary policies manifesting in high interest rates, hyperinflation and severe foreign exchange shortages. Therefore, a reasonable stability of these factors is also an essential pre-condition for all investment activities. Finally, one possible economic policy option for the sub-sector development promotion is the establishment of economic processing zones (EPZs). Through this mechanism, a number of sector specific incentives can be provided. With regard to the MRP environment, a number of issues need to be addressed. The need for a stable and supportive legal framework, is central for a systematic and efficient sub-sector development. Mineral rights which are easily transferable and of a reasonable duration, must be granted. Further, due to the unique nature of gemstone mining which combines exploration and mining, a single license to cover both activities, would save time and money for the small miners. In the administration of some provisions, such as those pertaining to environmental protection, health and safety standards and documentation, authorities may initially have to exercise some discretion and flexibility to allow for the
limited capabilities of small operators. With regard to the overly sensitive area of gemstone marketing, the only economically efficient way to improve market access and eliminate illegal trading practices, lies in the establishment of a free and open market, accompanied by a market based foreign exchange rate policy. In countries where gemstone production and trading is significant, dealers must be encouraged to establish gemstone exchanges where all matters related to buying, valuation and export, can be conducted. Recognizing the high geological risk associated with gemstone mining, options that minimize investment risks are important. Equipment leasing is one of the most practical approaches. The concept behind this option is to make capital mobile and not tied to any one project. This can also be encouraged through the formation of cooperatives where scarce resources, risks and responsibilities can be shared. Drawing on the parallel experiences from specialized banks of other sectors of the economy, such as agriculture, gemstone trading banks can also be established. They would primarily offer facilities to gemstone dealers for the purchase and export of gemstones. The bank can also provide credit lines to less risky lapidary and jewelry industry for equipment and working capital. The technology constraint typical of the sub-sector is a combined result of two factors, i.e., the lack of finances and the lack of technical and business management skills. Some financing options have already been discussed. The obvious remedy for improving the operational skills of miners is through extensive and ongoing training programs in the form of regular short courses under the auspices of miners associations. Further, the grant of mineral rights should be made conditional upon providing proof of technical competence. In addition, field consultancy services could be provided at affordable rates by the authorities. One of the key factors in the successful implementation of a MRP is the quality of the institutional framework support. Improving the promotional capability of the mining authorities will require that (i) institutions must have adequate professional resources including the right composition of mining engineers, geologists and gemologists with operational experience, (ii) motivated staff with a competitive remuneration scheme be put in place, (iii) an adequate travel budget and transport vehicles for inspection visits be provided, (iv) a SSM unit to deal with specific problems of small miners be established in cases where the sub-sector is significant, and (v) the establishment of field offices in high density mining areas. The lack of finances is usually the major cause of poorly motivated and inadequately resourced institutions. Government, which is the source of finances must recognize that it is only through a high promotional quality of the mining authorities that the sub-sector will be strengthened, monitored and put in a better position to contribute to the treasury. The resulting enhanced contribution of SSM to economic development, will provide the justification for government commitment. Although the downstream processing of gemstones has not received much attention by most producers in DCs, manifested by exportation largely of rough materials, it is the most important factor for increasing economic benefits from the sub-sector in terms of a higher social surplus and creating employment. Already, there are a number of limited initiatives in Tanzania (Kenya and Zambia to develop their lapidary industries. However, given the lack of lapidary skills in most DCs, it is apparent that strategies must focus on the massive training of nationals in this craft. This must be accompanied by the availability of financial assistance for the acquisition of processing equipment and working capital. In an effort to improve the provision of lapidary skills, the Zambian government in 2005 established the Gemstone Processing and Lapidary Training Center (GPLTC) under the Ministry of Science Technology and Vocational training in Ndola (. An assessment of its performance so far indicates declining standards due to poor government funding and lack of policy for value addition in the sector while both Tanzania (Branstrator, B, 2016) and Kenya (Njugunah M, 2017) have made announcements that within the next few years ban the export of gem-quality rough. Rather, the gemstones will be cut before leaving the country in an effort to add value to the stones and boost the economy. Kenya hopes to make Nairobi a gold and gemstones processing centre by offering tax incentives to importers of minerals from across East Africa.

Figure 4. Gemmological and Jewelry Vocational Training Centre in Arusha, Tanzania

Figure 5. Students at Gemstone Processing and Lapidary Training Centre in Ndola, Zambia.

It is evident that the successful implementation of promotional strategies in practice is made difficult by the large numbers of individual operators involved, their mobility and their remote locations. Therefore, reaching the target group with assistance programs requires special organizational arrangements. At the first level, the individual informal artisanal and small-scale miners must be encouraged to form single proprietorship firms, cooperatives, limited liability companies or any other registered legal entity. At the second level, these formalized
firms of partnerships must be encouraged to form associations. This must extend to the usually small numbers of lapidary and jewellery companies that may exist. The main objectives of associations are to represent the sub-sector group interest vis-a-vis authorities and promote the interests of its members.

Conclusions
It is quite evident from the above discussion that the gemstone sub-sector has the potential to drive the economies of DCs once the inherent constraints are resolved. The proposed model suggests some of the general strategies that could assist in achieving this goal. Of course, individual countries may have unique problems that may require a refined approach.

References


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