



Poverty alleviation and artisanal mining in Tanzania

by Wilson Mutagwaba

This paper summarizes the main findings of a research study conducted to establish the influence of technology in poverty alleviation in artisanal mining areas in Tanzania. It is recognized that technological aspects cannot be assessed without also taking into consideration socio-economic, institutional, and organizational aspects that in one way or another affect the choice and application of technology. These factors are therefore also examined.

Small-scale and/or artisanal mining in Tanzania can be traced back to the colonial period and has gone through different transformations over time. It has involved many of the minerals the country is abundantly endowed with, but mostly gold and gemstones, salt, kaolin, building and construction materials. In post independence Tanzania, however, its formal recognition is recent following the realization of its significant contribution to the national economy and as a significant source of livelihood for the rural population.

This sector has been a significant employer as proven by a number of studies.¹ Being largely a labour intensive operation, it has a greater impact on employment than the large scale mines. And although without a systematically conducted census, the population actively engaged in artisanal mining in Tanzania can be grossly exaggerated, its employment contribution is significant. Some of the contributing factors to the anomalies in population estimates include the miners' habits of shifting from place to place following rumours of new discoveries, social organizations and the politics involved. In 1993 it was estimated that there were 280 000 or more artisanal miners on full-time or part time basis.² About 3200 were also estimated to be formally employed in mining of salt, kaolin, coal, gold and other minerals in the country. Chachage³ notes that officially, there were 1440 small scale claim holders and 480 prospecting certificate holders in 1993. He further adds that at a very conservative estimate of 10 000 people per site (probably an overestimation), it is possible that there are about 900 000 people involved in small scale mining and auxiliary activities. While the most recent study conducted by Tandiscovery Ltd. in 1996⁴, contends that more than "555 000 people are directly involved in mining activities around the country, some of these are full time miners while others engage in both mining and other economic activities, especially farming."

In addition, a number of people are involved in the delivery of social services, e.g., food supply, health, personal services like recreation and entertainment. This group forms a significant percentage of the mining communities whose employment is actually created in response to the development of the artisanal mining activities.

Artisanal mining has also been discussed in relation to the significant incomes it generates to certain population groups. Although it may not be realistic to establish a fixed amount of income for such activities, estimates on incomes indicate that some participants earn incomes that are more than the current government minimum salary of TShs. 30 000 per month (about USD50). For example, according to a study done by Tandiscovery⁵, monthly incomes are estimated as follows; the Claim owner in reef gold mining areas gets about USD730, pit owner USD420, mine workers groups (5 people) USD859 or USD172 per individual miner. This is more than three times the minimum salary.

The sector is however plagued by various factors which limit its operational and productive capacity to become a reliable source of livelihood for the entire population concerned, despite its attractive potential. Gross inequalities in having access to mining rights, distribution of income, coupled with poor technical know-how, inadequate technology and thus low productivity and other constraints have trapped most of its population in poverty.

Nevertheless, addressing artisanal mining not as a mining problem but rather as a poverty issue requires a comprehensive approach, which necessitates a clear comprehension of the poverty in question. According to Cooksey⁶, an approach which sees "poverty essentially in terms of inadequate income, consumption or employment opportunities is a poor basis for explaining poverty in terms of socio-economic relations". Likewise, regarding the disfunctioning of a system simply in terms of physical or

Dr. Wilson Mutagwaba, State Mining Corporation, PO Box 4958, Dar-es-Salaam, Tanzania. Fax: +255-51-116 719.



material inadequacies is to claim, in other words, that solutions basically lie in the provision of such factors. For example, Priester et al.⁷ explain the vicious circle of small scale mining as basically caused by lack of training, finance and equipment which in turn generate other negative processes like low efficiency, low production, low wages, poor working conditions and others. However, the problems facing artisanal mining cannot be solved by looking only at its material inadequacies but also at the regulations and practices that attempt to manage it.

This nexus is important since it admits the fact that one cannot visualize poverty in relation to artisanal mining essentially as an instance of inadequacy in physical or material factors (in this case poor technology or working tools), without having an initial understanding of the socio-structural relationships and transforma-

tions taking place within the whole sector and between it and related ones. Being an economic activity, it involves the interaction of various levels and types of institutions. It likewise involves inter-relationships between various population groups each of which has a specific role in its development, and may have very different levels of gain from within it. In view of the question of poverty alleviation, it is thus imperative to explore these various complementary levels to be able to assess the extent of equity achieved by some and the possible factors which bind others in poverty despite the seemingly high income levels some individual miners have gained from the activity.

Technological considerations, however, feature as very significant because of their direct implication on output levels, safety and environmental aspects, which in turn determine the continued well-be-

ing of the populations involved in artisanal mining. As underscored in this contention, "measures to improve working conditions and output need to focus on the quality of work in artisanal mining rather than just the quantity. Any increase in the quality of human effort put to artisanal mining will be more than matched by the quantity, quality and value of output due to more efficient production and higher value added at the primary processing stage prior to sale."⁸

A research study was conducted under the support of the "Research on Poverty Alleviation, (REPOA)", to establish the influence of technology in poverty alleviation in artisanal mining areas in Tanzania.⁹ It was conducted in the mining areas of Mgusu and Rwamagaza (gold) in Geita, west of Mwanza, Mabuki (diamonds) in Misungwi, south of Mwanza, Marelani (tanzanite) in Arusha and Matombo-Ng'ong'olo (ruby) in Morogoro. The selection of these areas was mainly based on the intensity of mining activities for the respective mineral commodity and the area's accessibility. However, as mentioned above it was clear from the beginning that technological aspects cannot be assessed without taking into consideration the socio-economic aspects that in one way or another influence the choice and application of technology. This paper is an extract of the main findings in this research study.

Poverty and technology

Poverty is generally characterized by low incomes and the inability to satisfy basic needs. It also entails an extreme form of exclusion of individuals and families from the productive process, from integration into the larger society and from access to opportunities. The roots of poverty can be found in the unequal distribution of resources and opportunities, socially determined access to the benefits of progress and the inability of governments to fulfill their responsibility to compensate for social imbalances.

A study on poverty thus basically brings to light situations of deprivation of

Working tools in a small scale mining operation in Tanzania.

individuals, groups or communities beyond expected basic requirements of life. However, this deprivation can also be seen as the means and resources for changing one's situation. People are often forced by poor living conditions to enter into various productive enterprises despite the risks involved, or the strenuous conditions for production not only for envisaged benefits, but also for the need to attain basic requirements and to survive. In this regard, attempts to reduce poverty should go beyond the provision of basic services e.g., health and education, to become vehicles of social change by offering the opportunities to acquire skills that those living in poverty can use to construct their own environments through productive activity. Education, skills and technology improve not only the efficiency in production but also the life styles of the producers. Thus, although definitions of poverty begin by expressing a sense of lacking the minimum requirements of life, it should also include a situation whereby a person or a population lives in an environment or material circumstance which impedes the development of certain capabilities, such as that leading to increased productivity, among other factors (e.g., knowledge, information, or inequality in access to resources etc.).

Technology on the other hand refers to the aggregate of mental and physical capabilities designed to address a certain issue, e.g., a problem or production process. Its application thus implies the application of both human potentials (skills, knowledge, information) and physical or material aspects (e.g., equipment, tools and artifacts) to address the issue in question. With respect to poverty alleviation in artisanal mining, this description can be used to explain the objectives of efficiency, whereby technology is referred to as "an aspect of the relationship between man, the natural environment and the satisfaction of material needs and wants".¹⁰ It thus assumes a process linking the natural resources and people's capabilities to tap from it their material necessities.

Technology can thus be adopted to inject or enhance human productive capacities. This situation can be conceptualized through the following aspects:

- *Employment* – technological development allows more efficient use of human labour.
- *Economic* – in terms of its ability to improve or raise productivity and thus also incomes.
- *Time* – facilitation of the production process saves time for other activities.
- *Health and safety* – Will lead to improved health and safety standards.
- *Environment* – Adoption of environmentally acceptable technology.

This description however, falls broadly in what Nguluma¹¹ terms as mechanistic definitions of technology which do not take into account the social relationships involved in such technological applications. This is because, technology does not only entail "mechanistic aspects", it also embodies social aspects related to the organization of production and the nature of other social relations related to the processes of production, distribution

and consumption.¹² On the one hand, generally, the decision to invest in technology taken by most production enterprise is often based more on economic principles than social objectives, whereby profit maximization with minimum costs is regarded as primary rather than adhering to issues like promoting employment and higher income levels for society. As such, the profits accrued may not necessarily benefit all actors in the production process, which without an approach sensitive to the inequalities within the organization of production may make poverty alleviation attempts irrelevant. Technology which is sensitive to production only falls short of addressing poverty alleviation by being insensitive to consumption patterns and the nature of distribution. The organizational aspect of technology, on the other hand, is thus instrumental in promoting a poverty sensitive technology.

This implies that, technology does not operate in a vacuum. Its application in what Chungu and Mandara¹³ term the "technology climate", is normally what determines the nature of the technology to be applied, its effectiveness and its social and economic implications within



the sphere it operates. In relation to poverty, thus, this realization implies that while the processes of poverty are often aspects of other broader processes, e.g., lack of an appropriate technological infrastructure, inequitable macro-economic policies, depletion of environmental resources, etc., which deny people access to basic amenities in life, they are often mediated by institutional structures of law, policy, entitlement and practices which shape an individual's access to and control over resources. Poverty within artisanal mining can thus also be seen as an outcome of the limitations in the institutional and organizational framework guiding the sector. These factors, in many ways, determine or influence decisions for investing in the mining technology. The social organization of production and the nature of the inter-relationships between the different actors in mineral production, nature of mining rights as provided by law are among the various factors which have determined accessibility to, availability of and control or ownership of appropriate technology for artisanal mining.

The remainder of this paper summarizes the main findings of the REPOA research study.¹⁴ The results are presented under the following headings; Socio-Economic Issues, Institutional Aspects, Organizational Aspects, Technology and General Problems.

Socio-economic issues

During this study it was noticed that one of the fundamental issues that needs to be addressed in the question of artisanal mining and poverty, is identifying to whom the question of poverty alleviation is focused. This is essential because under the current set-up, there are obvious differential dispositions and benefits accruing to the various population groups within direct or related mining activities. On the one hand, a majority of the population that enters into such production is disadvantaged in the first place. Children, youths, women, social outcasts, etc., many of whom are forced to engage

in the sector because of poverty, are cases in point. Not only do they lack the capital to invest in it, but they are also disadvantaged in the processes of acquiring claims to be able to operate as entitled claim holders. They are thus at risk and are vulnerable to any dislocation that may occur.

At the same time, informal labour divisions were noticed to have cropped up in the mining areas and were being allowed to prosper as the authorities never seemed to be bothered by it. The license holder, or the claim holder, leases all or part of the claim to pit owners who often assemble a team of miners and remains in-charge of the mining operations. The claim holder in many cases is divorced from actual production processes but awaits to collect his 30-40 per cent of the earnings from each pit owner. Despite this acknowledgment, the claim holder is the only one formally recognized as the miner by the Government. Other functioning groups which include miners who carry out the actual mineral extraction, and specialized gangs that carry out special duties on contracts, e.g., blasting, processing, crushing, grinding etc., are officially non-existent. As a result the following problems arise:

1. The claim area is turned into a series of haphazardly located pits that are detrimental to the miners' safety and the environment.
2. The system is exploitative in that apart from paying for the license, most claim holders invest nothing in the area but reap the highest benefits.
3. The division of earnings between the claim holder/pit owner and the miners is usually determined after deducting the operating costs. There are usually no records of these costs other than a word of mouth from the sponsor.
4. The welfare of miners is in their own hands as they are not regarded as employees but as people with a non-binding contract with the pit owner. For example, the claim holder may

decide to lease a pit to another person with hard cash on short term basis without the miners' consent. This is known as "selling a shift".

Artisanal mining can be seen as an avenue for raising living standards through offering opportunities for gainful employment in the rural areas. It allows for a high degree of flexibility and may fit in with the seasonality of other economic production activities e.g., agricultural production and businesses. Artisanal mining has also provided a significant source of employment to women, youths and the rural unemployed population. However, to a majority, it is an unstable source of employment, depending on the availability of minerals and/or production levels and the government regulatory environment addressing the sector. Child labour was also witnessed mostly in mineral processing activities. Although some of the children admitted that they are attracted by visions of big money, it was gathered that most of them are compelled by the need for money for their families, while others are actually encouraged by their elders.

Overall it was however very difficult to establish a monthly rate of income for this sector because it all depends on successful production of minerals and also because the miners never keep records on production (i.e., they neither have data nor provide returns on production), or submit under stated production figures. Nevertheless, it was established that the incomes from successful activities are quite significant although they vary according to area, type of mineral and the number of people involved. In most cases, incomes are unequally distributed among the mining population (i.e. those engaged in production and the claim holders). In this respect, a majority of the mining population are still deprived economically and become trapped within the production system in expectation of breaking even in future.

According to the miners, income realized from gold mining can rise to as

Manual rock crushing in a small scale mining operation in Tanzania.

much as USD500 to USD1 700 per production season per miner. Drawing from the distribution system of income or produce, this implied that the claim holders benefited more in monetary terms. In the diamond mining areas, incomes were more erratic in comparison to production of gold and rubies. Most miners claimed that the normal amount was about USD800 to USD1 700 per six months period per person. The incomes of Merelani and Matombo are incomparable because of the very nature of gemstones themselves, the difference in mining and processing techniques, application of mechanical tools, etc. However, judging by material accumulation, the incomes in Merelani are substantial. For example, some of the miners have been able to purchase compressors worth USD 24 000 – 32 000. In Matombo, the dwindling market of their rubies plus the shortage of water for processing at certain times reduce miners' earnings substantially. Despite this, the miners acknowledge that it is still a worthwhile undertaking compared to other rural income generating activities.

Furthermore, in many cases, incomes from mining have been sufficient for household sustenance and as capital for other businesses and purchase of assets. Poor accounting and financial management systems have limited the capacities of the miners to invest in profitable ventures. This situation is aggravated by lack of banking services or because of lack of appropriate information on how to invest. It was however noted that much of the development in infrastructure in mining areas owed its status to mining. For example, Merelani, Rwamagaza and Mabuki are typical mining villages now developed into permanent settlements.

Vulnerability is another important dimension of poverty in artisanal mining basing on the 'delicate' social and political environment the miners operate within. Conflicting property (land) ownership policies render small miners vulnerable to dis-ownership when bigger or state interests overrule in the guise of compensa-

tion which is hardly worth the property (ref. the mineral rights overriding all surface rights), or the discrimination in offering prospecting rights to otherwise publicly owned land. Even under the current liberalized system where miners have to enter into negotiations with bigger companies interested in their areas, the idea of a fair game, is still far fetched. While big companies have the capacity to engage lawyers, engineers, economists and other professionals in negotiations, most artisanal miners do not have that capacity and can hardly understand, interpret or sometimes even read the negotiated contracts. As a result, most miners use their instincts to either accept a raw deal or just reject the offer.

Institutional aspects

It was established within the research study that the Government institutions, including the Mineral Resources Division (MRD) of the Ministry of Energy and Minerals (MEM) have failed to cope with the rapidly expanding artisanal mining activities in the country in terms of the provision of technical, regulatory and financial assistance. The coordination of functions and responsibilities between the zonal and resident/district offices of-

ten lags behind the need for mining rights and technical expertise. These deficiencies have impeded the creation of a suitable environment for the development of artisanal mining. In addition, the Government has not yet devised an equitable transfer system of revenue accrued from the mineral economic rent between the central and local governments. The implication is thus the failure to channel realized resources into local development; hence one finds districts like Geita which have been the "gold-pots" of the country for long still very far behind in terms of local infrastructural development, despite their significant contribution to the national economy. Resulting from this, a majority of the people remain inaccessible to most basic facilities.

There are a number of constraints stemming from related legislation or inefficiencies in the implementation of existing law or policy directives. This can be firstly discussed in terms of *property rights*. Protection of land ownership is the foremost significant aspect reflecting a concrete desire for development of artisanal mining. There is however much conflict generated by existing legislation related to land which has been the source of confrontation between the Govern-



and the people in most of the areas where artisanal mining is practiced. Under the existing legislation, land and minerals belong to the Government. As such, land is leased for a specified number of years for a particular use. If minerals are found in that piece of land by the person (or company) other than the developer of the land, the former can be compensated for the development done on the land but not for the land itself. This has resulted in people losing land upon which they grow seasonal crops or even grazing land. It was also noticed during the study that small miners who find minerals in their farms work under the illusion that they have automatic mineral rights. This can be attributed to both the lack of awareness on the miners side but also to the lack of an adequate land ownership policy.

It is the policy of the Government that artisanal mining areas be limited to indigenous Tanzanians only. As such, foreign investors are not allowed to operate in these areas unless there is a transfer of mineral rights. At the same time, it is also the Government's policy to encourage access to appropriate technology and finance by artisanal miners in a bid to transform their activities to more organized operations. Mining is a capital intensive undertaking and thus beyond the capability of most indigenous Tanzanians. For a poor country like Tanzania, one of the major sources of capital and hence investment in technology is through partnership with foreign investors. The country is in the process of reforming her policies so as to attract foreign risk investment. As such, creating barriers between artisanal miners and foreign investors through the disguise of protecting their interests, is self defeating.

Finally, mineral rights for artisanal miners are issued for a period of one year. This period was gathered as limiting especially when miners try to obtain loans or go into joint venture partnership. The period of one year is usually not enough for loan repayment and there is no guarantee for the renewal/extension of

mineral rights ownership. Also, the period usually involved in negotiations for loan acquisition or joint venture partnership, may eat up a big chunk of the one year mineral rights tenure period.

Organizational aspects

There are currently many deficiencies in the marketing system which have a direct impact on the artisanal miners. Firstly, there are limited opportunities for marketing within the production areas. Since 1995, the Bank of Tanzania (BOT) through the then National Bank of Commerce stopped purchasing gold from individual miners. It should be noted here that since 1990, BOT had been purchasing gold from individual miners with no questions asked which resulted in 13.84 t of gold being purchased between April 1990 – April 1994. Secondly, the prices offered by the banks during this time were too low compared to world market prices a situation which discourages the miners thus pushing them to informal marketing channels. For example, at the time of the visit to the gold mining areas, the price offered by the banks was USD 7.5 while that offered by the parallel market varied between USD 10-11 per gram. The world market price for gold was about USD 12.5 per gram. This, coupled with the inherent difficulties in making collections from the artisanal miners by nature of their informal and transient activities, accounts for the meager revenue in the form of taxes or royalties paid on mineral extraction. While mineral dealers and brokers were complaining of the bureaucracy in the issuing of licenses, most were being accused of involvement in illegal mineral trading. As such, at the time of the study, hardly any mineral dealer could be seen in the visited study areas and neighbouring towns.

The Regional Miners Associations, REMAs, have been commended for their role in indirectly assisting Zonal and Regional Offices in overseeing the smooth functioning of activities, but this has been basically when it touches certain interests, e.g., if it interferes with the accu-

mulation processes. Of late, however, the REMAs representation of the miners has declined particularly due to a clash of interests between leaders and members. It has been contended that the leadership often fails to identify with the miners as most of them put emphasis on pursuing their business interests rather than being engaged in actual mining. Other reasons include lack of operational funds. Operating basically on their member's contributions (fees), miners have gradually lost confidence on their leadership a factor that has led to a decline in membership and hence contributions. Apparently, most REMAs have no other solid sources of funds. In some mining areas, independent associations have been established to cater for the cooperative purposes after experiencing disappointments with REMAs (e.g., Merelani-Laisinyai Cooperative – MINASCO). Others have formed small working groups especially after the information that credit could be more easily channeled through such cooperative ventures (Mabuki-Misungwi, and Matombo-Morogoro).

In any case, the major factors leading to REMAs failure are; the mode of establishment of these organizations which was through a top-down approach after being initiated by the Government, the nature of their membership and the determination of any aspect of voluntary collaboration by the miners which is lacking. The implications include the lack of representativeness of the miners interests and loosely organized activities. Consequently, the REMAs have not been able to serve effectively as the coordinating organ between the Government and the miners in promoting the sector. The establishment of voluntarily developed associations e.g., MINASCO in Merelani is a reaction to this failure. Related associations include FEMATA, the Federation of Miners Associations, which was formed in 1984, but its functions are negligible. It does not have office accommodation although in January 1996, fresh leadership was elected to the top posts. The Tanzania Mineral Dealers Associa-

*Small scale mining in Tanzania.
Testing rich ore by panning.*

tion (TAMIDA) formed in 1989, was basically established as a link between the Government and the miners for marketing purposes. It was also supposed to offer technical advice on mineral marketing to the Government. TAMIDA is however not very favourable amongst miners particularly because most dealers have taken advantage of the ignorance on mineral quality prevalent amongst the miners by cheating or lowering prices in auctions, to their own (dealers) advantage.

Technology

Technological problems can mainly be categorized into those associated with mineral extraction, beneficiation, environmental and general problems. The problems associated with mineral extraction were noted at every level of this crucial stage in artisanal mining. The problems can be attributed to lack of technical know-how, lack of appropriate working tools and technology, chronic shortage of capital and other socio-economic problems. Lack of information to miners on different technical issues associated to mineral extraction, add to their problems. In most cases miners do not even know where to go in search of help.

The problems associated with mineral extraction that were observed include the following:

1. Miners have no knowledge of mineral extraction methods that are suitable for the geological conditions in the locality.
2. There is an obvious lack of geological information on the area. Thus, the depth, width, inclination, grade, etc., of the orebody are not known. This is aggravated by the fact that miners do not usually conduct any feasibility study prior to the commencement of production. Normally, conditions of the surrounding rocks are detected during production which is usually too late to take affirmative action.
3. In most sites, where mechanical equipment have been introduced, e.g.

Merelani, they are inadequate for the job as they are not linked to production capacity. As a result, there is under utilization of the equipment.

4. Location of pits is done haphazardly without any technical consideration thus endangering their stability. Pits are located within the zones of influence of others.
5. The sizes of pits are too small to warrant arrangement of a formal shaft, i.e. with manway, hoisting chamber, services, etc.
6. Where supports are used, they are inadequate and in most cases no supports are used, e.g. in the weak laterites of Rwamagaza. In addition the high cost of timber (logs) encourages mining without support.

In all mining sites there is a complete lack of adequate ventilation which has sometimes lead to fatal accidents, e.g. suffocation by CO gases at Mgusu gold mining area. Even in shallow pits that could make adequate use of natural ventilation, the lack of knowledge inhibits its use. It was also observed that expensive equipment like compressors are used to ventilate deep pits e.g., at Merelani. Apart from being an expensive way to

ventilate a pit, a substantial amount of moisture is added into the mine air.

There is not a single mining site that has got rid of manual haulage of ore from the face to hoisting point. As a result, a lot of ore and waste rocks are stocked underground unnecessarily. This complicates both miners and material movement and ventilation. Although some mechanical equipment has been introduced, e.g., at Merelani, the majority still hoist the broken rocks manually. As a result tramming and hoisting constitute one of the major delay points of the production cycle.

Most miners complained of underground water problems. Once mining has reached the water table or encountered any underground water, most operations are suspended due to lack of pumping equipment. The common approach of using a bucket and rope for dewatering is inadequate. On the other hand, there is an acute shortage of water during dry season which reduces washing activities. This is also attributed to lack of pumping and water storage facilities.

Problems with mineral beneficiation can be classified into two categories namely, inadequate equipment and lack of knowledge. The equipment problems



identified that contribute to low throughput and recoveries include those of crushing and grinding equipment (mainly for primary ores), classification and screening equipment (sizing) and mineral separation or sorting equipment. It was also noted that although artisanal mining involves the conventional processes such as crushing, grinding, classification, separation, etc., the knowledge of mineral dressing and metallurgical principles involved is inadequate. Some examples include:

1. Gold miners' rejection of the use of simple retorts for mercury distillation after amalgamation for fear of losing the gold in the retort. Further, there was little consideration or awareness of the seriousness of the hazards accompanying the use of dangerous chemicals like mercury. Miners could be seen handling mercury casually with bare hands, heating the amalgam in open air and thus releasing the mercury vapour to the atmosphere (there is also direct inhalation of this vapour by miners). Besides, mercury is kept in open containers thus allowing it to evaporate easily.
2. Miners complained of difficulties in solving amalgamation problems especially on cases where gold does not fully amalgamate with mercury.
3. Miners' complaint of being overstrained with inefficient screening (e.g., loose sediments with high clay content at Ng'ongolo, Matombo). Despite the fact that screening of gravel is done manually, there is lack of water at certain times of the year such that the initial removal of mud/clay is done with muddy water which may lead to losses of gemstones. In addition, conducting screening with a sticky feed, e.g., with muddy clay, results in blinding of the screens which leads to poor results.
4. There was a clear lack of interest or know-how from miners at Merelani to recover smaller gemstone particles

contained in mined materials which are a result of using blasting during underground extraction. Interviews with Tanzania Gemstone's Gemologist who accompanied us to the site revealed that gems under two carats are found in waste material in fair quantities despite their being marketable. The large stones that have no internal flaws or inclusions are rare though highly valuable. In addition, miners decline or are not able to process the gemstones further after sorting as a means of increasing their values (value added measures).

Technological problems also include environmental issues. The environmental problems that could be observed during this study are those categorised as direct effects, i.e., those which could be visually observed in the field. Indirect effects e.g., the food chain effects, require detailed scientific investigations which were beyond the scope of this study.

The excavated pits and dumps of rubble left behind after mining had ceased were observed to cause severe land degradation. As the pits and piles of rubble become obscured by grass, these areas become dangerous to both people and animals and thus a loss of grazing land. Some abandoned areas in Rwamagaza provide a good example. In addition, agricultural land is lost due to blanketing of the top soil with the waste rocks. The high demand for wood for construction and support leads to an irretrievable loss due to deforestation.

Siltation problems as a result of the washing of ore on river banks were too evident, especially in gold mining areas. Uncontrolled alluvial mining adds to siltation, destruction of river banks with consequences for accelerated erosion, flooding and change in drainage patterns. Although the mining at Mabuki in Mwanza Region cannot be categorized as alluvial, the nature of the terrain where mining is carried out and the washing method used, are good examples of the above problems. Chemical pollutants es-

pecially in gold mining areas where chemicals like mercury are widely used, are a cause for concern. In almost all artisanal mining areas visited, the addition of dust into both surface and underground air was observed. Underground drilling, ore loading, surface crushing and grinding are all dry processes generating enormous amounts of dust. Other observed environmental problems include the uncontrolled blasting in areas like Merelani leading to noise and vibration disturbances. In most sites there is an obvious destruction of the natural beauty due to the distressing sites left behind by haphazardly located pits and piles of rubble.

General problems

In addition to the above observed problems, there are others related to establishing an appropriate working environment which combines the limited organizational, institutional and technical aspects related to technology in artisanal mining as follows:

1. There was an obvious lack of technical advice to miners on sensitive issues like health and safety, transportation and storage of explosives, mine support systems, etc. In addition miners usually do not know where to go for consultation purposes.
2. Mine site inspections are very rare and when done they are too casual to have any effects.
3. There is a clear lack of information pertaining to geology, marketing facilities, equipment, safety matters, etc.
4. There is a complete lack of training facilities and programmes for the miners.
5. Although most working tools are fabricated on site, facilities available for this job are inadequate. Artisans innovativeness could be enhanced through formal/informal training.

Before concluding it is useful to also point at some positive trends identified in the study. Rural development conceived in the form of the mushrooming of rural

townships or peri-urban settlements is also attributed to artisanal mining activities. Most mining settlements start initially as mining camps with temporary shelters, giving the impression of lack of permanence to warrant significant capital or infrastructural investment. This is so because often, most miners are driven by the quest for wealth. They travel long distances or even cross borders into foreign countries responding to 'news' about mineral discoveries. Temporary shelters thus become the most immediate manner of settling done within the new exploit. However, experience has shown that some of these camps develop into permanent settlements or villages, for example, the visited sites of Mgusu, Mabuiki, and Merelani. The people invest basically in personal property like housing, transport and other businesses within the settlements or in their areas of origin. Services normally follow, e.g., health and education sometimes as a response to government intervention (e.g., in Mgusu where a primary school and a church have been built), and other services like food supply, which add to the permanence of such settlements.

Conclusions

Based on these findings, recommendations were made on different measures required from the miners, the Government, Miners Associations, and other related bodies, so as to promote safer and environmentally acceptable activities. The recommendations on policy matters were made by taking into consideration the fact that the Government was in the process of drafting a new mining policy. At the time of writing this paper, a new Mining Policy is already being enacted and the new Mining Act is in the process of being table to the Parliament. One of the notable changes which puts the two documents in line with some of our recommendations is the proposed increase in the tenure period of mineral rights from one to three years.

Apart from recommendations on policy and other socio-economic issues, the

study came out with recommendations on what we regard as appropriate equipment for artisanal mining and processing. Training of miners in issues relating to access and application of technology would enhance not only their productive capacity, but also their health and safety. Both mining and processing techniques were also recommended by taking into consideration the local environment. On the same lines and given the fact that most artisanal mining activities in Tanzania are carried out in very remote areas, recommendations on possible energy sources were made. Issues regarding child labour and gender imbalances which were observed during the study were recommended for further research. In sum, achievement of the above can only be realized by putting in place policies formulated specifically for promoting the artisanal/small-scale mining sub-sector. Such policies should not only aim at maximizing revenue flows to the Government, but also transforming the artisanal operations to more organized operations. The efforts being made by the Government and looking at the new Mining Policy and Act, give very encouraging signs for promotion of the activities of this sub-sector into sustainable ones.

Notes

1. Lwakatare (1993), Chachage (1995), Tandiscovery (1996).
2. Lwakatare (1993).
3. Chachage (1995).
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