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Protracted Environmental Issues on a Proposed Titanium Minerals Development in Kenya's South Coast

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This study takes cognizance of the fact that the TIOMIN (TIOMIN Resources Inc. of Canada) project has resulted in controversy over its handling of environmental issues and especially the Environmental Impact Assessment (EIA). The authors address many of the protracted issues that have slowed the development of the mining project in Kwale. The main emphasis is on the impacts of the mining and mineral separation processes on the environment, including the governing legislation, the role of consultation and public participation, and socioeconomic issues. In their public documents TIOMIN has specified neither the type of minerals it wants to extract from the area nor their chemical composition. It is well known, however that the titanium minerals and zircon targeted have impurities of iron, thorium and uranium. In the absence of an Environmental Management Plan, the effects of stockpiling radioactive wastes and other impurities that could possibly lead to environmental degradation in both the terrestrial and marine environments have not been publically addressed. The measures proposed to mitigate ecological damage as a result of the establishment of a minerals processing plant in the area seem inadequate. Pollution resulting from accidental spillage or breakage could have significant impact on marine life and residents living near the mining site. Other issues that have not been addressed satisfactorily pertain to the use of surface and underground water. The area already faces a huge water deficit and the calculations presented on aquifer recharge and stream flow rates do not indicate the large quantities of water that would be required in the mineral processing plant. The project, if approved in its present state, risks violation of international conventions. Furthermore, it could cause a conflict between Kenya and Tanzania in the event of an oil spill at the proposed ship loading facility at Shimoni. The proposed mining area includes the district's most fertile land, is home to many fisherfolk and is a major tourist destination. An analysis of the effects of this project on other available opportunities must be thoroughly understood to ascertain the economic and environmental benefits and costs of the mining venture. The proposed compensation rate of \$1,000 per acre, for resettlement for example, appears to be grossly inadequate.

We would like to thank Prof. Theo Davies and Dr. Victor Odenyo for their useful comments, anonymous government officers for access to unpublished reports, and Mr. Joseph Kanda for preparing the drawing.

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Compensation should take into account family size and structure family assets and the cost of relocation.

Keywords ecosystem services, environmental questions, legislation, open cast mining, resettlement, ship loading facilities, titanium minerals, water abstraction

Introduction

The existence of detrital heavy minerals in the form of local beach and dune deposits has been recognized for many years along the Kenyan coast (Pulfrey 1942; Thompson 1956; Williams 1962; Halse 1980; Abuodha and Nyambok 1991; Abuodha 2003). TIOMIN Resources Inc. of Canada, with TIOMIN Kenya Ltd. and Kwale Titanium Minerals Ltd. as subsidiaries have carried out a reconnaissance exploration in the coastal areas of Kenya and confirmed the economic potential of heavy mineral mining. The preliminary survey (TIOMIN Resources Inc. 2002) focused on the southernmost deposit sited in Kwale District. The survey revealed high grades of heavy minerals consisting of titanium minerals and zircon.

The Kwale project objective is to extract heavy minerals from old dunes in the Kwale District at sufficient volume to be economically viable. It is proposed that after mining, the sands will be processed in a primary concentration plant (wet plant) to recover heavy mineral concentrates. These concentrates will then be separated into their constituent mineral products in the Mineral Processing Plant (MPP) located adjacent to the proposed mining area in Kwale. The products will comprise ilmenite, rutile, and zircon. These will be transported to a ship loading facility located at Shimoni and sold on the international market. It is envisaged that this project will generate foreign exchange in export revenue, create employment, and improve the gross domestic product (close to 1% GDP) of Kenya.

The Kwale project is the largest mining venture since independence. In Kenya, the mining and quarrying sector accounts for only 0.14% of GDP, the majority of which is contributed by a soda ash operation at Lake Magadi followed by fluorspar mining in the Kerio Valley. Both soda ash and fluorspar are exported as raw materials, but stagnant world prices have had a negative impact on the sector in recent years.

The TIOMIN Prospecting License covers the Mambroi, Sokoke, Vipingo, and Kwale areas (Figure 1). The resources within these four separate concessions are estimated to total 5.6 billion tonnes, equivalent to 40% of the world's ilmenite and rutile resources. Exploration data indicates that the Kwale deposits alone have 0.2 billion tonnes of titanium-rich sands. TIOMIN expects to use 56 km² of land in the Maumba and Nguluku dune areas for mining. These two areas of the Kwale concession contain economic concentrations of heavy minerals, with average grades of the order of 5.7% and 3%, respectively. The deposit in question and the proposed operation could sustain a 15-year mine life. The initial production rate at Kwale is estimated to be 300,000 tonnes a⁻¹ of ilmenite, 75,000 tonnes a⁻¹ of rutile, and 45,000 tonnes a⁻¹ of zircon. The former two are titanium oxides minerals whereas the latter is a silicate of zirconium.

TIOMIN is investing US\$140 million and provided that the company meets all the legal requirements, production is scheduled to start in 2007. The government has granted TIOMIN a Prospecting License, a Special Mining Lease and an Environmental Permit, even though the Environmental Impact Assessment remains contentious to date. The first assessment was carried out by Coastal and

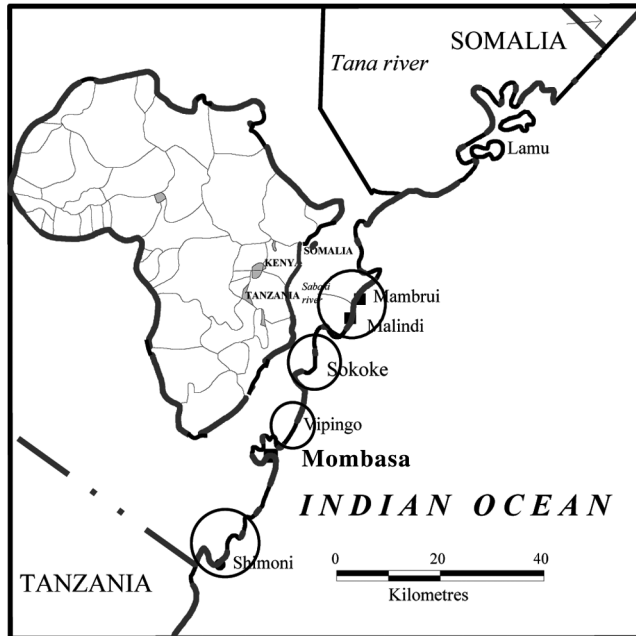


Figure 1. Map of the Kenyan coast showing the four concessions covered by the TIOMIN Prospecting License; circled from north-southward, they are Mamburi, Sokoke, Vipingo and Kwale areas.

Environmental Services of South Africa an agent appointed by TIOMIN. Notwithstanding allegations of conflict of interest. This procedure is required by law. Some local people did their own assessment, which disagreed with the first one but a court case in which the local residents demanded higher compensation from TIOMIN was ruled by the High Court in favor of the company.

Other than the benefits cited there are serious environmental concerns that may need to be addressed before the project can proceed. Abuodha (2002) has given a critical environmental assessment review of the project. The issue of compensation, resettlement, and effects of the project on the area's marine life are considered the most serious of the environmental concerns. The mine will directly displace about 5,000 people and will seriously disrupt their social structures. This article addresses some of the protracted environmental issues that may not have been addressed satisfactorily by the project proponent and the licensing authorities.

Who Will Benefit from Titanium Mining?

It is still unclear how the titanium minerals can be exploited to ensure maximum economic benefits for Kenyans. There is an apparent need to have enabling policies on the integration of titanium earnings into the local and national economies and for which a revenue plan on the project is necessary. This would reveal to Kenyans the expected revenues with plans for their management and would help to forestall the possibility of corruption and mismanagement of these finances by the government managers.

On a socioeconomic perspective it is clear that mining would result in multiple user conflicts with various economic activities in Kwale. The climatic conditions and fertile soils in the proposed mining area support luxuriant agriculture. The main crops cultivated are maize, cassava, watermelon, pineapples, and assorted vegetables. On many farms, coconut, mangoes, and cashew nuts are grown. The few uncultivated areas are used for grazing of domestic livestock that include cattle, goats, and sheep. The area also has high potential for sugarcane growing and part of the area required by the project includes lands of the former Ramisi Sugar Factory. Loss of access to the sea and fish landing points would be detrimental to the fisherfolk, especially after they are resettled further inland. Kwale district and its surrounding settlements and coastline are a major tourism destination. This has never been considered and not been adequately discussed in the mining development plan, although tourism is the leading contributor to the Kenyan economy.

An “opportunity cost” analysis of this project that considers in detail the current economic activities in the area including fishing, tourism, and sugarcane growing must be made to determine the financial and economic multiplier effect of the project. In addition, an environmental economic analysis must be used in the calculation of project finances; this will ensure that the project internalize the cost of impacts on human beings and the environment, such as loss of ecosystem services (externalities) in the total cost of the project (Sida 2003).

The project will bring financial benefits to the country and invigorate a sector seen as largely dormant. TIOMIN is expected to pay royalties, rent, and corporate and other taxes to the government, and thus increase the revenue base of the local and national economy. Furthermore, such a substantial amount of revenue will not only increase the GDP but will also earn much-needed foreign exchange. It is estimated that 200–250 people will be employed directly for operations on the mine site. During the peak phase of construction, 1000 people mostly local, will be employed. Attracting over 1000 people to a new location will result not only in a regional multiplier effect on about 10,000 people but will also increase demand for both commercial and social services. Other economic benefits of the project include construction of all-weather quality roads, and the building of new, upgraded or relocated community facilities such as schools, health centers, churches, and mosques.

The mining company seeks to export the ore through Shimoni for further processing abroad. Construction of a smelting plant at Kwale or Mombasa, however, would contribute to a local “value added” on the minerals mined and might realize desired multiplier effects on the local economy by creating more jobs and increased revenues for the government.

The Mineralogy and Geochemistry of the Heavy Minerals

TIOMIN had stated in its application for a special mining lease that it intends to mine all minerals found in the area. It is contended by the authors that the application and subsequent license must specify the minerals to be mined. This disclosure is important since royalties and corporate taxes paid to the government are calculated on the basis of the minerals specification.

The heavy mineral sands are composed primarily of ilmenite, hematite, magnetite, rutile, and zircon, with trace amounts of garnet, monazite, tourmaline, hornblende, and augite. The chemical composition of titaniferous ilmenite averages 51.1% Fe_2O_3 and 47.9% TiO_2 . The iron that occurs in ilmenite in appreciable

quantities could possibly be extracted economically as a by-product in a smelting plant. Rutile contains 96.2% TiO_2 but has impurities of uranium and thorium at 28.0 ppm and 24.7 ppm, respectively. The main constituents of zircon, which is a silicate ZrSiO_4 , are 66.0% Zr, 32.5% SiO_4 , and impurities of uranium and thorium at 309 ppm and 143 ppm, respectively. Manganese, chromium, and vanadium are also found in trace quantities.

Scientists have expressed concern that the mining wastes could expose human, marine and plant life to high doses of radiation. TIOMIN and the Australian Nuclear Science and Technology Organization (ANSTO) have noted that radioactivity level of combined impurities would be 74 bq/g and 50bq/g, respectively.

According to the World Health Organization (WHO) and the International Atomic Energy Agency (IAEA) standards, 75 bq and above is considered as dangerous. The difference between the TIOMIN data and these standards is very close. The development of mitigation plans should address any effects resulting from the generation, transportation, and disposal of radioactive wastes. Improper handling of wastes could result in stockpiling of impurities on land and water that might lead to significant environmental degradation.

The Mining Methods and Mineral Separation Process

Mining of titaniferous heavy minerals involves a number of processes, each with intrinsic adverse environmental impacts. The mining and mineral separation processes are highlighted here with their possible environmental consequences.

The Mining Process

The mining process will be in the form of open cast mining. The mining process is proposed to start with the Maumba dunes for about seven years. TIOMIN proposes to use mechanical excavation to remove the sand from the dune for further processing. It is estimated that about 11 million tonnes of material will be processed each year. The effects of devegetation will produce a significant change in the population status of species, including impacts on species diversity and loss of special habitats such as those used for breeding, resting, food, or migratory sites.

The Primary Concentration (Wet) Plant

In the primary concentration (wet) plant, sand will be slurried with water, and gravel, roots, and leaves will be removed by screening. A large volume of water and electrical power will be needed in this wet process. It is important to address the availability of these resources. Secondly, the handling of suspended solids and dissolved heavy metal substances are of environmental concern.

The Mineral Processing Plant

The mineral processing plant will be established immediately northeast of the Nguluku dune. This plant will process the heavy mineral concentrate coming from the wet plant and separate it into ilmenite, rutile, and zircon products. In general, the mineral processing plant proposed by TIOMIN consists of a feed preparation circuit where ilmenite is separated, a rutile circuit, and a zircon wet gravity circuit,

which leads to a zircon dry circuit. Each circuit generates valuable minerals to be transported to the ship loading facility and some rejects that will be pumped to the tailings dam. The remnant of this process will be quartz sand and clay with small quantities of heavy minerals. The mineral processing plant will generate dust in both the rutile and zircon dry circuits. Therefore, dust abstraction systems are mandatory in order to reduce suspended particulate matter in the air and associated environmental health risks to the workers and neighboring communities. The mitigation measures suggested by TIOMIN to address the ecological impacts of building a mineral processing plant appear inadequate. The environmental risks should not be underestimated, as any possibilities of accidental pollution due to spillage, of breakage could have significant impact in the neighborhood of the plant and populations living downstream.

Tailings Disposal Dams

Tailings disposal dams will be constructed to hold portions of washed ore that are regarded as too poor to be processed further. The dams will be created in depressions dug out of the top soil. One of the greatest environmental problems of mining is the leakage from such sludge dams (Sida 2003).

Tailings dam failures result generally from an overflow of the slimes caused by heavy rains. Risk of seepage, leaching, or breakage of the tailings dam could have significant impact, which must be addressed in detail with adequate mitigation measures. For example the risk of the dam bursting owing to incorrect dimensions can be minimized by ensuring that the safety margin is sufficient. Further, disposal of gypsum poses the danger of gypsum leaching in groundwater with possibly significant impact. This should be considered along with the presence of radioactive elements in the area and that 600 tonnes of sulphuric acid will be used per year. The mitigation measures provided therefore may not be adequate to offset this. When the tailings dam dry up during the dry season, wind erosion and transport could cause workers and people living in the neighborhood to be exposed to potentially harmful dust.

Related Infrastructure and Material Transport

Section 58 (1) and (4) of the Environmental Management and Coordination Act of 2000 (EMCA) requires that projects that are bound to have a wider impact require the completion of an EIA. Furthermore, EMCA requires that category A projects, which include large scale mining development projects, be subjected also to a comprehensive EIA study. So far, no EIA has been conducted in regard to the proposed development of related infrastructure such as roads, power supply, port, and new settlements despite being included in the second schedule of the Act. The development of these infrastructures without the relevant assessments is in contravention of the EMCA. This provision also affects any drilling for the purpose of utilizing groundwater resources.

The project proposes to construct a small access road of 5 m wide designed for light traffic between the wet plant and mineral processing plant. However, permanent access to the actual mine site will be along the existing D546. The road to the ship loading facility at Shimoni will be upgraded. It is therefore envisaged that there will be site-specific environmental impacts related to road infrastructure such

as vegetation clearing and soil erosion associated with road construction. It is also envisaged that there will be an increase in (heavy) transport on access roads.

A pipeline system will be constructed from the wet plant to the mineral processing plant to facilitate the transportation of 600,000 tonnes a⁻¹ of heavy mineral concentrates. The pipeline system was probably the best alternative; it is considered a compromise between capital and operating costs as well as environmental impacts.

The mining operations will require large amounts of power. It is envisaged that a diesel-powered plant with a generating capacity of 16 megawatts will be established. Environmental concerns in this case include air pollution from gas emissions, especially the release of SO_x, NO_x, CO, CO₂, volatile organic compounds (VOC), polycyclic aromatic hydrocarbons (PAH), heavy metals, and particulate matter. Many of these are greenhouse gases which have an effect on global warming. Possibilities of acid rain as a result of emissions from the plant must also be considered.

The EIA report by TIOMIN indicates that the project would transport by tanker 600 tonnes a⁻¹ of sulphuric acid, 600 tonnes a⁻¹ of slaked lime and 30,000 tonnes a⁻¹ of heavy fuel. No attempt has been made to ascertain the possible impact(s) on other road users especially at the Kilindini Ferry.

Exploitation of Surface and Groundwater

The technology used in this operation will consume a significant quantity of water. The availability of this amount of water is still uncertain. A more thorough study involving hydrological systems analysis and simulation models is required to arrive at the most suitable water supply options. The proponent is also required to understand the obligations under the Water Act Cap 372 (Republic of Kenya, 2002) and put measures in place to ensure that all requirements of the Act are fulfilled. The Act vests the rights of all water to the state and the power for the control of all bodies of water with the minister. The powers are exercised through the Minister and the Director of Water Resources in consultation with the Water Catchments Authorities and Water Regulatory Boards. It aims at among others; conservation, apportionment, and use of water resources. The ministry is mandated to monitor pollution of any watercourse and water user fees.

TIOMIN estimates the consumption of water at 34,000 m³ day⁻¹, assuming 50% recovery. It has identified three potential sources of supply which include River Mkurumudzi, Koromjong Dam and groundwater aquifer. The flow rates in the River Mkurumudzi are not enough to meet the water demand throughout the year. With drought in the area being cyclic and flows recorded as minimal at 190 m³/day⁻¹, the water resource of this river does not seem adequate for exploitation. The proposal by TIOMIN to exploit groundwater in the Kilindini aquifer is probably more viable; this option should however be incorporated into the National Water Master Plan.

The possibilities of salt water intrusion in the Kilindini aquifer should not be underestimated, as excessive pressure on the aquifer is bound to lead to severe draw down. Since the boreholes are located near the Gongoni forest, an occurrence of salt water intrusion would lead to serious damage to the forest ecosystems, especially with increasing demand for fresh water. The National Water Master Plan shows the area will be experiencing a water deficit equivalent to 9,000 m³ day⁻¹ by 2008. Utilization of water from this source should therefore take into consideration

competing demands of the other water users in the local community for livestock watering and environmental retention.

More studies on the hydrochemical characteristics of the aquifer are needed to determine its water quality for future auditing. The quality and safety of water generated from the mineral processing could be troublesome. This is mainly due to the impurities contained in some of the minerals. A possible release of radioactive elements and heavy metals in the water could lead to toxic consequences for both human beings and animals.

Ship Loading Facility at Shimoni

Shimoni is located 35 km south of the Kwale deposit. Site investigation for a proposed port at Shimoni revealed that there is a deep-water channel protected by fringing reefs. The older reefs form the base of Wasini Island, which is home to two Swahili villages, Wasini and Mwakirio.

The development of a ship loading facility at Shimoni could disrupt the current fishing activities in the area and grossly affect the livelihood of the local people. Shimoni is an important tourist destination due to its uniqueness and close proximity to the Kisite/Mpunguti Marine National Parks managed by Kenya Wildlife Service. The Fossil Coral Garden and historic Shimoni Caves are unique touristic features. The area is also important for swimming, snorkeling, diving, dolphin watching and bird watching.

The Wasini Channel will need to be dredged to accommodate shipment of the expected heavy loads. The destruction of coral reefs and changes to sediment transport patterns could cause critical impacts to the marine ecosystem.

The role of Kenya Ports Authority (KPA) appears to have been overlooked, yet it has the statutory mandate to oversee development of all port facilities along the Kenyan coast. Considering the costs and benefits of other alternative sites such as Dongo-Kundu for location of port facilities, it could be economically and environmentally appropriate to access the Kilindini harbor in Mombasa using a railway network instead.

Although TIOMIN considers the risk of ship accidents and oil spills as improbable, such an eventuality could have severe ramifications on the coastal and marine environments. Because of the close proximity of Shimoni from the Kenya/Tanzania border, any spillage could bring about intercountry conflict. Since no EIA has been carried out for the port, there are no mitigation measures put in place to undertake a cleaning exercise or compensate the affected should such a spill occur.

Consultation and Public Participation

Consultation and public participation (CPP) is an EMCA (Republic of Kenya, 2000) and World Bank (1991) requirement for EIAs in mining development projects. In the proper definition of CPP, involvement of the local populace would benefit the project in the following ways:

1. Improve understanding of the potential impacts of proposed projects;
2. Identify alternative sites or designs, and mitigation measures, to improve environmental and social soundness;
3. Clarify values and trade-offs associated with these different alternatives;

4. Identify contentious issues;
5. Establish transparent procedures for carrying out proposed projects; and
6. Create accountability and a sense of local ownership during project implementation.

Public participation has been one of the problems with the titanium project. TIOMIN has had varied consultation and public participation at levels targeting government authorities and the affected communities. At the community level, the major mode of communication was through public meetings, the “baraza.” Ombura (1997) and Balinda et al. (2003) refer to the problem with this approach to public participation within the EIA process. It often follows the authoritative and delegative approach when a District Officer (DO) calls an ad hoc meeting to propagate the government statements and position. These statements are usually misconstrued as “Government Development Agenda.”

The critical concern in the review process is to what level the affected and interested parties were involved, considering that the spatial scale of the impacts could stretch outside the mining area. There was need to include the views of as many interested parties as possible, including local universities and research and development institutions in the development of participation plans. The result has been poor information disclosure mechanisms by both the project proponent and the relevant government departments dealing with the issue.

Danger of Violation of International Conventions

An international convention is a legally binding contract that binds all concerned member countries to respect and act according to its provisions; disrespect of which attracts international sanctions (UNESCO 1996).

There are a host of conventions, which Kenya has ratified and is legally required to follow in regard to the proposed mining project. Approving the project in its current state would be contrary to the provisions and spirit of these conventions. Some of the conventions that would be contravened include:

1. International Convention for the Prevention of Pollution of the Sea by Oil, 1954, as amended in 1962, 1969, and 1971 and ratified by Kenya on 12 December 1975;
2. International Convention for the Prevention of Pollution from Ships, London, 1973 (MARPOL) that was ratified by Kenya on 12 December 1975;
3. Conventions on the High Seas, Geneva 1958, ratified by Kenya on 20 July 1969;
4. Convention on the Continental Shelf, Geneva 1958, ratified by Kenya on 20 September 1969;
5. London Conventions on the prevention of marine pollution by dumping environmentally hazardous wastes and other matters at sea, London, 1972 and ratified by Kenya on 17 January 1976 (see Ship loading facility at Shimoni);
6. African Convention on the Conservation of Nature and Natural Resources, Algiers, 1968 and ratified by Kenya on 16 June 1968;
7. UN Convention on the Law of the Sea, Kingstone, 1982 and ratified by Kenya on 10 December 1982;
8. Kenya and Tanzania Treaty on the Delimitation of the Territorial Waters Boundary between the two states signed in 1975, and was effective from 9 July 1976;

9. Convention on Biological Diversity, Rio de Janeiro, 1992;
10. UN Framework Convention on Climate Change, 1992; and
11. Basle Convention on handling, transport and disposal of hazardous waste.

Environmental Legislation, Policies and Standards

It is a World Bank (1991) requirement for category A projects which include mining to be subjected to a full EIA study. TIOMIN Kenya Ltd., being an affiliate of a multinational TIOMIN Resources Inc. of Canada is obliged to meet International Standards ISO 14001 as part of their environmental policy. In addition to International Standards Guidelines and international treaties that Kenya is party to, there are also several domestic laws that govern this matter.

The Constitution of Kenya, Chapter 5 Section 75 provides for the protection of property. The manner in which the issue of acquisition of land for mining has been executed in this case contravenes Section 75. According to the constitution, the government must show that it needs the property for a public purpose and that full, just, and prompt compensation shall be paid.

The Environmental Management & Co-ordination Act (EMCA) No. 8 Section 58 (2) requires an EIA Licence before the operation of the project can proceed. The Kwale titanium project is the first major project to undergo a full EIA under the new law. In this case several provisions within the EMCA touching on environmental safety will be contravened. EMCA is a framework law to coordinate and regulate different sector-specific legislations. EMCA came into operation with the establishment of the National Environment Management Authority (NEMA) in 2002. The role of NEMA is to set EIA regulations and administrative procedures in a nonpartisan, professional, and coordinating mode.

The Mining Act (Cap. 306 Laws of Kenya). The government authority in the field of minerals development is the Mines and Geological Department in the Ministry of Environment and Natural Resources. Of concern in legislation is that the Mining Act (enacted in 1940) has outlived its relevance, and is therefore a source of the current land use and mining lease conflicts. According to the Mining Act, all the minerals belong to the government and the landowner has no right. This concern of mineral ownership rights is stirring controversy in land compensation for displacement where value of land is still measured on its original agricultural value. The government can lease out the land in question for 21 years after which the land will revert back to the people, but only after adequate restoration by the mining company. Based on experience in Macalda Gold Mines and the Kerio Valley Fluor-spar Mines in western Kenya this provision is more observed in its breach. The Mining Act, therefore not only needs a review to address the concerns raised, but also to consider its harmonization with EMCA (2000) in order to inculcate the principles of sound environmental management.

Land Acquisition Act (Cap. 295 Laws of Kenya). The practice of acquisition of land for public interest is stipulated in this act. Usually, the government acquires land compulsorily under the Land Acquisition Act. The underlying assumption is that the planned activity is superior to everything else and justifies the sacrifice of interests of all nationals. Compensation is paid at a rate determined by the government agencies and the people are ordered to vacate the land and seek settlement elsewhere.

It is also important to mention other local laws relating to the environment, health, and safety as well as those dealing with the specific sectoral problems of exploitation and preservation of resources, namely:

- The Public Health Act (Cap 252 Laws of Kenya),
- Physical Planning Act (Cap. 286 Laws of Kenya),
- Agriculture Act (Cap. 318 Laws of Kenya),
- Water Act (Cap. 372 Laws of Kenya) revised in 2002,
- Forest Act (Cap. 385 Laws of Kenya),
- Factories and Other Places of Work Act (Cap 514 Laws of Kenya), and
- Electric Power Act No. 11 of 1997.

There is an urgent requirement that these Legislative Acts be harmonized with the framework law, EMCA, to allow effective regulation and enforcement. This harmonization process will also remove the conflict of interest and ambiguity regarding which of the laws is superior in natural resource management. The authors have proposed use of the EMCA as the overriding coordinating legislation.

Furthermore, there are a number of laws applicable to the protection and conservation of marine and coastal environments in East Africa. These laws, given the location of the project area are likely to be affected, considering the proposed development of a ship loading facility at Shimoni.

Environmental Management Plan (EMP) and Rehabilitation

An EMP details the measures to be taken during the construction, operation, and decommissioning phases of the mining project. When mining processes are discontinued, there are required processes of rehabilitation and restoration. While an EIA focuses on scoping adverse environmental effects anticipated and how they will be mitigated, an EMP is an enforceable plan of action that forms the basis on which the proponent will take responsibility. An EMP provides an essential link between the impacts predicted and mitigation measures specified in the EIA and operational activities. It should not only outline impacts and mitigation measures, but also include responsibility, timescales, costs of mitigation, and sources of funding.

The EMP that has been developed by TIOMIN (TIOMIN Resources Inc. 2002) lacks many essential features. For example, it does not show how the mining area will be rehabilitated and restored or what percentage of the gross income is going to be utilized for this purpose. After decommissioning the mine 15 years down the line, the potential for complete and successful rehabilitation and restoration will be lessened given that the processes unleashed on the landscape can be profound.

Compensation and Resettlement of Landowners

As noted above, there is limited opportunity for compulsory acquisition by the government for a public purpose under the Land Acquisition Act (Cap 295 Laws of Kenya). However, the operating company has acted contrary to this provision on the issue of compensation. Its conduct is synonymous with compulsory acquisition by a person other than the government.

The initial compensation rates of Ksh 9,000 an acre for resettlement and an annual lease of Ksh 2,000 that were offered to Maumba and Nguluku farmers were grossly inadequate (1\$ = Ksh 80). Recently, the government unilaterally

increased the compensation rate to Ksh 80, 000 after resistance by the community and protracted court battles. Compensation rate should consider the family size and structure. Valuation of assets should include structures, trees, and other viable land use systems or community shared resources in order to calculate the correct compensation rates.

Involuntary displacement of the population may augment poverty, unemployment and landlessness. Uncertainty in the resettlement program may also manifest itself in dislocation of social structure; cultural identity, social cohesion, and social networks may irrevocably be disrupted, as individuals, families, and communities are unlikely to settle adjacent to their former neighbors. It is difficult to qualify and quantify convincingly the social impacts in monetary terms to arrive at a just compensation. They can only be factored in the “opportunity cost” analysis as contingency and surrogate measurements.

The compensation plans should reflect the realities of resettlement such as:

1. Dramatic increase in the market value of land in the whole area owing to demand;
2. Many of the landowners are squatters and have no legal land registration documents to show security of tenure;
3. The suitability of the resettlement area in terms of climatic conditions and opportunities; and
4. The cost of relocation and support during the transition period.

Conclusions

1. Limited water, energy, and land resources will attract massive demand, and the project proponent has not adequately addressed these.
2. A detailed Environmental Management Plan is required to address continuous rehabilitation of the mining area.
3. Related infrastructure and new relocation areas will cause wide impacts and TIOMIN needs to commission separate EIA for them.
4. Construction of a smelting plant will add value to the minerals and the multiplier effect will contribute to more jobs and revenue for the government. Iron that is present in ilmenite in rather appreciable amounts could be also be extracted as a by-product.
5. Public participation and adequate consultation, including as many interested parties as possible would educate the hostile public on anticipated environmental impacts and economic benefits expected from the mining venture.
6. The TIOMIN project has revealed many conflicts in the national laws which need to be harmonized with EMCA for effective implementation.
7. An environmental economic analysis of the project would internalize the costs on human beings and environment, such as ecosystem services, in the total cost of the project.

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