



NATIONAL ENVIRONMENT MANAGEMENT COUNCIL

**3RD SCIENTIFIC CONFERENCE ON ENVIRONMENTAL
SUSTAINABILITY IN TANZANIA:**

MINING AND ENVIRONMENT

ABSTRACTS

**26TH – 29TH MAY 2009,
NSSF BUILDING, MWANZA**

**Supported by: DANIDA through EISP, UNDP through P-E Programme, Chamber
of Mines and the National Environment Management Council (NEMC)**

BACKGROUND

Introduction

One of the shared issues facing countries with mining activities is the deterioration of its environmental quality such as surface and ground water, air, coastal and marine environments. Others include deterioration of biodiversity, health hazards, and conflicts in land use and other resources. The mining sector faces major challenges of ensuring sustainability and integrating environmental and social concerns into mineral development which should ultimately contribute to sustainable economic growth and poverty reduction in the country.

In this context the National Environment Management Council (NEMC) has organized her 3rd Scientific Conference on Environmental Sustainability Tanzania with a focus on “**Mining and Environment**”. The major objective of this conference is to provide a platform for various stakeholders: scientists, managers, investors, practitioners and decision makers to share information in this area of great economic importance for poverty eradication and sustainable environmental conservation. The Conference is being held in Mwanza from 26th through 29th May, 2009.

Objectives

The specific objectives of this conference are to:

- Provide an opportunity for stakeholders in mining sector to present scientific papers and exhibitions on sustainable mining and closure issues;
- Provide an opportunity for all stakeholders to discuss challenges and environmental issues related to mining for the purpose of formulating recommendations on relevant management actions;
- Encourage ongoing national, regional and international networking;
- Facilitate documentation of current scientific knowledge and experiences through publication of quality scientific papers, proceedings and other means of information dissemination and sharing; and
- Raise public awareness on the importance of sustainable mining for sustainable environment and socio-economic development.

Major Topics

Major topics in this conference include: Small scale mining: Prospects, opportunities and challenges, Environmental impacts of mining, Policy and legal issues in mining and environment, Socio-economic impacts of mining, Mine closure, Water Resources Management, Small scale mining: Prospects, opportunities and challenges, Environmental impacts of mining, Policy and legal issues in mining and environment, Socio-economic impacts of mining, Mine closure and Water Resources Management.

Organisation of the Conference

To enhance partnership and efficiency, an Organising Committee was formulated, drawing members from key stakeholder institutions. The Organising Committee has been meeting to discuss, advise and deliberate on key issues for a fruitful conference. NEMC which is the organiser has been on the lead, serving as a secretariat to the Organising Committee.

Outputs

A number of tangible outputs include: Conference proceedings; Priority issues and recommendations for further actions; and Priority areas for research.

Members of the Organising Committee:

- Bonaventure T. Baya - Director General (NEMC): Chairman
- Ruzika N. Muheto - Director, Environmental Planning and Research (NEMC):
Deputy Chair
- Winifrida Mrema - Ministry of Energy and Minerals - Environment Section
- Elizabeth Nkini - Ministry of Water and Irrigation
- Twaha Twaib - Ministry of Natural Resources and Tourism – Wildlife Division
- Crispin Kinabo - University of Dar es Salaam - Geology Department
- Angelina Madete - Vice President’s Office – Department of Environment
- Emmanuel Massawe - Lawyers Environment Action Team (LEAT)

Secretariat

Fadhila H. Khatibu
Arnold Mapinduzi
Francisca Eugene
Jamal Baruti
Rose Sallema
Yohana Mtoni
Kanani Mudiguza
Benedicto Kilemo
Angel Mwatujobe

CONFERENCE PROGRAMME

FLOOR MANAGER: A. MAPINDUZI

DAY 1: TUESDAY 26TH MAY, 2009		
<i>Rapporteur: F. Khatibu, J. Baruti and E. Massawe</i>		
TIME	ACTIVITY/EVENT	RESPONSIBLE
SESSION I: OPENING <i>Chair: J. Mrema</i>		
0800 – 0900	Registration	SECRETARIAT
0900 – 0910	Arrival of Guest of Honour	DG-NEMC
0910 – 0920	Welcome remarks	MAYOR
0920 – 0930	Welcome remarks	RC – MWANZA
0930 – 0940	Objectives of the Conference	DEPR – NEMC
0940 – 0950	Opening Remarks	DG – NEMC
0950 – 1010	Opening Speech	GUEST OF HONOUR
1010 – 1020	Vote of thanks	MEM
1020 - 1050	Group photo and Health Break	
SESSION II: SETTING THE STAGE <i>Chair: J. Mrema</i>		
1050 – 1110	Keynote: Implementation of Environmental Policy and EMA in the Mining Sector: Prospects and Challenges for the Future	A. MADETE
1110 – 1130	Keynote: Environmental management practices in the mining sector	MEM
1130 – 1150	Mining and Conservation: past, present and future scenarios	J. G. MREMA
<i>1150 – 1220</i>	<i>Discussion</i>	
1220 – 1240	Climate Change: Impacts on the mining sector in Tanzania	L. VAN DEN BERG
1240 – 1300	Dimensions of carbon footprints of the mining operations in Tanzania	DEPR
<i>1300 – 1330</i>	<i>Discussion</i>	
1330 – 1420	Lunch Break	
SESSION III <i>Chair: J. Mrema</i>		
1420 – 1440	Constructed wetlands for hydrocarbon and sediment control at Resolute Tanzania Limited Golden Pride Project, Nzega, Tanzania	A. MACHA
1440 – 1500	Exploring the available environmental and cost benefit approaches for mine water savings	G. G. MWAKYUSA AND W. MUTAGWABA
1500 – 1520	Arbitration in water conflicts as alternative to litigation: The case study of Geita Goldmine	E. NKINI
<i>1520 – 1550</i>	<i>Discussion</i>	
1550 – 1610	Unraveling environmental sustainability around mining areas in Tanzania: Will corporate social responsibility policies and practices deliver the promises?	D. KASONGI

1610 – 1630	Social and environmental impacts of gold mining in Lake Victoria Goldfields, North-western Tanzania	C. KINABO
1630 – 1650	Artisanal mining and environmental pollution, could regularization solve the problems	A. G. MWAKAJE
1650 – 1710	Health Break	
1710 – 1730	<i>Discussion</i>	
1730	END OF DAY 1	

DAY 2: WEDNESDAY 27TH MAY, 2009		
<i>Rapporteurs: C. Kinabo R. Sallema, and D. Kilemo</i>		
SESSION IV		
<i>Chair: R. Ntakamulenga</i>		
0900 – 0910	Recap on Day 1	FACILITATOR
0910 – 0930	International Cyanide Management Code – Certification Barrick Mines, Tanzania	I. TURNER
0930 – 0950	Ground water pollution caused by seepage from Tailing Storage Facilities (TSF): A case study of gypsum dumpsite in North of Ghent, Belgium	Y. MTONI AND C. WALRAEVENS
0950 – 1010	Mercury contamination in domestic fowls and selected food crops in Geita, NW Tanzania	C. KINABO
1010 - 1040	<i>Discussion</i>	
1040 – 1100	Health Break	
1100 – 1120	Geomedical hazards caused by toxic contaminants in mining areas – A clinical perspectives	M. ZENGO
1120 – 1140	Salt scalding investigation of a waste rock dump in Golden Pride Project, Tanzania	N. MWENESI
1140 – 1200	Acid Rock Drainage: An overview of Global Acid Rock Drainage Guide (GARD)	R. REYNEKE
1200 – 1230	<i>Discussion</i>	
1230 – 1250	Opportunities for Mineral Prospecting and Explorations in Protected Areas in Tanzania	T. TWAIBU
1250 – 1310	The impacts of mining activities on forest resources in Nyamongo Gold Mine, Tarime District, Tanzania.	V. TILUMANYWA AND P. MARO
1310 – 1340	<i>Discussion</i>	
1340 – 1430	Lunch Break	
SESSION V		
<i>Chair: Mr. R. Ntakamulenga</i>		
1430 – 1450	Environmental and Social impacts of sand mining activities along Mbezi and Mpiji Rivers, Dar es Salaam	Y. MTONI AND D. MWITURUBANI
1450 – 1510	The Role of MPA in controlling coral mining practices in Tanzania	H. M. MAHINGIKA AND N. E. MBIJE
1510 – 1530	Opportunities and challenges in administering EIA in mining projects	F. Rugiga
1530 – 1600	<i>Discussion</i>	
1600 – 1620	HEALTH BREAK	

1620 – 1640	Promotion of gender equity and women empowerment in mining	T. MWASHA
1640 – 1700	Environmental Management at Golden Pride Projects	A. MACHA
1700 – 1730	Discussion	ALL
1730	END OF DAY 2	

DAY 3: THURSDAY 28TH MAY, 2009		
FIELD EXCURSION		
VENUE: CONFERENCE HALL		
0800 – 0820	Briefing	MAPINDUZI
0820 – 0830	Boarding	ALL
0830	Departure for Field Excursion	ALL
1700	Return to the Venue	ALL

DAY 4: FRIDAY 29TH MAY 2009		
<i>Rapporteurs: Mr. K. Mudiguzza, Ms. F. Eugene and Ms. Winnie Mrema</i>		
SESSION VI		
<i>Chair: R. N. Mubeto</i>		
0900 – 0910	Recap on day 2	RAPPORTEURS
0910 – 0930	An Introduction to Social Closure Planning	C. TEOLIS
0930 – 0950	Tanzania Challenges Pertaining to Mine Closure	W. MUTAGWABA
0950 – 1010	Socio-Economic and Environmental Aspects of Mine Closure: A Tanzania Perspectives	Y. MTONI AND I. C. MJEMA
1010 – 1030	Tulawaka Gold Mine closure planning	E. SUMAY
<i>1030 – 1100</i>	<i>Discussion</i>	
1100 – 1120	Health Break	
1120 – 1140	Challenges associated with enforcement of Environmental Standards in the mining sector	R. NTAKAMULENGA
1140 – 1200	Sustainable environmental management practices in mining, Tanzania	K. SHOO
<i>1200 – 1230</i>	<i>Discussion</i>	
1300 – 1400	Lunch Break	
SESSION VII		
<i>Chair: R. N. Mubeto</i>		
1400 – 1420		
1420 – 1440	Discussion	ALL
1440 – 1600	The way forward: Issues for research	FACILITATOR
1600 – 1630	CLOSING	GUEST OF HONOUR
1630 – 1700	Health Break	
1700	END OF THE CONFERENCE	

CLIMATE CHANGE IMPACTS ON THE MINING SECTOR IN TANZANIA

L. VAN DEN BERG
CAMCO, South Africa

Companies across the globe are acting to tackle a new challenge to the way businesses think and operate. This challenge is climate change. From potential impacts on assets and operations, through to regulatory changes and the emergence of new markets, climate change is rising rapidly up the global business agenda. Companies that respond to climate change as a strategic issue are well positioned to mitigate their climate risks, whilst benefiting from the substantial opportunities on offer.

There are various risks presented to the mining industry in Tanzania by this phenomenon:

- Regulatory Risk
- Investor Risk
- Reputational Risk
- Competitor Risk
- Physical Risk

Sound response measures are required to reduce the risk exposure of mining operations and their surrounding communities to changes in legal, market and environmental conditions brought about by climate change. To achieve this, appropriate adaptation measures are required to ensure effective company preparedness. By investigating these adaptation techniques, various opportunities present themselves in the fields of:

- Reduction of Carbon Emissions
- Reduction of Consumption of Electricity
- Alternative Energy Sources
- Reduction in Consumption of Fossil Fuels
- Biomass, Land use and Forestry
- Carbon Market Opportunities Including The Clean Development Mechanism
- Health and Safety, Including Disaster Risk Reduction
- Corporate Social Responsibility

Through thoughtful investigation and implementation of these opportunities, climate change related risks for the Tanzanian mining community can be minimized and new opportunities for cost reduction, industry leadership and environmental compliance advanced.

THE DIMENSIONS OF CARBON FOOTPRINTS OF MINING OPERATIONS IN TANZANIA

RUZIKA N. MUHETO

Directorate of Environmental Planning and Research, National Environment Management Council (NEMC), P. O. Box 63154, Dar es Salaam. Email: rmuheto@yahoo.co.uk

Mining is one of leading sectors with higher contributions to the national economy. The economic development should go hand in hand with environmental and social considerations. This will enhance sustainable development. One of the most significant impacts of mining operations is the emission of greenhouse gases that cause global warming. The greenhouse gases (GHG) emitted by a particular entity are collectively referred to a carbon footprint of that entity.

There are global initiatives of some companies to understand their respective carbon footprints and take actions to reduce emissions through various mechanisms, carbon trading being the major incentive. The situation is different for Tanzania. The current environmental management practice especially in mining operations does not pay much attention on management of GHG.

This paper tries to review the carbon footprints of mining operations globally and relates the global situations with the Tanzanian context. The paper also identifies some bottlenecks and recommends some actions.

**Constructed Wetland for Hydrocarbon and Sediment Control at Resolute Tanzania
Limited Golden Pride Project,
NZEGA – TANZANIA**

A. MACHA

Golden Pride Project, Nzega. Email: anaelm@resolute-ltd.com.au

The Golden Pride Project is the gold mine located in Nzega District, in central North of Tanzania. The mining lease covers an area of 33,998 ha, sited about 18 km North of Nzega Township. The project is owned and managed by Resolute (Tanzania) Limited.

Infrastructure has been built to support the mining operations; one of the most important facilities is the Earthmoving contractor workshop and yard. The Earthmoving contractor's yard covers an area of approximately 3 ha. The yard comprises mine truck wash pad, refueling bay, workshop, stores, offices and lay down areas. All surfaces within the yard are considered to be disturbed and comprise either impervious surfaces e.g. roofs and paved areas, or compacted earth surfaces. Yard runoff occurs during the Wet Season between December and April when over 90% of annual rainfall typically occurs. This yard has a history of sediment and hydrocarbon discharge during the Wet Season. There is potential for this to impact off-site environments as this drainage system reports to adjacent agricultural lands (rice pads, maize crops and grazing lands).

It is predicted through hydraulic modelling techniques that the constructed wetland system will manage the volume of water produced from the entire yard area and treat runoff water to the desired water quality. This system is a passive treatment system and shall remain in place at closure of the site.

EXPLORING THE AVAILABLE ENVIRONMENTAL AND COST BENEFIT APPROACHES FOR MINE WATER SAVINGS

*G. G. Mwakyusa and W. Mutagwaba

MTL Consulting Company Limited, PO Box 77894, Dar-es-Salaam, Tanzania.

The mining industry in Tanzania is growing at a very high speed with about six large scale operations all of them commissioned in less than 12 years. This high growth brings a higher demand of resources required for the extraction of minerals among those resource water being the highly demanded and consumed. This brings up a need to control and preserve this most important and cheap commodity which at the same time is becoming scarce in the entire world. This can be controlled in two ways of water saving; the demand side control through water savings and recycling and the supply side control through restrictions and tariffs alterations. This study focuses mainly on the demand side control (recycling/dewatering) since that is the more practical approach. The initial stage in dewatering is to decide the type of disposal to be adopted either wet or paste tailings disposal. This is then followed by the flow sheet development in this paper six water recovery flow sheets are presented. The study conducted from a selected case study in Tanzania reflects a possibility of savings about US\$ 13 million for a period of 8 years. The increase in water demand, an expand in stress and scarcity regions as well as the rapid growth of the mineral processing industry makes the whole idea of dewatering of tailings for paste disposal a necessity.

ARBITRATION IN WATER CONFLICT AS ALTERNATIVE TO LITIGATION CASE STUDY IN GEITA GOLD MINE

E. NKINI

Ministry of Water and Irrigation, Dare Es Salaam

Arbitration is effective in water Governance since it brings stakeholders together to examine the political processes and analyze water governance systems. It creates a platform for conflict resolution, negotiation, social learning and collective decision-making. It helps to build trust among the participants and promote information exchange. The discussion normally centered on real cases and focus on action. It has been suggested that dialogue among conflicting parties is faster and leads to better outcomes than subjecting the disputes to legal process, which sometimes take a long time to reach legal agreement. In this paper a presentation is made on the application of arbitration as conflict management mechanism in mining. The process has confirmed the reality that dialogue is superior to judicial proceeding, especially to developing country where corruption is rampant and court procedures extremely lengthy.

UNRAVELLING ENVIRONMENTAL SUSTAINABILITY AROUND MINING AREAS IN TANZANIA: WILL CORPORATE SOCIAL RESPONSIBILITY POLICIES AND PRACTICES DELIVER THE PROMISES?

D. KASONGI

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Destinations for natural resource-based foreign direct investments have always been rendered fragile, almost making environmental sustainability debate rhetoric. Escaping the resource curse has been a challenging endeavour for local and central government institutions vested with environmental governance stewardship. Lessons from North Western Tanzania's gold rich districts indicate that environmental governance in such context requires a comprehensive approach bringing together analyses of benefit sharing, competently managed restoration and a framework for participatory management. The promises of sustainability measures are always encapsulated in Corporate Social Responsibility frameworks, the conventional wisdom for the corporate sector to redress negative impacts and contribute to sustainable local development.

The paper examines the expectations of communities and local government institutions on the development labelling of Corporate Social Responsibility around mining sites in North Western Tanzania. Recent analyses by ACORD in Geita District found no evidence on the conventional wisdom that corporate sector compliance on Corporate Social Responsibility will provide local compensation on sustainable local development including environmental considerations. In practice; there are no explicit frameworks for neither responsibility or accountability for companies' compliance. This reality is exacerbated by weak institutional linkages amongst regulatory bodies at local and central government levels, absence of regulatory competence at local government level and unprepared ness of the local governance.

The far reaching implications of systemic failure in environmental governance around mining areas are the spiralling natural resources conflicts, critical community reactions from communities including arson to sabotage investments and community loss of trust to local government system.

The paper concludes that, unless national environmental regulatory bodies expedite the establishment of frameworks and processes for environmentally responsive Corporate Social Responsibility alongside filling the competence vacuum at local government level on accountability monitoring, the worst case scenarios of the resource curse will be inescapable.

SOCIAL AND ENVIRONMENTAL IMPACTS OF GOLD MINING IN LAKE VICTORIA GOLDFIELDS, NORTHWESTERN TANZANIA

C. KINABO

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Email: kinabo_2003@yahoo.co.uk*

Since the enactment of the Mining law in 1998, Tanzania has become a new frontier for large-scale, technology intensive gold mining, which has opened the doors for international mining operations. However, the country has been slow to take advantage of the experiences and findings of others mining countries in order to ensure mining actually benefits those it influences most within her own borders. Clearly, Tanzanian Mining Policy advocates that communities must participate in activities that directly affect them as a means of achieving sustainable development. Yet this has yet witnessed in practice. Companies avoid dealing with most of environmental and social issues simply because they are translated into the new Mining Act of 1998 from the Policy of 1997. This factual right has therefore contributed little to the community development and environmental rehabilitation programs.

Parallel, the enactment legalized small-scale mining operations in exclusive areas have made important contribution towards rural employment. Conversely, this pattern of socio-economic development has increased environmental impediment – mercury pollution, land degradation and water pollution. Policies, technological demonstrations and educational initiatives have addressed mercury problem without overall success since planning to implementation of such initiatives do not in many occasions involve mining community needs and prevailing local geological conditions. This paper critiques the policy and legal reforms in the mining sector to address social and environmental and highlights how the industry and the Government can improve the sector's performance.

ARTISANAL SMALL-SCALE MINING AND ENVIRONMENTAL POLLUTION: CAN INNOVATIONS ON INSTITUTIONAL FRAMEWORK AND BUILDING CAPACITY SOLVE THE PROBLEM?

A. G. MWAKAJE

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Tanzania has a great mining potential for numerous minerals such as gold, base metals, diamonds, coal and phosphate. The Mining sector also plays a key role for livelihoods, employment and its contribution to the GDP. Over 1,000,000 Tanzanians are engaged in mining and more than 90% are artisanal and small-scale mining (ASM) actors. However, the impacts of ASM on environmental pollution are of high concern. There is a high level of Mercury (Hg) concentration in river sediments and soils within gold mining activities. ASM lead to degradation of landscape aesthetics, pollution to ecosystem health, and is linked with health problems such as malaria, sexually transmitted diseases and spread of HIV/AIDs.

This study investigated the strengths and weaknesses of the current institutional framework governing ASM mining sector and suggests innovations that could redress environmental pollution problems. The study focused on analysing institutions governing (policy, laws, regulations and organisation) ASM and the capacity gap of the ASM and how these affect environment. The choice of ASM and environmental pollution was purposive. ASM is growing at an unprecedented rate and environmental pollution/degradation is alarming.

The methodology for data collection involved reviewing different policies, laws and institutions governing the mining sector in Tanzania. Consultations were made with stakeholders including the Ministry of Minerals and Energy, The Vice President's Office – Environment and Ministry of Natural Resource and Tourism. Further, there was intensive review of different case studies of ASM and best practices were highlighted.

Although policies and laws of the mining sector are comprehensive and address most of the issues pertaining to ASM very little has been done on the ground. The process of applying for licence indicated in the Mining Act of 1998 and Mining Regulations of 2002 is long and bureaucratic, and hence deter many of the ASM to comply. On the other hand, The Mining Advisory Committee (MAC) which regulates the mining sector does not represent the interests of ASM. The legal requirement for environmental management and protection under ASM is fairly comprehensive, however very little is indeed enforced. Illegal mineral trade across the border is high and the profits and potential foreign exchange earnings is not realised by the government.

Capacity gaps in the ASM include poor mining technology and high risk involved in the sector. Most of the ASM do not have adequate capital to improve productivity and banks are wary of ASM producers due to high transaction and operational costs of working with them. The poor relationship between ASM and large scale produces affects their performance and most of the scarce resources have been used in security instead of production. It also affects ASM from acquiring knowledge and capital assistance from large scale mining.

Recommendations for further improvement includes, minimising environmental pollution through better organization, training and introduction of environmentally friendly technologies. There should be also efficient credit services for ASM operators including formation of SACCOS.

INTERNATIONAL CYANIDE MANAGEMENT CODE – CERTIFICATION: BARRICK MINES, TANZANIA

I. TURNER

Cyanide Code Specialist for: Barrick – Tanzania, Freight Forwarders Group, Orica Mining Chemicals

The "International Cyanide Management Code" for the Manufacture, Transport, and Use of Cyanide. In the Production of Gold" (Code) was developed by a multi-stakeholder Steering Committee with the stated objective to "improve the management of cyanide used in gold mining and assist in the protection of human health and the reduction of environmental impacts." The International Cyanide Management Institute (ICMI) is the governing body for the Code. Signatories to the code must be audited for compliance within three years of becoming a signatory.

Barrick Tanzania needed to ensure that all of its mines in the country became certified under the Code. At the same time it was essential that the Producer and the Transporters were also certified under the Code. The Producer and Supplier of Cyanide - Orica Mining Chemicals had their production facility - certified in November 2006. This audit also included transport within Australia. The sea transportation was considered Code Compliant

The author had spent several years involved with HSE in Eastern Africa and had built a reputation on the needs of the Code and especially the approaches required by the Mines, Producer and Transporters to effect safe management of Cyanide. Using the Code's Auditor's Guide as a basis, a "table-top" audit was conducted at the mines and the transporters. This gave a Gap Analysis which was used to formulate action plans for each operation.

Once the action plans were in place, it was decided to have an external Third Party Audit company conduct Pre- Audits on Barrick - Tulawaka Mine and the two Transporters Freight Forwarders - Tanzania & Kenya. Using the external auditors gave a better insight into the actual interpretations of the Code. Barrick decided that, since several mines had been externally audited, there were enough experienced personnel within Barrick to perform internal Pre-Audits on Barrick - Bulyanhulu & North Mara Mines.

In both cases the Pre-Audits established gaps and action plans to close those gaps. By early 2008 arrangements were made to start the Code Audit process. These were completed over a period of approximately eight months by an external Third Party Audit company. With the exception of Barrick – Bulyanhulu, which was found to be Code Compliant "at audit", all the operations were found to be substantially compliant "at audit".

The gaps identified by the auditors however, were minimal and were closed within the ninety day audit submission period. The Auditors submitted the evidence to the ICMI. Their review process takes about 6-9 weeks. Once agreed by the ICMI the "Compliance Notification" is posted on the ICMI Website. These were posted as follows: Freight Forwarders (I) 22 May 2008; Freight Forwarders (K) 27 May 2008; Barrick Tulawaka: 31 July 2008; Barrick Bulyanhulu 13 February 2009; Barrick North Mara Audit - 15 December 2008 - awaiting posting.

The two-year project has been beneficial to both Barrick Tanzania Mines, Freight Forwarders Tanzania and Kenya. The true beneficiary of compliance to the "International Cyanide Management Code" has been Tanzania. We have better informed, trained, and protected workers at the mines and in other sectors of the infrastructure which can only lead to better environmental protection.

GROUNDWATER POLLUTION CAUSED BY SEEPAGE FROM TAILING STORAGE FACILITIES (TSF): A CASE STUDY OF GYPSUM DUMPSITE IN NORTH OF GHENT, BELGIUM

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Groundwater pollution, often due to contaminant seepage from mine or industrial waste disposal sites, is a worldwide problem. Such contamination of groundwater resources potentially poses a substantial risk to local resource users and to the natural environment. This paper was prepared focusing on a case study of gypsum dumpsite in North of Ghent (in Belgium) with the aim of sharing the facts and ideas on the ways improperly managed or constructed tailing storage facilities (TSF) can cause water pollution, the effects of such pollution and how we can control the pollution. This case study is significant important to the country of Tanzania just like any other countries conducting mining and mineral processing activities. Many operations are involved in processing minerals to separate the wanted minerals/metal from the host rock. Processing operation can adversely affect the environment, more so, by causing water pollution problems, through the disposal of resulting wastes. Gypsum is a by-product of the manufacturing of phosphoric acid from phosphate rock (apatite). A case of gypsum dumpsite pollution was investigated by geophysical prospection. The electromagnetic prospection successfully mapped the lateral distribution of pollution whereas the depth distribution of pollution was described by well logging. By combining these results together with the results of water analysis, 3-dimensional demarcation of the plume pollution was established. The considered groundwater reservoir comprises KZ2 (the upper aquifer), KL (semi-pervious loamy layer) and KZ1 (the lower aquifer) layers. KZ1 and KZ2 are permeable aquifers contrary to KL in which groundwater mainly flows in the vertical direction. The lower aquifer KZ1 has higher hydraulic conductivity than the upper aquifer KZ2. This has enhanced somewhat more spreading of pollution in the former than the latter. Contaminated water percolating from the gypsum dumpsite gets into groundwater through the unsaturated zone to the water table and travels away in the form of a spreading plume of contaminated groundwater in the direction of groundwater flow. In order to determine the groundwater flow in the study area, piezometric measurements were carried out for both KZ2 and KZ1 aquifers. From the established isoline maps of hydraulic heads, the groundwater mainly flows to the northeast direction to the canal tunnel at Zelzate. A part of groundwater flows to the northern direction of the study area and also to the southeast direction towards the canal "Ghent-Terneuzen".

MERCURY CONTAMINATION IN DOMESTIC FOWLS AND SELECTED FOOD CROPS IN GEITA, NW TANZANIA

C. KINABO

University of Dar Es Salaam

Mercury (Hg) accumulation in agricultural soils from informal gold mining operations increases export potential of the metal to the environment. Concentration of Hg in domestic ducks (*Anser sp.*), chicken as well as selected food crop tissues (beans *Phaseolus vulgaris*, groundnuts *Arachis hypogaea*, sweet potatoes *Ipomoea batata* and yams *Calocasia sp*) were analyzed in artisanal small scale gold mining village at Mgusu in Geita District, NW Tanzania. Total mercury (THg) content in tissues was determined by absorption spectrophotometric methods. Highest THg levels (mg/kg) in domestic ducks were found in liver (ducklings: 30.5; juvenile: 254.1; mature ducks: 590.2), followed by gizzards (ducklings: 45.9; juvenile: 230.3; mature: 254.6), lungs (ducklings: 12.2; juvenile: 29.1; mature: 46.9) and feathers (ducklings: 0.1; juvenile: 62.1; mature: 198.3). Similar trend was also observed in domestic chicken. Highest total mercury were found in liver (chicken 5.3; juvenile 690.9; mature 1066.7), then by gizzards (chicken 69.3; juvenile 99.7; mature 140.5) and lungs (chicken 9.4; juvenile 36.6; mature 109.3). Feathers showed values ranging between 0.0 for chicken, 121.8 for juvenile and 345.4 for mature hens.

Plants showed both spatial and temporal variations in Hg concentration, as noted in different sites. Highest THg concentrations were found near amalgamation ponds, which varied from 462 ppb (dw) in sweet potatoes, followed by beans (410 ppb) and yams (100 ppb). The lowest values were found mostly in groundnuts, which were below the detection limit of 0.01 ppb (dw); in fact, groundnuts grown in same places as potatoes and beans were free of mercury contamination. Clearly, mercury uptake occurs because of abiotic sources and is absorbed selectively by food crops, while domestic fowl's is indiscriminate. THg in animal tissues was correlated with both inhalation of inorganic mercury and gaseous dimethyl mercury. The content in feathers was correlated to inorganic Hg exposure during bathe in both amalgamation pond waters, soils and sediments.

GEOMEDICAL HAZARDS CAUSED BY TOXIC CONTAMINANTS IN MINING AREAS: A CLINICAL PERSPECTIVE

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The fast-developing field of medical geology (geomedicine) which deals in part with the threat to health from natural silent poisons could help explain the toxicology of elements released or used in the mining areas. Since the focus in natural hazards work is almost exclusively on the effects on human, the introduction of geomedicine, with its extended concerns for animals and plants, might help balance anthropocentric attitudes toward the environment and, thus, to stress continuities within the biosphere. Different health problems such as ataxia, optic neuropathy, encephalopathy, cardiovascular disorders, kidney problems, infertility, cancer, skin diseases, partial paralysis, metal fever, osteomalacia and many others have been reported in mining communities. Most of them are linked to toxic contaminants such as mercury, cyanide, lead, arsenic, and uranium. The main source of these elements is the ore carrying the mined element/gem and the chemicals used to help separate the intended mineral/element from the ore. If improperly managed, the toxic elements get contaminated in water sources, soil, plants, and air. Through ingesting contaminated water, plant parts or breathing contaminated air at certain dosage, humans are poisoned. A comprehensive review on the source, route/path and physiological abnormalities these elements cause in the human body is the focus of the paper. Understanding these facts, geomedicine, on a more practical level, may stimulate and provide guidelines to policy makers and planning authorities in their dealings with places where high or low natural background levels for chemicals released in mining areas to soil and water can harm humans, plants or animal health.

SALT SCALDING INVESTIGATION OF A WASTE ROCK DUMP

N. MWENESI

Golden Pride Project, Tanzania

The Golden Pride Project (GPP) is located in the Lusu Ward, Nzega District, and Tabora Region in central Tanzania. The mining lease covers an area of 3,375 hectares, about 18 km North of Nzega. Resolute (Tanzania) Limited (RTL) is the manager of the project operations, and the mine has been operating for nine years. The processing of gold ore is done by the cyanide leaching method, and the tailings generated are discharged to the two large paddock style storages. Waste rock is disposed of in two waste rock dumps, namely the North Waste Rock Dump (NWRD) and the South Waste Rock Dump (SWRD).

Salt scalding visible at the soil surface was observed at the (SWRD) over an area of approximately 2ha, and the area was permanently saturated throughout the last three dry seasons. Some other wet spots were also observed at the SWRD toe, benches and batters. A 20cm deep trench excavated at the lower bench trench filled with water after 24 hours in the middle of the dry season.

An investigation was undertaken in December 2007 to determine the source of salt scalding in order to determine whether it emanated from the tailings dam, the SWRD or natural sources. The investigation was also done to identify problems associated with the particular source of salt, and to provide recommendations for a solution. Laboratory results indicated elevated level of salts moving from the lower bench of the SWRD towards the wet area. SWRD infiltration, solute transport and consequent evaporation are believed to be the source of salt water scalding at the South West side of the SWRD and Tailings Dam No.2. This is clearly evidenced by the water which is seeping from the SWRD and accumulates in the trench. The results of the laboratory investigation demonstrate the relationship between the water in the lower bench trench and the water at the Swamp.

The main purpose of this study was to ensure Long-term stability of the SWRD and also to make sure that the dump leachate would not be transported through the Bundomo Creek towards the Bundomo River and cause adverse impacts on people using the river.

ACID ROCK DRAINAGE: AN OVERVIEW OF GLOBAL ACID ROCK DRAINAGE GUIDE

R. REYNEKE

Acid rock drainage (ARD) is formed by the oxidation of sulfide minerals when exposed to air and water. It is a natural, ongoing process that takes place in all geological units which contains sulfide minerals. In undisturbed areas these minerals are normally enclosed in rock masses and only the outer few, in the weathered zone, are exposed to oxygen and water, making a very small percentage of the sulfides available for the generation of ARD. Activities such as mining that involve the excavation of rock with sulfide minerals may expose these sulfides and accelerate the process.

The drainage produced from the oxidation process may be neutral to acidic, with or without dissolved heavy metals, but always contains sulfate.

The potential of ARD from mining was identified as early as 1556. In 1698 ARD was identified in Pennsylvania coal mines and since 1970's much research has been done on ARD processes and impact reduction. Most of the research, however, focused on specific issues, were related to specific commodities, were done in particular geographical areas and was not readily available.

The International Network for Acid Prevention (INAP) is an industry group created to help meet the challenge of acid drainage. It was established in 1998 to fill the need for an international body which mobilizes acid drainage information and experience. INAP has sponsored the development of the Global Acid Rock Drainage Guide (GARD Guide).

The GARD Guide deals with the prediction, prevention, and management of drainage produced from sulphide mineral oxidation, often termed "acid rock drainage" (ARD), "saline drainage" (SD), "acid mine drainage" or "acid and metalliferous drainage" (AMD), "mining influenced water" (MIW), and "neutral mine drainage" (NMD). The GARD Guide also addresses metal leaching caused by sulphide mineral oxidation. This paper presents a short overview of the key elements in the GARD Guide.

OPPORTUNITIES FOR MINERAL PROSPECTING AND EXPLORATION IN PROTECTED AREAS – TANZANIA

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Wildlife and Wetlands of Tanzania are unique natural heritage and resources that are of great importance both nationally and globally. Their importance lie both in the biological value of the species and habitats found in Tanzania, and their potential to contribute to sustainable development. It is for this reason that Tanzania is setting aside a network of Wildlife/Wetlands protected or conservation areas. Protected areas (PAs) in Tanzania are comprised of 15 National Parks, 34 Game Reserves, 38 Game Controlled Area and Ngorongoro Conservation Area, together they cover 24% of the total land surface area. The importance of PAs is emphasized in International Conventions that Tanzania has ratified. The economic values of mining and the role it can play in poverty alleviation, increase revenue and employment opportunities cannot be underestimated. This paper provides an overview of the current position of the Wildlife Division (WD) on the issue of prospecting and exploration of minerals in PAs which are under the jurisdiction of the Director of Wildlife. It presents the pros and cons of conservation versus mining, and allows participants to discuss and consider whether the government should permit (or not permit) mining operations in designated protected areas. The 2003 World Parks Congress, IUCN and the International Council on Mining and Metals (ICMM), have been in dialogue about mining in PAs, and pledged “not to explore or mine in World Heritage Sites and in IUCN categories of PAs I-IV.

The challenges to sustainable development in developing countries are to alleviate poverty, while upholding the economic foundations of the economy. A win-win situation may be achieved when all participating countries have laid down policy foundation for sustainable extractive industries in PAs, that is, setting standards, criteria for land use planning, zoning, compensatory fee and concession structures. The new proposed Wildlife Conservation Act No.5 of 2009 section 20 (2) prohibits “any person to collect sand, prospect or mine in any game reserve”, but it is still silent on other conservation areas. The Wildlife Policy (2007) and the Wildlife Conservation Act, (1974) are not in harmony with the Mineral Policy, (1997), the Mining Act, (1998) and Mining Regulations (1999). The Wildlife Management Areas (WMAs) Regulations (2003) on the other hand does prohibit mining in WMAs. However, the 2008 revision to the Wildlife Act (still a Bill), has adopted a more precautionary, and pragmatic approach, aligned with the Environmental Management Act cap 191 in relation to mining in protected areas. Besides the conditions provided in the Act and its regulations and drawing on the lessons learnt from case studies, Tanzania extractive industries need to consider the establishment of an Advisory Body, represented by decision makers of all relevant sectors.

This paper does not advocate for mining in protected areas, it presents a framework to be adopted if the State indicates that mining is more beneficial to the economy.

THE IMPACTS OF MINING ACTIVITIES ON FOREST RESOURCES IN NYAMONGO GOLD MINE, TARIME DISTRICT, TANZANIA

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The area around Nyamongo in Tarime district has been mined for more than 40 years. The great potential of gold minerals in Nyamongo necessitated the establishment of a large plant by the name North Mara Gold Mine under Barrick Company that was opened in 2002. The mine has displaced local people, resulting in clearance and deterioration of natural forests. Despite all the activities and their negative impacts on the natural forests in Nyamongo, there is no documented information on the extent to which the forests have been degraded and lost. The objective of this study was to evaluate the impact of mining and provide information on the extent of natural forest resources degradation and loss due to gold mining in Nyamongo area. Both qualitative and quantitative research designs were employed. A total of 115 respondents were interviewed. Data was obtained through questionnaires, interviews, observations, resource mapping, documentary review and Geographical Information System analysis.

The findings indicated that poor working practices and inferior technologies used by small-scale miners have greatly affected natural forest resources in the area. It further revealed that the Nyamongo gold plant has not only displaced local people but also deprived them of income related to small-scale mining without providing alternatives. The study also revealed that charcoal and brick making activities are carried out to supplement incomes from small-scale mining and agricultural activities.

The study indicated that about 93.8% of forestland declined from 1960s to 2006. The impact on forest resources was more significant in Mrito village where only a small part of Miriminsi forest remains today (about 2% of the total forestland). The study recommends that the government needs to implement land use and town planning for Nyamongo especially in Nyangoto and Matongo villages where settlements are not planned.

ENVIRONMENTAL AND SOCIAL IMPACTS OF SAND MINING ACTIVITIES ALONG THE MBEZI AND MPIJI RIVERS, DAR ES SALAAM, TANZANIA

Y. MTONI AND D. MWITURUBANI

This study covers part of Mbezi and Mpiji River systems, which are located from Bagamoyo road in the northwest to the coast of the Indian Ocean where the two rivers drain water. The study investigated sand extraction activities and their social and environmental impacts to the communities in the study area.

Sand extracted from Mpiji and Mbezi Rivers is on an average of 2500 tons per day: about 1800 to 2000 tons of sands are extracted daily from Mpiji River and 700 tons from Mbezi River. Some sand extractors have been involved in these activities for more than ten years while the majority of them have been participating in sand extraction activities for the period ranging from one to ten years. Unfortunately, people involved in these activities operate illegally and with little consideration of negative environmental impacts. Both at Mpiji and Mbezi sand is extracted from river beds and carved from river sides/banks. Sand is also extracted from pits located between 100 to 500 meters away from Mpiji river.

Major environmental problems resulting from sand extraction include change of landscape, damage to riverbanks, vegetation clearing, soil erosion, disturbance to groundwater, change in river course and destruction of the infrastructures (mainly roads, bridges, caravans and water pipes). The majority of sand extractors are aware that their activities cause these environmental problems, but continue with them because of lack of alternative employment. However, some sand extractors indicated anxious to learn methods that can protect the environment during the extracting activities but at the same time meeting their livelihoods.

The increased demand of sand by the construction industry in the City of Dar es Salaam is mainly as a result of human population growth (rural-urban migration and high natural birth rate), which demand more infrastructures. Sand is extracted to provide raw materials for construction of residential, commercial and office apartments/buildings and other structures, such as roads and bridges. Since sand is required both for the present and future generations, there is a need to locate suitable areas where sand can be extracted sustainably: determining extractable volumes and ensuring that extraction methods have less-negative impacts to the society and the environment; and putting in place a restoration programme that reduce risks.

This study revealed that most of sand extractors are not aware of the existing environmental legislation that is important in protecting the environment. Ideally, implementation of the existing legislation before, during and after extraction will help restorations of the environment in order to regenerate itself to its original form.

THE ROLE OF MPA'S IN CONTROLLING CORAL MINING PRACTICES IN TANZANIA

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Coral reefs are very important in Tanzania, both ecologically and socio-economically, as major fishing grounds and tourism attraction. Numerous fringing and patch reefs are located along the Coast about two-thirds of Tanzania coastline. These reefs have been observed to be partially or severely degraded by human causes. These immediate human causes have been triggered by various socio-economic problems, particularly rampant poverty. After decades of human and natural impacts there is only limited reefs recovery. While earlier approaches to management were aimed at non-use of coral reefs in Marine Protected Area, recently approaches have been aimed at Integrated Coastal Management (ICM) whether in zonation into core Protected areas or Multiple use areas is based on participatory decision making, involving fishing communities and other stakeholders. Some notable management initiatives include involvement of communities in reefs monitoring, restoration and eco-tourism. This paper presents analysis of trends of coral mining include blasting of massive areas of reefs or large scale removal of corals manually in patches throughout a reefs. It also provides recommendations for further research and coral reefs Management strategies.

OPPORTUNITIES AND CHALLENGES IN ADMINISTERING EIA IN MINING PROJECTS

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Environmental Management practices require that developers of projects, regulators and stakeholders ensure that projects are both economically and environmentally sustainable, and that prevalence of projects bring forth benefits that would otherwise not be thought of in situations where there are no such projects. New roads are opened, old ones get up-graded, employment is created, services are introduced that benefit many and environmental settings are changed to meet requirements of the new development. The requirement to conduct EIA for projects that are likely to produce significant negative environmental impacts is placed to ensure that no foreseeable such impacts are either avoided or mitigated. Positive impacts also are identified to ensure that they are ameliorated.

In Tanzania, environmental management is guided by the Environmental Management Act (EMA Cap 191) and EIA and Audit regulations (2005) at the apex. However, sector laws and regulations pertaining to environmental management are recognized by the framework environmental law and regulations. The brief experience with the implementation of EMA Cap 191 which came into force in July 2005 has brought forth a number of challenges that need to be resolved. Associated with the challenges, are opportunities for improvement and making better use of resources to achieve sustainable development. Some of these challenges are:

- Sector legislation which came into force before EMA Cap 191, prescribe environmental approval to mining projects centrally to the EMA Cap 191. There are cases where the EMA Cap 191 has been ignored because the sector legislation are not consistent with its requirements.
- Mining projects are associated with a diversity of features that require specific expertise and experience on the part of regulators. However, the mining sector is expanding at a pace that supersedes the capacity of the regulators to properly handle. In addition, the nature of the mining projects is that most of them have a short life span, but some of the environmental hazards they can cause can transcend to generations.
- There are no established criteria for benefit sharing to ensure that a reasonable amount of benefits that accrue from these projects are used for environmental restoration and reparation activities. How far such consideration can be regulated is something that needs to be urgently acted upon.

The opportunities associated with the mining projects are many, but the following are identified to be most significant:

- To recognize the gaps that exist in our legislations and cause action to be taken to address them early enough; perhaps with participation of the developers
- To use the projects to train our experts and bridge the relevant experience and skills capacity gaps that exist in the regulatory institutions; cooperation and willingness of the developers is extremely important for that to happen.
- The services that the projects introduce for their own use can be designed to ensure that they also take into account the long term needs of the communities around and the nation at large; relevant stakeholder involvement from the early stages is a prerequisite to that (speed and matching of plans could be an issue here)

This paper focuses discussion on the above issues and recommends that mining activities can contribute to sustainable development in Tanzania, if they are properly regulated and basic challenges are addressed well in time. In that respect both the Developers and the Government are seen to have the greatest role to play for that to happen.

THE PROMOTION OF GENDER EQUITY AND WOMEN EMPOWERMENT IN MINING

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This paper provides an overview of current gender equity and participation of women in mining. The promotion of gender equity and women's empowerment is central to sustainable and equitable development. Careful analysis reveals, however that even though policies and strategies put in place have provided enabling environment. Challenges still exist. These include among others social transformation of gender relations and women empowerment in priority sectors such as mining.

Extreme poverty is largely concentrated in rural areas. There are high rates of illiteracy, and unemployment among women. At the community level, women are still tied to traditional; roles and opportunities for social and economic advancement are limited. For women who are involved in mining they face constraints which need to be addressed. Marketing strategies are lacking and access to markets limited. Women have almost no access to effective technologies and entrepreneurial training is non existent. At institutional level, the gender breakdown in the education system reveals that very few women have accessed technical training courses. There are societal constraints for women to seek technical education and training and low participation by women in technical occupation has further increased gender disparities. Since improving the country's human capacity would enable development in mining to occur at a reasonable pace, the roles of women in mining cannot be ignored. Community groups, small producers association, women networks, NGOs, private sector and government departments and other training institutions need to get involved in creating programs to address above mentioned issues. Specific gender-focused activities such as workshops on role of women in post-secondary education and women entrepreneurs will encourage more women to consider career outside the traditional occupations and motivate others to run successful business. While in mining environmental sustainability remains the overall strategy, specific activities such as: developing courses in resource management and including sound environmental practices in curriculum by training institutions and vocational training centers need to be emphasized.

ENVIRONMENTAL MANAGEMENT AT GOLDEN PRIDE PROJECT

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Resolute Tanzania Limited Golden Pride Project (GPP) is located in the Nzega District, Tabora Region in Tanzania. The mining lease covers an area of 3,375ha and is 18 km north of Nzega town. The Management and monitoring of the Environment at the GPP is according to 2007 Environmental Management Plan and Environmental Management System (EMS) in accordance with ISO 14001 - Environmental Management Systems and Resolute Corporate Standards. Resolute has received a number of awards for the excellence in environmental management in Africa and Australia.

The GPP Environmental Management System is regularly audited against the Resolute Safety, Health and Environment Management Standards and Guidelines. The auditing is carried out by external certified auditors.

A total of 872,601 tree seedlings have been raised at the Golden Pride Nursery between 1999 and 2008 where 529,414 seedlings have been planted onsite and 388,627 have been donated to the local communities. As a result of the progressive rehabilitation and natural vegetation regeneration, fauna have been returning to this area. A total of 226 species (173 birds, 8 butterflies, 21 reptiles and 24 mammals) have been identified at the site. In recent years only indigenous species have been planted in site rehabilitation.

Golden Pride Project, like other mine sites, is facing challenges that include lack of staff with appropriate experienced in mining industrial management, waste management stream, project dependency and closure standards.

TANZANIA'S CHALLENGES PERTAINING TO MINE CLOSURE

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The Mining Industry in Tanzania has been growing fast since the second half of the 1980s following the economic restructuring that were embarked on by the Government then. The enactment of the Mining Policy in 1997 and the Mining Act in 1998 attracted more investment in exploration which led to development of six gold mines between 1997 and 2005. A number of potential new mines are in advanced different stages of feasibility studies and/or construction. Two of the smaller mines that had limited mine life are already in the advanced stages of mine closure. In addition, the ever growing small-scale mining poses mine closure challenges resulting from abandoned workings that are spread all over the country. Also, some of the mines that were mined prior to the 1970s still have their legacies some of which might have regional impacts.

The regulatory framework governing mine closure in Tanzania is very weak and only limited to a few regulations which form part of the Mining (Environmental Management and Control) Regulations, 1999. These regulations provide some limited requirements for reclamation and rehabilitation during the mine operation. The Environmental Management Act, 2004 which is the principal environmental legislation has general provisions calling for safe decommissioning, rehabilitation and restoration of the ecosystem with no regulations. At the time when the mines are beginning to consider closure, the country finds itself facing the main challenges on how to regulate these closures. There are basically no standards, guidelines or procedures for preparation of closure plans, calculation of closure costs and addressing socio-economic issues at closure. Without any standards, guidelines or regulations, each mine adopts what they regard as being good practices in other countries in the preparation and implementation of mine closures. This in turn puts the regulatory authorities in difficult position. This paper analyses the current situation and proposes the required standards, regulations and guidelines for mine closure.

SOCIO-ECONOMIC AND ENVIRONMENTAL ASPECTS OF MINE CLOSURE: TANZANIA PERSPECTIVE

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The benefits which communities get from mine projects when operating include employment, income from export revenues and royalties, and improvements in infrastructure such as roads, schools and health clinics. Problems associated with mine closure include; deterioration of local infrastructure, water supply and other services provided the mines, and loss of land for other economic/livelihood uses e.g. agriculture as a result of the environmental damage caused by mining. Mine closure is a complex task that involves economic, social and environmental risks. The primary concerns for mine closure and reclamation are to ensure public safety and health, environmentally stable conditions compatible with the surrounding environment are achieved and to minimize environmental impacts caused by mining. During ten years of implementation of Tanzania Mineral Policy (1997) and Mine Act (1998), six large gold mines, two medium scale mines (one for diamond and one for tanzanite) and a number of small mines mainly for gold, diamonds and gemstones, were established. Exploration of other minerals such as uranium, iron, copper and nickel is also ongoing. The government's process of policy review, which is currently under-way intend to continue to attract investment in exploration and mining. But as new mines are developed there is a growing concern within the communities directly affected by mining that not enough has been done by mining industry to minimize the human and biophysical impact of mining.

Communities surrounding mine sites have continued to become dependent on the infrastructure and services provided through the local mines. When the mine closes, the mining company hands over these services to government institutions. The Government is not set up to manage such services, and not all of the services are financially viable. To address these concerns, capacity building is required within both mining communities and local governments.

Although Tanzania has environmental safeguards in its policies (e.g. Environmental Impact Assessments "EIA", Environmental Management Plans "EMPs"), strict enforcement is required in order to maintain environmental quality in areas where mining is currently taking place and in areas where mining activity has been concluded. Regulators need to use enforcement strategies to ensure a culture of compliance, including inspection and audit of mine sites to ensure the use of best practice methods, review of environmental monitoring results and evidence of community engagement. Enforcing changes to operations now, if they are not 'mining for closure' (mining that will enable effective and efficient mine closure in compliance with the accepted mine closure plan) is essential to lower the risk to the environment and the public.

CHALLENGES ASSOCIATED WITH THE ENFORCEMENT OF ENVIRONMENTAL STANDARDS IN THE MINING SECTOR

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The mining and metallurgical sector is vital to the development and economic growth of developing country like Tanzania. The products of the sector (including metallic and non-metallic minerals, construction materials or fertilizers) are not only essential for developmental activities and many industrial processes, but are also often a valuable source of foreign exchange earnings.

The geological and metallurgical history of Tanzania indicates rich mineral resources, some of them known to be in abundant supply. Still, Tanzania faces deficit in many minerals. Considering the growing future needs and security of supply these minerals, Tanzania has to enhance its resource base considerably through various options, including intensive exploration drive, improving the recovery and production from the existing resource base and supplies through imports. Tanzania also needs to enhance its export potential of a number of minerals and metals, for which it has sufficiently large reserves.

Mining operations frequently involve a high degree of environmental impacts, which can extend well beyond the extent of mineralized areas. The impacts of a mining operation commence with exploration activities, extend through extraction and processing of minerals, and may continue well beyond post-closure of the operation.

In comparison with many other sectors, the potential social and environmental issues associated with mining and mineral processing operations are both significant and complex to manage. The fixed location of the mineralized zone of interest imposes a constraint on all aspects of mining developments including the method of mining, location of mine facilities, requirements for new infrastructure and services (or conflict with existing infrastructure), and the suitability of waste management or disposal methods. This in turn profoundly influences the environmental, social and health impacts of mining developments, as well as the economic viability of developing a given mineralized zone.

The Environmental Management Act Cap 191 stipulates that any person, being a proponent or a developer of a major project should undertake Environmental Impact Assessment (EIA). Under the same act, Tanzania has also made regulations prescribing the Environmental Quality Standards for Air, water and Soil, which should be adhered to by all major projects, including the mining sector. However, in conducting and reviewing Environmental Impact Statements (EIS) the environmental challenges that we face in mining projects are two fold:- Firstly, environmental, social and health costs should be given adequate consideration while determining the economic viability. Secondly, adequate mitigation measures should be incorporated into the project cycle, including project design, implementation and decommissioning plans.

This paper presents the environmental issues associated with mining activities, and the extent to which environmental issues should be addressed with the goal to ensure that the mining and mineral industry becomes sustainable. But also discusses on the challenges that the regulating authorities face in the enforcement of Environmental Quality Standards in the mining Sector.

SUSTAINABLE ENVIRONMENTAL MANAGEMENT PRACTICES IN MINING IN TANZANIA

K. SHOO

Large Scale Mining Companies tend to conduct their operations under strict internationally accepted Best Practices currently referred to as Sustainable Mining Practices. Included among those practices are the Sustainable Environmental Management Practices in Mining.

In establishing mining activities at Bulyanhulu in 1999, Barrick Gold Corporation had to adhere to international and the host country requirements such as financing conditions on the International front and licensing conditions on the Host country side. However, in developing the Statements and guiding documents such as Environmental Impact Statements and Environmental Management Plans, Barrick Gold Corporation employed best available technology capable of meeting the social, physiographic, climatic, biological and geochemical nature of the materials and the site to create guidelines and policies for the Mining Project at different phases starting from exploration through to decommissioning and closure. Such practices were adopted by the mine management team and the documents have been regularly reviewed and updated to ensure that they comply with the changing legal and other requirements in line with the sustainable development requirements.

To ensure that these practices are maintained and continually improved; Barrick Gold Corporation developed an Environmental Management System (EMS) to be adopted by all mining and project development operations so as to ensure consistency and use of auditable environmental management tools. Therefore, Bulyanhulu Gold Mine Limited (BGML) has subscribed to the Barrick EMS as a tool for managing processes, products and activities but on top of that BGML is striving to update the Barrick EMS to ISO 14001 so as to get ISO accreditation by first quarter of 2010. All Environmental Management Systems (EMS) require that a company implementing that EMS complies to, not only the legal requirements of the host country but also to all the other requirements to which the company subscribes to.

As part of the requirements for obtaining the mining license from the Tanzanian Government, Barrick Gold Corporation had to submit the following documents together with the application letter; Environmental Impact Statement (EIS), Bankable Feasibility Study Report, Mining Plan and conceptual Environmental Management Plan (EMP). The conceptual EMP was updated and re-submitted to the Government after two years of operation and this became the working EMP for Bulyanhulu Gold Mine; which was last updated in 2007.

The Bulyanhulu Environmental Management Plan (EMP) is used as a tool to properly manage the areas that could be impacted by the mining and allied activities or operations. The areas that are of immediate concern are water, air, land, chemicals and waste management to mention but a few. Through years of operation and ensuring continual improvement; Bulyanhulu Gold Mine has been able to demonstrate that it is possible to become a “Zero” discharge site when it comes to pollution and pollution control.

This paper is about Sustainable Environmental Management Practices in Mining in Tanzania with particular reference to Bulyanhulu Gold Mine experience.

MINING AND ENVIRONMENT

FIELD EXCURSION GUIDE: GEITA GOLD MINE



28th May 2009

Introduction

Albeit it's essential contribution to human development, the Mining Industry is subject to intense and widespread criticism and opposition, apparently for the perceived environmental damage caused by mining and associated activities. This despite the fact that environmental damage due to mining and mineral processing is minor in comparison to that from other human activities such as agriculture and urban development. In response to this poor public image and in tandem with the emerging environmental movement of the past four decades, the mining industry has overhauled its environmental performance. Major advances have been made in control of pollution from mine wastes and in the rehabilitation of areas disturbed by mining operations. More recently, the industry has been developing principles and procedures to ensure that the mining operations benefit the host communities. This has been accentuated by the fact that more and more minerals are being extracted from remote, undeveloped areas, sometimes inhabited by indigenous people like Lake Victoria Goldfields. As a result of these initiatives, the situation now is that most mining projects can be developed for the benefit of all stakeholders, with environmental impacts that are clearly and demonstrably acceptable.

The National Environment Management Council (NEMC) conducts its 3rd Scientific Conference on Environmental Sustainability, which, this time will be carrying the banner of "Mining and Environment". The conference is designed as a portal for providing unbiased and accurate information about mining, its effects on the environment and the attendant social costs and benefits. The conference is also in line with its major mineral policy objectives, to minimize or eliminate adverse social and environmental impact of mining activities. Intended audience includes public and private sector, environmental and mining professionals, researchers and regulators, practitioners and concerned members of the public.

Mining History

The Tanzania is rich in minerals. This has both advantages and disadvantages for human wellbeing and the environment. In order to understand the duality of this statement, it may be interesting for conference participants to know a little of the history of Tanzanian Mining Industry. Mining history in the country started during the German Colonial Period. The earliest organized prospecting and mining took place in the Lake Victoria region in 1894. Mining began at the Sekenke Mine in 1909. After 1930, gold production was substantial and increased steadily until World War II. By 1967, the gold industry had declined to insignificance, only to revive after 1974-75 when the world gold price increased greatly. Beginning in April 1990, the Bank of Tanzania began buying gold at the world market price through commercial banks, paying miners in Tanzanian shillings calculated at the parallel-market rate for the US dollar rather than at the official rate. Diamond mining, which had been relatively minor prior to 1940, received a major boost with discovery of the Mwadui Mine in 1940.

Besides gold and diamonds, which have long been the mainstays of mineral production, mining of other commodities has been relatively modest, namely for copper, lead, phosphate, coal, kaolin and gemstones. In the late 1980's, the Government attempted to

capture the revenues being generated from gem mining by licensing private companies to buy, cut and export gemstones being produced by small-scale miners. Coloured gemstones (excluding diamonds) are an increasingly important mineral product. In 1989, small miners produced about 10 tonnes of precious and semi-precious stones. Tanzania's most famous gem is tanzanite, a sapphire-coloured variety of zoisite discovered in 1967. Other important gemstones are ruby, sapphire, emerald, garnets and lesser quantities of zircon, tourmaline and other minerals.

In the late 1990's, several mining companies from Canada, United Kingdom, Australia and South Africa arrived in Tanzania, interested in gold exploration and development. From 2000, production of gold at an industrial scale is growing, especially from the mines surrounding Lake Victoria Goldfield. To-date the country has become one of the fastest-emerging gold producers in Africa, and is now the continent's third-largest gold-producing country after South Africa and Ghana. One of the areas of visit is Geita Gold Mine (GGM), which is a product such exploration investments.

Mining and Environment

The health aspects of mining have been appreciated for decades and while employed on the mines, miners have access to sophisticated medical care. Scientific investigations on long term effects on miners are, however, fairly recent. Environmental impact studies have also become important comparatively recently and the technology required is still being developed.

Mining and Environment, a conference dealing with the environmental and health aspects of mining, is a stimulating forum for communication across borders and between scientific disciplines. The aim of the conference is to facilitate interdisciplinary discussions about all environmental and health issues concerned with the mining and refining of ores and to visit one of mining companies in order to appreciate this vigorous mining industry in the country.

The Geita open pit gold mine, Figure 1, is 80km south-west of the town of Mwanza in the north-west of Tanzania and is 100% owned by AngloGold Ashanti. It is the biggest of the group's eight open-pit mines in Africa and is its only operation in Tanzania. Prior to April 2004, the mine was managed under the joint venture agreement between Ashanti and AngloGold. Since the merger of these businesses Geita is now a wholly owned subsidiary. In 2007, Geita produced 327,000oz of gold, equivalent to 6% of group production. Open pit operations commenced in 2000 with recent studies indicating the potential for underground operations.

Geology and reserves

The Geita gold deposit is an Archaean mesothermal orebody, largely hosted in a banded ironstone formation (BIF). Mineralisation is found where auriferous fluids, which are interpreted to have moved along shears often on BIF-diorite contacts, reacted with the BIF. Some lower-grade mineralisation can occur in the diorite as well (usually in association with BIF-hosted mineralisation). Approximately 20% of the gold is hosted in the diorite. As of 31 December, 2007, AngloGold Ashanti reported Geita as having total mineral resources of 109,290kt, with total reserves of 67,989kt, which were located during exploration drilling operations.

Mining and processing

Geita is a multiple open-pit operation with underground potential, which is currently serviced by a 6Mtpa carbon-in-leach (CIL) processing plant. Standard open-pit mining methods are employed, as shown in Figure 2. Hard overburden is drilled and blasted, hydraulic excavators are used to load waste material into a fleet of 100t dump trucks exposing the gold-bearing ore material which is directed to the processing plant.



Figure 1: Open pit mine operation, GGM



Figure 2: From the air, GGM

Production

Production and grades have started to improve at Geita after a disappointing 2006 due to gold crush. AngloGold Ashanti projected that gold production at Geita would increase to between 330,000oz and 340,000oz at a cost ranging from \$605/oz to \$615/oz. The production problems were made worse by the collapse of part of the Nyankanga pit sidewall during the first quarter of 2007, which covered a portion of the higher grade orebody. The collapse of the Nyankanga pit in the first quarter delayed access to the higher grade exposed ore in this area and resulted in the mining plan for the year being revised.

Production, and tonnage throughput in particular, was further hindered by wet ore, mill lubrication problems and a full-scale shutdown of the primary crusher for planned maintenance as well as damage to the ball mill discharge which led to reduced processing plant availability. The resumption of ore mining from Nyankanga in the third quarter of 2007 led to a marked improvement in production over that period, however harder material and poor grades saw a reduction in plant throughput which flowed through to reduce gold throughout in last quarter. AngloGold Ashanti reported a 9% fall in cash costs to \$452/oz with the increased level of production. Reduced expenditure on equipment re-builds and contractor services also contributed to the containment of costs. Capital expenditure for 2007 was \$27m (2006: \$67m) which was spent largely on the replacement of heavy earthmoving equipment.

The future

AngloGold Ashanti has undertaken numerous studies of the Geita site and surrounding areas and identified. At the end of 2007 advanced grade control drilling had begun at the Star & Comet project in preparation for the start of mining in the second quarter of 2008. Exploration activities during 2007 focused on strike additions at Area 3 and the detection of regolith gold anomalies below laterite cover through air core drilling (Figure 3). Early results suggest the potential for an approximately 1.7km zone of mineralisation on strike at Area 3. The regolith programme identified a 2km gold in saprolite anomaly that requires follow-up

drilling. The results of a scoping study into the underground potential at Nyankanga and Geita Hill are forthcoming are yet to be finalised.



Figure 3: Exploration drilling operations. Note the masking system, helmet, field boots, which are essential components for personal safety