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Legacy Gold Mine Sites & Dumps in the Witwatersrand: Challenges and Required Action

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Abstract

Legacy mine shafts and waste dumps in the Witwatersrand continue to create social and environmental challenges for communities, even in areas where gold mining ceased over 100 years ago. The slow pace of eradication of these gold mine shafts and waste dumps (or lack thereof) results in conflict between the communities and authorities, particularly the Department of Mineral Resources and Energy (DMRE) as the relevant authority in the field of environmental management in mining. This paper examines, through a literature review, the past and present legislative framework that resulted in legacy mine shafts and dumps and how communities find themselves living next to these mine sites, which results in social and environmental problems. The paper further explores the governments, particularly the DMRE, proposed initiatives to empower those who intend to extract value from the abandoned mines while curbing the scourge of crime in affected communities.

Keywords

Mine Waste Dumps, Communities, Pollution, Challenges

1. Introduction

Since the 1880s, when modern gold mining started, Johannesburg has been the catalyst of economic growth for South Africa and, by extension, the African continent from its gold resource endowment [1].

Notwithstanding the economic benefits, gold mining in Johannesburg has resulted in numerous mine shafts and vast volumes of mine waste and residue in the form of waste rock dumps and tailings dams that were largely left unrehabilitated. These mine shafts and waste dumps left a legacy that contributes to en-

vironmental pollution and ecological degradation through dust and pollution of water resources, which has been witnessed by the public outcry raised by surrounding communities, Non-Governmental Organisations (NGOs) and others [2].

Legacy mine shafts and waste dumps negatively affect the quality of life of surrounding communities through air and water pollution, thereby creating health concerns. They create physical barriers to people's security and freedom of movement, which impedes sustainable development programs [1] including illegal mining, minors falling into mine shafts, drownings in mine water, and accumulations in abandoned holes and voids, and surface subsidence cases. The incident in Krugersdorp in July 2022, where communities took the law unto themselves [3] indicates society's frustration at the DMRE and relevant authorities' lack of action in eradicating illegal miners in these abandoned mine sites [4].

2. Legacy of Gold Mining in Johannesburg

According to Watson and Olalde [5], formalised mining dates back to the 1860s with the discovery of diamonds and gold, which then propelled rapid industrialisation and urbanisation, kicking off the rapid economic development of various mineral deposits such as the Witwatersrand goldfield. To this day, Johannesburg is one of the largest metropolitan cities in Africa. This discovery led to the establishment of the world's largest goldfield called the Witwatersrand goldfield [6], consisting of the West, Central and East Rand as sub-goldfields. As a result, secondary industries such as railway linkages, and factories to manufacture steel, explosives, and protective clothing, amongst others, were created to support the gold mining activities in Witwatersrand and surrounding mining towns.

2.1. Environmental Legacy

During the gold mining, underground tunnels were created to extract ore and crushed rock waste, with gold processing residues being deposited at ground level, which led to the formation of substantial mine dumps and tailing dams in Johannesburg. These underground tunnels, dumps and tailings cover a large footprint. They mostly remain unrehabilitated, resulting in the creation of environmental problems such as air pollution through dust and water pollution. This pollution includes groundwater contamination in the form of Acid Mine Drainage (AMD) [2].

Gold mining towns, particularly Johannesburg as the economic hub of South Africa, have attracted a large population concentration which remains exposed to these environmental impacts caused by the mine waste residues (dumps and tailings dams) in particular [7]. Most studies indicate that environmental impacts range from AMD from the oxidation of sulphides; to airborne radioactive dust causing health risks; and the sterilisation of land where these mine shafts,

residue dumps and tailings are located [8]. During rainy seasons, water collects in cavities with acidic and heavy metals, which eventually find their way into the underground water supply, rivers, and dams. This results in harmful contamination of aquatic life and health dangers to humans due to acidic water flowing into streams and borehole water households use for domestic and agricultural purposes [9].

2.2. Social Legacy and Challenges

Over time, the gold mining activity attracted unskilled labourers from rural areas within South Africa and migrants from the neighbouring Southern African countries looking for economic opportunities, resulting in rapid population growth and informal settlements in the Witwatersrand [10]. Both formal and informal settlements created around current and closed gold mining areas developed a dependence on the gold mining value chain through local secondary economies until mining activities ceased. This was compounded during the apartheid years when forced removals resulted in communities like the Riverlea community being forcefully placed near the mine dumps [11].

Informal settlements have since settled near the mine dumps, which today creates social problems resulting from illegal mining performed by the so-called "Zama-Zamas" scavenging for gold concentrates from closed mining activities [12]. These informal settlements continue to pose challenges to town planning and the services the local municipalities provide. Criminal activities have been recorded in these areas due to limited security by authorities such as the police and other law-enforcement agencies [13].

2.3. Illegal Mining

Abandoned gold mine sites have become hot spots for artisanal and small-scale miners looking for opportunities to scavenge for gold to sell for economic survival [7]. The fact that these artisanal and small-scale miners do not have requisite authorisations to work in these abandoned sites renders such activities illegal mining. These illegal activities pose several risks to society, such as safety and security to surrounding communities [14]. Increased cases of crime in surrounding communities, such as rape, house burglary and prostitution, have been reported to be prevalent in areas infested by illegal mining activities [13].

With over 6000 derelict and ownerless mine sites, the Department of Mineral Resources (DMRE) programme of sealing and rehabilitating abandoned mine shafts is slower than envisaged due to a lack of resources [15]. After sealing the shafts, illegal miners create alternative openings around the sealed shafts to enter underground tunnels [16], thus sabotaging DMRE rehabilitation initiatives in spite of limited budgetary resources.

The media reports that they are often heavily armed with rifles and terrorise local communities with minimal South African Police Service (SAPS) intervention [17]. Krugersdorp, Roodepoort, Carletonville, Germiston, Springs and Be-

noni, among others, have seen instances where illegal miners have taken control of the legacy mine shafts and mine waste dumps and terrorised surrounding communities with gang rapes and killings reported more often in recent times [18]—Krugersdorp gang rape being the recent case.

3. Legislation Governing the Gold Mining Industry

The South African government started effectively regulating the mining industry in the 1950s in response to growing international awareness of the looming environmental crisis [19]. **Table 1** contains a list of current legislation in effect in South Africa with a brief description of the Act's overall aim.

The 2007 DeBeers vs Attaqua (Case No. 3215/06, Orange Free State Provincial Division, 13 December 2007) court ruling revealed that the various listed legislation in **Table 1** was not adequately aligned in their current form, thus resulting in the current disconnect between authorities and the different spheres of government in the implementation of environmental management and rehabilitation in the mining industry [20]. Notwithstanding that this judgement was handed in 2007, the Mineral and Petroleum Resources Development Amendment Act, Act No 49 of 2008, did not address the gap highlighted by the court ruling in DMRE's authority on legacy mine waste dumps and tailings.

Table 1. List of current legislation in the S.A. mining industry.

Act name and number	Brief description
Constitution Act, Act No. 108 of 1996	Section 24 protects everyone's health and well-being by preventing pollution and ecological degradation.
Mine Health and Safety Act, No 29 of 1996	Provide for the protection of the health and safety of employees and other persons at mines.
Mineral and Petroleum Resources Development Act, Act No. 28 of 2002 (MPRDA)	Transferred mineral rights from private holders to government as guardians of peoples of S.A. and made provision to benefit Historically Disadvantaged South Africans (HDSAs).
Mineral and Petroleum Resources Development Amendment Act, Act No. 49 Of 2008	Bill enhances provisions related to the regulation of the mining industry through the beneficiation of minerals and the promotion of national energy security to streamline administrative processes and align them with previous Acts.
National Environmental Management Act, Act No. 107 of 1998 (NEMA)	Provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for coordinating environmental functions by an organ of the state.
National Environmental Management: Waste Amendment Act, Act No. 26 of 2014	Provide for the regulation of mine residue and stockpiles under NEMA. DMRE is the competent authority in terms of the National Environmental Management Laws Amendment Act, Act No. 25 of 2014 (NEMLA).
National Water Act, Act No. 36 of 1998	Provide for fundamental reform of the law relating to water resources.
Precious Metals Act, Act No. 37 of 2005	Provide for the development of precious metals in the best interest of the people of South Africa.

Source: SAHRC, 2016 [17].

Most legacy mine shafts and dumps have been left unattended in their current form with minimal accountability from regulators [2].

3.1. Legislative Instruments for Enforcement and Monitoring

Section 24 of the Constitution affirms global principles of sustainable development, which have now been incorporated both into the Minerals and Petroleum Resources Development Act (Act 28 of 2002 as amended), known as MPRDA and the National Environmental Management Act (Act 107 of 1998 and its amendments) known as NEMA.

The government has been criticised for lacking the capacity to enforce laws and regulations in the mining industry [21] that would have restricted the deterioration of the South African gold mining industry. Public sentiments suggest that the gold mining companies are left to continue with the practices entrenched during apartheid, where they were above the law. This is demonstrated in that they are still not held accountable for continuously monitoring closed mine shafts and eradicating or rehabilitating the legacy mine waste dumps despite the vast profits they derived from these resources [22].

It is widely reported by researchers and regulators that most abandoned mine shafts, dumps and tailing dams were created some decades before the current legislation, dating back to the beginning of the 20th century. The MPRDA, like many other laws, does not work in retrospect. As a result, the current enforcement provisions in the MPRDA do not apply to these old mine shafts and dumps. The DMRE as the custodian of environmental laws has the responsibility to apply provisions of NEMA to enforce accountability in retrospect where mines closed prior to the MPRDA.

3.2. NEMA and "Duty of Care"

Section 28 of NEMA's "Duty of Care" enables the Competent Authority to retrospectively hold anyone who caused environmental damage accountable, irrespective of the legislation being in place. The MPRDA and NEMA have been applied disjointedly by the mines with no clear custodianship of environmental management in the mining industry. However, that has since been corrected through National Environmental Management Laws: 3rd Amendment Bill (NEMLA 3 enacted in 2014). All environmental provisions except mine closure have been repealed from the MPRDA, enabling only NEMA to regulate the mining industry's environment (including mine waste). The DMRE has been entrusted with enforcing the National Environmental Management: Waste Act (NEM: W.A.) in the mining sector. All mine waste dumps are regarded as waste and regulated in the NEM: W.A.

3.3. NWA and Prevention of Pollution

Section 19 of the National Water Act requires land owners or any land users or occupiers of land conducting an activity that causes, has caused or is likely to

cause pollution of water causes to take reasonable measures to prevent any such pollution from occurring or recurring by taking measures. These measures are, amongst others; eliminate any source of the pollution, and remedy the source of the pollution—in this instance, rehabilitation of the legacy mines would effectively eliminate the source of water pollution.

4. Gold Mine Closures and Abandonment of Mine Shafts and Dumps

The advent of democracy in South Africa brought hope for the country and the mining industry in particular, through the abolishment of legacy practices and work structures that oppressed historically disadvantaged South Africans [23], resulting in mine workers getting rights to unionise [24] thus bargaining for higher wages and improved working conditions. Instead of realising the envisaged prosperity, MacFarlane [23] states that this era has experienced unprecedented mine closures, particularly in the gold mining sector, thus leaving large numbers of mine workers unemployed. Not only did mines close, but the mining houses also ceased to exist, and some faced liquidation, leaving most of the mine shafts and dumps derelict and ownerless [15], thus creating regulatory challenges in enforcing accountability in rehabilitating these abandoned mine sites and tailings [25].

With the MPRDA (2002) introducing stringent environmental management legislation and financial provisions, several gold mines excluded some dumps from their old licenses when they converted into new order Mining Rights [22]. Presumably, intending to avoid accountability resulted in abandoned mine shafts and dumps, leading to the DMRE classifying them as derelict and ownerless (D&O). To give effect to Section 24 of the Constitution, the rehabilitation of D&O mine dumps reverts to the state's responsibility [15]. In light of Section 24 of the Constitution, the state now has a responsibility to rehabilitate using tax payer's funds. The state has failed to rehabilitate all D&O mine dumps due to budgetary constraints since this legacy is not only in gold mining but also throughout the country, including asbestos dumps that were given priority alongside coal mines [15].

4.1. Liquidations and Mine Closures

In the recent past, the industry has witnessed several mines closing down due to liquidation, leaving such mines unrehabilitated and without proper closure plans. Liquidations are legislated by the Companies Act, thus limiting the powers of the MPRDA in enforcing closure requirements in liquidated mines. Blyvoor Gold mine, Central Rand Gold Mine (CRG) and Mintails are examples of mining operations placed under provisional liquidation without adequate financial provision for post-closure rehabilitation [26]. These mines closing without setting aside adequate financial provisions for rehabilitation (despite this requirement in terms of the MPRDA and NEMA) creates regulatory challenges in

enforcing accountability in the rehabilitation of these abandoned mines.

4.2. Issuance of Mine Closure Certificates

Current mine closure requirements for issuing closure certificates for mineral rights by the DMRE require consent from the DWS in terms of Section 43 of the MPRDA to incorporate water sustainability aspects laid out by the mining legislative framework as minimum criteria. The lack of comprehensive water management programmes and strategies limits positive recommendations for DWS to issue such consent for closure due to the anticipation of latent water pollution—a contributing factor explaining the lack of mine closure certificates issued by DMRE [5] an argument often raised as an excuse for companies abandoning operations or placing them under voluntary liquidations. "Mining companies frequently move economically exhausted assets into care and maintenance or divest as a means to avoid closure costs" [27] and perpetual responsibility for environmental liability post-mine closure.

The level of adherence to MPRDA, NEMA and NWA by mine management is perceived by affected communities as low, with minimal consequences as the mechanisms for compliance monitoring are weak [26]. Watson *et al.* (2019) [5] further argue that the shortage of mine closure skills and knowledge within the regulator is also a contributing factor to the reluctance to issue closure certificates.

4.3. Enforcement by Government Authorities

Department of Water and Sanitation (DWS) suggests that mining companies have become adept at using regulatory weaknesses to avoid spending the necessary funds on protecting water resources from the impacts of mining [28]. The South African Human Rights Commission (SAHRC) concurs and says that the DMRE has not taken adequate steps to secure financial guarantees for rehabilitating damage to the environment and water resources [17]. The SAHRC argue that "*despite extensive regulation and notable attempts by some mining companies and government to implement progressive and sustainable projects, current industry practice is characterised by inconsistent legal compliance and reflects concerning legislative gaps*", which have let non-compliant mines get away with no liability [17].

5. Government's Action Plan

5.1. Draft Mine Closure Strategy

Mine Closure plans have been mandatory since the promulgation of the MPRDA in 2002; however, implementation and enforcement remain a challenge for both mining companies and regulators, an assertion confirmed by the Human Rights Commission Report, 2016. The challenge is that mines cease operations at different times, thus resulting in cumulative impacts not only on closed mines but also on operating mines at a regional scale. This results in negative

impacts on neighbouring operating mines and communities in instances where mines are closed without an integrated closure plan. As a result, landowners and neighbouring operating mines often inherit unplanned liabilities having to manage environmental and social challenges resulting from closed mines within the region [15]. A case was seen in the abrupt closure of Mintails operations in the Krugersdorp, creating negative impacts on the interconnected underground water system and creating a source for illegal mining activities in the region [28].

To address this, the DMRE developed a Draft National Mine Closure Strategy: in May 2021 as a proactive approach to the sustainable closure of mines. The strategy acknowledges that mines are regionally interconnected in many ways, *i.e.*, environmentally, socially, and economically. The intent was to embrace the integrated closure of mines and succession of post-mining land use with concurrent economic diversification for sustainable livelihood post-mine closure at a regional scale. The strategy suggests noble solutions for future mine closures; however, the concern is the silence in the strategy on how to deal with legacy mine dumps and closed shafts in retrospectively for mines that were created and closed prior to legislations that require financial provision for mine closure rehabilitation and succession.

5.2. Artisanal and Small-Scale Mining Policy

Artisanal mining in this country predates the gold and diamond rush, where indigenous people mined gold and other metals [29]. This was until it was stopped by the apartheid regime that barred black people, thus creating a platform for the formation of giant conglomerates led by the likes of Cecil John Rhodes, Oppenheimer and others who dominated the mining industry for over a century.

In 2002, the MPRDA made provision for small-scale miners to formalise participation by disadvantaged persons to address previous imbalances caused by the Apartheid regime by ensuring that the historically disadvantaged gain economic benefits from the mineral resources through Section 27 of the said Act. This was in recognition of the positive economic impact of issued mining permits through employment creation and socio-economic investments. The government developed this policy to grow the artisanal mining sector and in response to pleas from the public for opportunities in the mining sector. The DMRE state that this policy intends to promote access for those interested in artisanal mining to apply for mining permits and get funding assistance in pursuit of rooting out illegal mining in abandoned mine sites [4].

The artisanal mining sector poses unique attributes involving numerous syndicates operating sophisticated supply chains, thus requiring well-researched tailor-made approaches [30] from society, such as the Minerals Council, universities, law enforcement agencies, and community-based organisations.

5.3. Specialised Police Force to Combat Illegal Mining

The Minerals Council of South Africa argues that illegal mining is driven by the

increasing joblessness and economic hardship experienced across the country [31]. The rapid rise in illegal mining in the country indicates that the current legislation (MPRDA and NEMA) is ineffective in combating these activities.

Section 5(4) of the MPRDA prohibits mining without statutory authorisations such as environmental authorisation and mining rights or permits. Further, Section 4 of the Precious Metals Act, 2005, specifically declares possession and disposing of unwrought precious metals without the requisite license an offence – gold in this instance.

Illegal miners escape into underground tunnels through mine shafts unsafe for police officials to track them, thus frustrating efforts by authorities to effect arrests [32]. Several arrests have been reported for those found with gold-bearing material and unlicensed gold refining equipment in their possession [33]. However, the challenge is that most of those seen on the surface conducting small processing activities run away from their gold-bearing possessions and processing equipment, which then raises a question on the charges laid against those arrested and the success of such convictions and their effectiveness to deter out illegal mining bring scepticism to local communities on the prospects of eradicating these activities.

The Hawks, in conjunction with the SAPS, have made notable arrests of several illegal mining kingpins in the West Rand [34]. However, the public has lost hope in the police's prospects of successful convictions of those arrested due to a number of high-ranking police officials implicated in illegal mining indicates [35].

The Minister of Mineral Resources and Energy has since briefed the National Council of Provinces (NCOP) about plans to establish a police force dedicated to rooting out illegal mining in old mining areas [36] to be trained in the various pieces of legislation to close all possible gaps for successful prosecution.

6. Conclusions

In spite of the South African mining legislations generally aligned with international best practices [37] and aspirations, the ongoing challenges around abandoned mines suggest that implementation of the various pieces of legislation by different government authorities with overlapping responsibilities remains a challenge for sustainable development current and post mine closure [5].

The creation of employment opportunities for the youth, in particular, will go far in the eradication of illegal mining. This intervention through effective legislation must be paired with improved implementation and enforcement of the legislation.

McKay [31] argues that "unless stronger penalties are imposed-and police and legal responses stepped up-the current situation is unlikely to change".

Turning around the deterioration of the gold mining industry in South Africa will require innovative, transdisciplinary strategies and effective partnerships with various stakeholders, including affected communities, academia, private

business entities, mining houses and regulators [38].

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Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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