



Review of mine closure planning, processes, and a post-closure strategy at Tshikondeni coal mine

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Abstract

Since the discovery of gold on the Witwatersrand in 1886, mining has been at the centre of South Africa's development. Although mining continues to contribute significantly to the country's economy, it is a temporary land-use activity, and mine closure is inevitable. This paper reviews mine closure planning at Tshikondeni coal mine, which commenced in 2014 with the initiation of mine closure. The review presents the mine closure processes undertaken at the Tshikondeni coal mine as regulated by South Africa's principal mining legislation, the Mineral and Petroleum Resources Development Act 28 of 2002, and other relevant regulatory frameworks. To compile this review: (1) A desktop study was conducted; (2) empirical data was collected through one-on-one interviews with research participants at Tshikondeni coal mine; and 3) physical observations were made of the rehabilitation at various mine operations within the Tshikondeni coal mine complex. Research participants consisted of mine officials from different departments, i.e., human resources, and environmental, social, and business strategy, who were directly involved with the Tshikondeni coal mine closure. A questionnaire with semi-structured questions was developed. It was utilised to acquire a better understanding of mine closure planning at Tshikondeni coal mine and identify mine closure processes that aim to achieve post-mining land uses and align with Tshikondeni coal mine's post-closure strategy, namely the Tshikondeni Legacy Project, with a post-closure strategy that has the potential to transition a mining economy to an eco-tourism economy that can preserve livelihoods and self-reliant communities.

Keywords

mine closure, mine closure planning, rehabilitation, engagement, financial provision, relinquishment

Introduction — mine closure

Mineral resources are finite. When they are exploited through mining activities, the mine will eventually reach the end of its life or a level at which mining is no longer economically viable. At that stage, mine closure is inevitable, and mine operators need to initiate a mine closure process. The concept of mine closure dates to the nineteenth century. It has since developed differently across mining jurisdictions and is driven primarily by environmental impacts (Field, 2019). As the concept of mine closure progressed, it shifted from the core idea of reclamation towards remediation and mine closure has become a critical phase in the life cycle of mining operations (Field, 2019). Historically, mining has left a legacy that affects natural and social aspects negatively. Therefore, future mining activities, rightly or wrongly, will be judged against the legacies of past and current poor performers (Worrall et al., 2009). Unplanned or poorly planned mine closures often lead to environmental liability associated with unrehabilitated mine sites (Cowan et al., 2010). The success of mine closure relies primarily on planning with a clear understanding of the key closure hazards and associated risks for the mining site (McCullough, 2016) and, additionally, on well-defined mine closure processes and the allocation of financial resources (Butler, Bentel, 2011).

To undertake proper mine closure planning, several national and international industry guides have been developed (Butler, Bentel, 2011). These planning frameworks and guidelines began to develop in the early 2000s as sufficient attention to mine remediation/rehabilitation started to be recognised increasingly as a key aspect of sustainability in the mining industry (Cowan et al., 2010).

In general, major mining jurisdictions regulate mine closure primarily under their principal mining and environmental legislation, as is the case in South Africa. The first introduction of mine closure in

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South Africa, particularly in mining legislation, was in the Minerals Act 50 of 1991 for surface rehabilitation. As mining legislation evolved, the provisions for mine closure have expanded and extended beyond the construct of surface rehabilitation.

Tshikondeni coal mine (TCM) is a South African mine owned by Exxaro Resources Ltd. TCM presents one of the recent cases of mine closure. A review of the TCM mine closure aims to provide insight into the approach undertaken through mine closure planning and mine closure processes towards a sustainable post-closure economy that can support self-reliant mining communities.

Tshikondeni coal mine

TCM is situated in the northern region of the Limpopo Province within the Vhembe District Municipality and the Mutale Local Municipality, and it is adjacent to the northern boundary of the Kruger National Park (KNP), as indicated in Figure 1 (TCM Social and Labour Plan, 2018). TCM is a metallurgical coal mine owned by Exxaro Resources, which is also the mining right holder.

The mine has a lease area of 22,027 ha, made up of two portions namely the eastern portion and the western portion (Exxaro Mineral Resources and Ore Reserves Report, 2014). The western portion is where the majority of TCM activities are located, and it is approximately 16,500 ha. TCM started operating in 1984 as an underground coal mine using the bord and pillar mining method. The mine comprised six shafts, namely Nyala, Eland, Duiker, Nari, Mopani, and Kremetart (Exxaro Mineral Resources and Ore Reserves Report, 2014).

The mine further had three opencast mini pits that were mined from 2011 to 2014. Since its inception in 1984, TCM mined up to 580 kilotonnes per annum of premium metallurgical coal, which was supplied solely to ArcelorMittal for steel production. TCM's mineable coal reserves have since been depleted and the mine has been undergoing closure since 2015 (Exxaro Mineral Resources and Ore Reserves Report, 2014). Hence, Exxaro Resources has developed a post-closure economic strategy to transform the area from mining to ecotourism by taking advantage of the proximity of the mine to both the Makuya Nature Reserve and KNP.

Background – Makuya Nature Reserve

Makuya Nature Reserve is part of the Vhembe Biosphere Reserve. It is internationally renowned for its wildlife, cultural diversity, and unique biological resources. Makuya shares a fenceless border with the Kruger National Park (KNP), which is within the Greater Limpopo Transfrontier Conservation Area (GLTFCA), bordering Pafuri, as represented in Figure 1 (Vhembe District Municipality IDP Review, 2019/2020). The nature reserve is managed in terms of a co-management agreement between the Limpopo Department of Economic Development, Environment and Tourism (LEDET) and the Makuya Tribal Council.

Makuya Nature Reserve is strategically positioned within the GLTFCA, which is a socio-economic development node for two activities, namely conservation and tourism. Before it being declared a nature reserve, the land was used for grazing, hunting, and collecting thatching grass and medicinal plants (Webster, 2007). Currently, three tribal communities derive some economic value from the land through hunting activities and the LEDET, which pays the community conservation levies for the land. LEDET pays an annual conservation levy of R12/ha and the hunting activities at Makuya Nature Reserve generate an annual income more than R2 million (DEFF, 2003). The funds generated from both the hunting activities and the conservation levy are intended for the benefit of community development as well as conservation activities. The conservation levy is transferred to the tribal authorities for the development and benefit of the communities.

Methodology

Mine closure planning is implemented by undertaking several processes that include closure planning, stakeholder engagement (community and employees), progressive rehabilitation, financial provisioning, compliance and monitoring, and relinquishment. This review was performed in three steps: 1) A desktop study was conducted; 2) empirical data was collected through one-on-one interviews with research participants at Tshikondeni coal mine; and 3) physical observations were made of the rehabilitation at

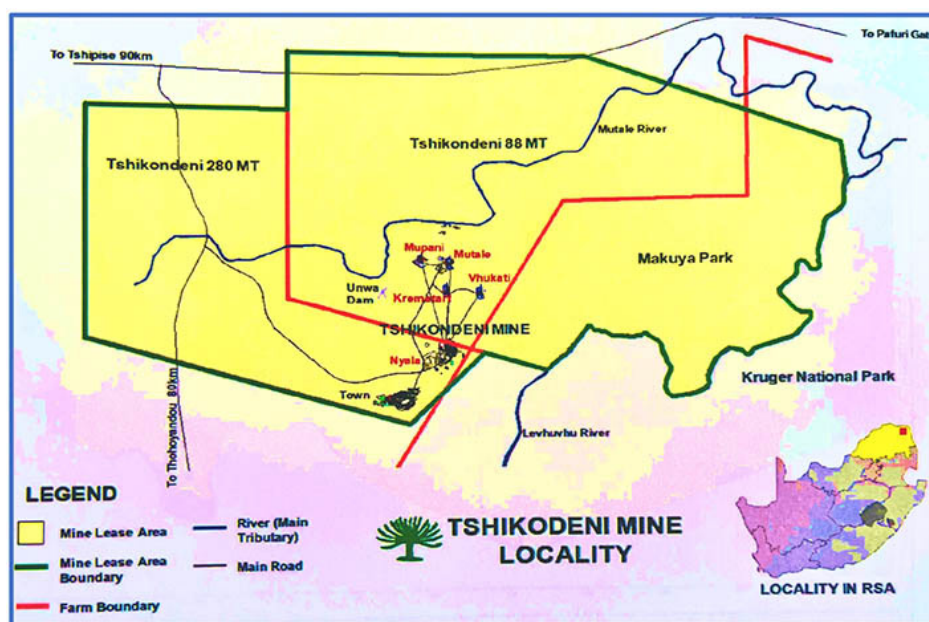


Figure 1—Tshikondeni coal mine location and lease boundary (TCM Social and Labour Plan, 2018)

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various mine operations within the Tshikondeni coal mine complex. Research participants consisted of mine officials across different departments (i.e., human resources, environmental, social, and business strategy) who were directly involved with the Tshikondeni coal mine closure. A questionnaire with semi-structured questions was developed. It was utilised to acquire a better understanding of mine closure planning at Tshikondeni coal mine.

Furthermore, the findings from the interviews and observations at the TCM site are juxtaposed to the mine closure provisions in South Africa's mining legislation. These provisions are in the principal mining legislation, the Minerals and Petroleum Resources Development Act 28 of 2002 (MPRDA), the National Environmental Management Act 107 1998 (NEMA), and National Water Act 36 of 1998 (NWA) that have provisions for environmental management, including rehabilitation and mine water management, respectively, as well as financial provisioning for rehabilitation, decommissioning, and closure activities in the Financial Provisions Regulations 2015 under the NEMA and the recently gazetted draft National Mine Closure Strategy (NMCS) under the MPRDA. According to the strategy, regional mine closure plans are intended to align the individual mines' closure plans that are situated close to one another. Thus, regional mine closure plans aim to "prevent or minimise adverse long-term environmental and socio-economic impacts and create a self-sustaining natural ecosystem or alternative land use" (Draft NMCS, 2021). This will also encourage collaboration among mining companies in mine closure planning and develop sizeable alternative economies that will sustain mining communities post-closure. In addition to the legislation above are provisions for addressing downscaling and retrenchments for any company with employees, as per the Labour Relations Act (LRA) 66 of 1995.

Findings and observations

Mine closure planning at TCM

Mine closure planning for TCM began approximately three years before the actual closure commenced. When initiating the mine closure process, the mining right holder generally undertakes several activities that include addressing the legal obligations, developing the mine closure plan, collecting data for analysis, and engaging with relevant internal and external stakeholders.

Initiating mine closure at TCM

TCM began downscaling its operations in 2011 in preparation for mine closure, which was planned to commence in 2014/2015. Thereafter, the mine initiated section 189(1) of the LRA process as per the prescripts of the law when an employer intends to institute retrenchments. TCM eventually ceased to operate in late 2014 when the viable coal resources had been exhausted. In December 2016, the mining right holder submitted TCM's environmental management plan for closure to the then Department of Mineral Resources. The environmental management plan was approved in December 2017. Additionally, as required by law, each mine operation with a mining right has the legal obligation to implement social labour plans (SLP) for the mining communities as per regulation 41 of the Amended Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA). An SLP allows the mining right holder to contribute positively to the long-term sustainability of its communities through social and economic projects. As part of the social strategy toward mine closure, TCM conducted a situational analysis of the surrounding communities of Mukomawabani, Mutele B and Sanari. Independent consultants

were appointed to undertake the study in 2017. The findings were used as input into the SLP. A top critical need observed amongst the three surrounding villages was access to water. Consequently, findings from the situational analysis report were implemented as social infrastructure projects that included three crèches (one in each village), a community hall in Mukomawabani Village, and 56 houses (twenty houses in Mukomawabani Village and eighteen houses in both Sanari and Mutele B villages, respectively).

Developing a mine closure plan

TCM's mine closure plan was developed by independent consultants who took guidance from the relevant regulatory frameworks to comply with the mine closure requirements of various regulatory bodies. This reiterates findings from a survey by Milaras et al. (2014) indicating that mining companies often outsource mine closure plan development to independent consultants instead of using in-house personnel.

Stakeholder (community and employees) engagement

The stakeholders most affected by mine closure are the employees and communities. Employees are at risk of losing employment, and communities that have secured economic opportunities with the mine as a supplier or service provider are at risk of losing employment, and also lose benefits from social projects initiated by the mine under the SLP. Thus, when TCM initiated mine closure, stakeholders, including employees and communities, were engaged.

Community engagement

During mine closure planning, communities can be engaged using an SLP as an instrument that registers their expectations for post-mining land uses, aiming to achieve self-reliance. However, the key to value creation and self-reliance in mining communities is their ability to be organised. The Royal Bafokeng Nation (RBN), although not a traditional community where Tshikondeni coal mine is located, presents a great model of the importance of organised mine communities with clear balanced governance structures. RBN is a native Setswana-speaking community of approximately 150,000 people who live on their ancestral land of 1,400 km² near Rustenburg, in the North-West Province, South Africa.

The fundamental building blocks on which the RBN's governance structure is built are *kgosi* (king), *morafe* (nation/community) and land. The structure does not apportion any hierarchical status between *kgosi* and *morafe* but realises that *kgosi ke kgosi ka morafe*. This means the community maketh the king; therefore, without the community, there can never be a king. RBN engagements with external stakeholders are built precisely on this principle and communal decisions are made through their three-legged governance structure, as presented in Figure 2, during internal engagements.

According to Ostrom (2000), "in self-organised regimes the rules have to be clear to all participants and the members need to know with whom to cooperate". Furthermore, a research study conducted by Medvey (2010) at Makuya Nature Reserve about surrounding communities found that communities are often faced with the challenge of striking the right balance between their traditional practices and democratic institutions. Although, traditional communities such as the Makuya have a form of communication structure through their tribal authority, communities have expressed their dissatisfaction with tribal authorities who made decisions on their behalf without in-depth engagement (Medvey, 2010).



Figure 2—Royal Bafokeng Nation's three-legged governance structure (Moumo Integrated Development, 2013)

Hence, based on Ostrom's (2000) self-organised regimes and Medvey's (2010) findings, the Makuya traditional community, as one of the surrounding communities of the Makuya Nature Reserve, may be perceived and categorised as not being a self-organised traditional community. This may pose a risk to the success of Tshikondeni Legacy Project (TLP) to deliver a sustainable post-closure economy after relinquishment. Makuya Nature Reserve is co-managed by LEDET and the Makuya traditional community, thus the institutional arrangement between the two parties needs to be solid for a successful post-closure economy. Proper management structures and commitment are critical for driving TLP post-closure, otherwise, an alternative economy envisioned to deliver a sustainable future is at risk to fail. Whilst organised communities are a key factor to the success of projects, it is also critical for communities to take ownership of projects.

The Makuya community has adopted the motto of "Nothing on our land about us for us without us"; therefore, the community expects their needs and their presented projects to be considered during mine closure planning without feeling that certain projects are imposed on them (Mazibila, 2015).

SLP projects, particularly those developed to support communities' livelihoods post-mine closure, need to be inclusive and consider communities' inputs. Communities often suggest developmental projects that address their immediate social needs. If those needs are considered, it may be easier for communities to commit and take ownership of the economic projects that are implemented by mining companies (Medvey, 2010). Therefore, continuous engagements with communities to empower them may lead to communities accepting these economic projects. In turn, this may lead to communities taking ownership of these projects after relinquishment and becoming self-reliant.

Employee engagement

The employee engagement as per section 189 is presented in the closure planning, and the section 189 profit-to-revenue ratio of the relevant mine to be less than 6 per cent on average for an agreement was signed to protect the people. Section 52(1) of the MPRDA requires the holder of a mining right to notify the Minister of Mineral Resources in the prescribed manner where prevailing economic conditions cause the continuous period of twelve months. Additionally, if any mining operation is to be scaled down or cease with the possible effect that 10 per cent or more of the labour force or more than 500 employees, whichever is the lesser, are likely to be retrenched in any twelve months, the holder of the mining right remains responsible for managing the retrenchment processes because of its obligations in terms of section 52 of the MPRDA.

At TCM, the process of equipping employees in low-skilled positions with portable skills to pursue alternative employment and participation in meaningful economic activity has been ongoing during the mine closure phase. The portable skills provided include training in poultry farming, tiling, and plumbing. TLP, as a post-closure strategy, also includes skills development aligned with SLP initiatives that will provide communities with training and skills that will serve the biodiversity, economy, and conservation of the area.

Progressive rehabilitation

At the TCM site, rehabilitation of areas that were once opencast pits and openings was observed. The pits were filled with soil and left to be revegetated naturally with native vegetation that aligns with its post-mining land uses. Thus, rehabilitated areas that were covered with soil were left to revegetate naturally with grass and mopane trees, as can be observed in Figures 3 and 4. Although quantifying

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Figure 3—Photograph of rehabilitated Mutale box cut at the TCM complex



Figure 4—Photograph of rehabilitated mini pit 3 with cattle grazing at the TCM complex

the amount of rehabilitation conducted at TCM is beyond the scope of this study, observations of the physical rehabilitation confirm that progressive rehabilitation was conducted to return the land to its original state before mining. The rehabilitation of box cuts and mini pits began in 2016. During a site visit in November 2018, the holes were filled and covered with topsoil. A desktop study on land rehabilitation revealed that 198 ha of land was disturbed because of mining activities at TCM. By the end of Exxaro's 2020 financial year 139 ha of land had been rehabilitated.

Figure 5 illustrates the previous TCM coal-processing plant infrastructure at the mine complex. All the coal-processing plant infrastructure was decommissioned and dismantled to make way for land rehabilitation as per mine closure provisions in the MPRDA and its regulations. The area was rehabilitated completely and covered with topsoil, returning the land to the wilderness that it was prior to mining activities, as indicated in Figure 6.

Financial provisions

The desktop study indicated that the financial provisioning at TCM was calculated as per the Financial Provision Regulations 2015. The results were first published in December 2015 and amended in September 2018 to align with the new financial regulations. According to Exxaro's Environmental, Social and Governance (ESG) Report of 2021, all business units within Exxaro review their financial provisions for mine closure and rehabilitation on an annual basis. At this point, amendments to rehabilitation

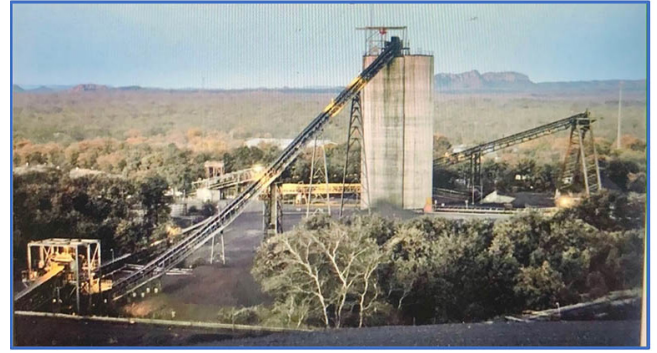


Figure 5—Tshikondeni coal-processing plant during its life of mine (Cornish, 2012)



Figure 6—Rehabilitated land where the coal-processing plant had been situated

plans and closure objectives are in line with the environmental management plan. Quarterly, the mining company makes financial contributions to the trust based on closure cost estimates for the remaining life of the mine (Exxaro Resources, 2021). Exxaro has established a groupwise rehabilitation fund, rehabilitation and other environmental liabilities, an environmental rehabilitation fund, and a coal central trust fund. In addition to these financial vehicles, an amount of R4,242 million is provided as a bank guarantee to cover shortfalls in financial provisions and any other environmental liabilities that may arise (Exxaro Resources, 2020). Table 1 presents the mine closure financial provisioning for TCM as extracted from Exxaro's ESG report of 2020 (Exxaro Resources, 2020).

An accurate calculation of the total amount anticipated for financial provision is critical and a prerequisite for achieving mine closure objectives, including rehabilitation. The survey of Milaras et al. (2014) on mine closure planning found that mine closure planning is usually conducted poorly and that inadequate funds are allocated towards the process. A survey conducted (Intellidex, 2018) to assess the financial provisions of several South African mining companies found that the disclosure by mining companies regarding rehabilitation and mine closure does not provide adequate, meaningful, and comparative information. The sufficiency of financial provision allocated by companies cannot be confirmed based on the information disclosed in their annual integrated reports.

Therefore, Intellidex's survey could not conclude definitively on the sufficiency of financial provisioning. The information disclosed by mining companies, as also noted in TCM's mine closure, included: (1) The financial instruments used to provide for future rehabilitation obligations; (2) estimated amounts for

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environmental rehabilitation and mine closure obligations, and funds and guarantees available to meet those obligations (Table 1); and (3) responsible individual/entity for estimating the quantum of the environmental rehabilitation and mine closure obligations.

Compliance and monitoring

The legislation and regulatory framework set provisions for mine closure planning. Furthermore, it provides compliance parameters for processes undertaken during mine closure, such as stakeholder engagement, rehabilitation, and financial provisioning. Compliance with these processes is regulated in the MPRDA, NEMA, EIA, and Financial Provisions Regulations. Firstly, a mining right holder needs to submit a mine closure plan to the Department of Mineral Resources and Energy as per section 43 of the MPRDA. NEMA section 24 and EIA Regulations 2017 present provisions for rehabilitation compliance. The desktop study found that the progressive rehabilitation undertaken at TCM was conducted in terms of the current legislation and regulatory framework and is continuously monitored to comply with the desired/planned final land use. The allocation of financial provision for closure was also compiled as per the Financial Provisions Regulations of 2015 (Exxaro ESG Report, 2022).

Relinquishment and monitoring

When TCM reaches its final stage, the Makuya Tshikondeni Development Fund intends to relinquish the mine site gradually to the final land user, namely the Makuya Tribal Council, through the TLP. To mitigate against the failure of the project, TCM intends to relinquish and transfer the TLP progressively to the final land user, to deliver an alternative economy. The following section discusses the economic activities proposed in the TLP that leverage the infrastructure that was invested during the life of Tshikondeni coal mine.

Post-closure strategy

Tshikondeni Legacy Project (TLP) is a mine closure strategy developed by Exxaro Resources. The project is administered under a section 21 company, named Makuya Tshikondeni Development Fund, which comprises representations from Exxaro, the Makuya Tribal Council, and ArcelorMittal. The project is funded by a partnership between Exxaro and ArcelorMittal to the value of R16 million. The project is part of the Post-mining Investment Programme within the Limpopo Province, valued at R228 million. TLP is positioned as a post-closure alternative economy strategy that is implemented in partnership with relevant stakeholders.

Tshikondeni Legacy Project

Tshikondeni Legacy Project (TLP) proposes ecotourism as an



Figure 7—Prefabricated housing at Tshikondeni mine village



Figure 8—Demolished prefabricated house at Tshikondeni mine village

economic activity to replace mining. The project further intends to address the socio-economic aspects of the surrounding communities to preserve their livelihoods post-closure. The economic and developmental initiatives planned in the TLP are intended to deliver sustainable post-closure livelihoods based on integrated final land use. Post-closure economic activities to be delivered through the TLP are based on mined land that, although it has been rehabilitated to its original use, is better resourced to transition to an alternative economy. Over the duration of the life of mine, mining companies invest in varying infrastructure, some of which will be optimised for the post-closure economy. During mine closure at TCM, some of the invested infrastructures were demolished (Figure 7 and Figure 8), whilst another infrastructure was included to fulfil post-closure outcomes (Figure 9 and Figure 10).

Therefore, the combination of infrastructure and the Makuya Nature Reserve present a viable opportunity for the surrounding communities to derive sustainable value that can preserve their livelihood. Throughout the life of mine (LoM), TCM further invested in developmental projects such as photovoltaic solar panels (Figure 9) and water reticulation (Figure 10).

Table 1
Financial provisioning for TCM closure 2019-2021

Year	Estimated resources immediate closure cost (Rm)	Estimated residual liability (Rm)	Trust fund balance (Rm)	Guarantee	Funding shortfall to be covered over remaining LoM	Remaining life in years
2019	19	30	191	49	(190)	0
2020	10	22	197	49	(215)	0
2021	13	6	219	49	(249)	0

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Figure 9—Photovoltaic solar panels (1,037 kWp) at TCM



Figure 10—Joint venture water reticulation project

When TCM was still operational, photovoltaic solar panels were erected to supply renewable energy for mining operations and household use at the mine employees' village. The water project was a joint venture between the Mutale Local Municipality and Exxaro TCM as an SLP initiative to supply four surrounding communities with portable water.

These two projects fulfil the developmental needs of the communities by supplying basic services, electricity, and water. They are also drivers of the economic activities planned in the TLP to establish an alternative economy.

Alternative economy

Findings from the one-on-one interviews with research participants highlight the importance and need to educate communities on the feasibility and viability of SLP projects, particularly those intended to be sustainable post-mine closure. To preserve livelihoods, communities must be engaged in the objectives of SLP projects and their role in economic contribution. The TLP is TCM's closure strategy and incorporates some of the SLP projects with the potential of being sustainable beyond closure.

The SLP projects that were implemented at TCM before initiating mine closure include Musunda Citrus Farm, Makuya Cattle Lot and Sanari Skills Development Centre. These projects have been identified to survive post-closure, but to be sustainable, the communities must be committed to managing the projects to preserve their non-mining livelihoods. However, the Makuya community claims that these projects have been imposed on them (Medvey, 2010). The community voiced their dissatisfaction about TCM not considering their projects, which include classrooms and a science laboratory at Makuya Secondary School, as SLP initiatives. This highlights a critical point of misalignment between the mining company's plan and the community's expectations and desires.

By including communities in project development engagements and during mine closure planning, mining companies can address the communities' dissatisfaction. This will allow mining companies to incorporate the communities' developmental needs as best as possible into economic projects that are planned to support a post-closure future and mitigate against the risk of an 'artificial economy'.

An example of such an artificial economy is a De Beers-owned diamond mine in the Northern Cape. Kleinzee, once a thriving diamond-mining town owned by De Beers, underwent mine closure in 2010. During mine closure, De Beers invested approximately R90 million towards post-closure socio-economic projects in Kleinzee and another neighbouring town, Koingnaas. De Beers invested significant financial resources as part of their post-closure strategy to preserve the livelihoods of the people of Kleinzee and those previously employed at the mine, ensuring that they would not become financial burdens to their respective local municipalities. Several projects, such as an enterprise development hub, a wind farm to generate clean energy, and a small-scale abalone farm, were proposed as alternative economy projects. Mine infrastructure was repurposed for some closure projects, and pumps were converted to reticulate seawater for an oyster farming enterprise. The alternative economy projects were envisioned to create a total of 5 000 jobs and contribute to the local economy as per the De Beers mine closure plan. In 2012, De Beers transferred the town of Kleinzee to the local municipality and proclaimed it a public town. However, alternative economy projects under the local municipality failed to reach planned targets in terms of employment and a sustained post-closure economy, which resulted in some community members leaving town in search of employment elsewhere. The collapse and failure of this post-closure alternative economy could be attributed to the insufficient time frame allocated between the implementation of the projects for the alternative economy and the relinquishment and misalignment of proposed post-closure economic activities.

Furthermore, whilst communities' developmental needs are urgent and immediate, economic projects suggested by mining companies are geared to drive an alternative economy post-closure and sustain communities' livelihoods. To transition to an alternative non-mining economy, the TLP proposes projects that will transform Tshikondeni from a mining economy to an ecotourism economy. Ecotourism, as the proposed alternative post-closure economy, intends to deliver a dual purpose: biodiversity and economy conservation.

Proposed projects under the TLP align with the government's National Biodiversity Economy Strategy (NBES) as documented in the integrated development plans for the Vhembe District. NBES has identified and demarcated the Tshikondeni Biodiversity Economy Node within the Makuya Nature Reserve. The economic activities will be supported through a partnership between government departments (Department of Forestry, Fisheries and Environment, SANParks, LEDET, and the Department of Rural Development and Land Reform) and the Peace Parks Foundation, a non-governmental organisation.

Wildlife hunting, including trophy hunting, is an old-fashioned activity still being practised by the Makuya traditional community. This is one of the significant drivers of the biodiversity economy within the Tshikondeni Biodiversity Economy Node. Associated industries such as taxidermy and the sale of game meat are also planned as economic activities that will support ecotourism. The NBES strategy as documented in the IDPs for the Vhembe District, identifies the sale of live game at auctions as a potentially lucrative business where the price paid for any animal ranges between

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R10,000 and R800,000, with an average price of R225,224 per animal. This unlocks economic opportunities for the sale of game meat, animal skin for leather, bones, and horns. Furthermore, including local entrepreneurs in ecotourism presents opportunities to create employment for the Makuya communities who will ultimately become self-sufficient.

Conclusion

The TCM, in undertaking mine closure, has considered and complied with the legal obligations presented in various South African legislative frameworks. As indicated in the aforementioned, TCM initiated mine closure 5 to 10 years before the end of LoM, which is regarded to be too close to the end of LoM in terms of mine closure planning frameworks (ICMM, Integrated Mine Closure: Good Practice Guide, 2019). The TLP proposes sustainable land-use initiatives with the potential to transition a mining economy to an alternative post-closure economy that will deliver self-reliant communities.

According to Kretschmann (2018), an effective post-mining strategy like the TLP can potentially provide several opportunities to reinvent previous mine operations and create new jobs. The successful control and management of post-mining risks are fundamental to the effective use of these opportunities (Kretschmann 2018), and failing to do so may create an 'artificial post-closure economy' that ultimately yields undesirable results, as seen in the case of the Kleinzee mine closure.

An economy that can replace a mining economy is not only critical but also a necessity for the survival of mining communities that have depended on the mining economy for their livelihoods. An effective progressive rehabilitation for proposed land use choices is a prerequisite to transitioning a mining economy to an alternative post-closure economy. Therefore, during mine closure planning, the proposed final land uses must drive the type of progressive rehabilitation that supports post-mining land uses, enabling a sustainable post-closure economy. TCM also needs to allow the communities and final land users to propose and present their desired economic projects for an alternative post-closure economy. The TCM rehabilitation is on a path to delivering the expected land uses that will carry the proposed economic closure projects for an alternative economy of ecotourism. However, to realise a sustainable post-closure economy, TCM must consider affording sufficient time to initiatives in the TLP to progress from the project phase and to become self-funding from income generated from the proposed ecotourism activities. This is to shift their dependency on the funding from the mine operator to avoid creating an artificial economy that cannot sustain itself post-closure.

Thus, the relinquishment criteria for the TCM must be registered in the TLP to mitigate against the risks that often result from premature and abrupt withdrawal of project funding. Abrupt withdrawal from projects may lead to project failure; ultimately resulting in an unsustainable post-closure alternative economy (Gardiner et al, 2015). In conclusion, planning mine closure closer to final relinquishment fails to recognise that closure planning is a process and not an event. Implementing alternative economy projects closer to relinquishment may lead to an artificial economy and, ultimately, the failure of the post-closure economy.

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