

Legislative frameworks and sustainable mining practices in South Africa: integrating environmental and socio-economic objectives

Jeanette Erasmus ^a, Jacques Potgieter ^{a,*}

^a E-TEK Consulting, South Africa

Abstract

As climate change intensifies, the mining sector faces the dual challenge of maintaining economic viability while upholding environmental responsibilities. This paper provides a comprehensive review of the South African Mining Act and related regulatory frameworks, focusing on the implementation of end land use plans (ELUPs) and closure criteria as critical tools for achieving sustainable post-mining landscapes. The study delves into key legislative instruments, including the National Environmental Management Act 107 of 1998 (NEMA) (Republic of South Africa 1998) and the Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA) (Republic of South Africa 2002), and examines their integration with sustainable development goals (SDGs) to foster ecological resilience and socio-economic development.

Central to the discussion is the role of ELUPs and closure criteria in guiding the rehabilitation of mining sites. ELUPs serve as strategic frameworks that set long-term goals for land use after mining operations have ceased, while closure criteria provide specific, measurable standards to achieve these goals. The paper emphasises the importance of aligning mining activities with climate-conscious strategies, ensuring that post-mining landscapes not only restore ecosystems but also contribute to the economic and social wellbeing of local communities.

The review highlights how the South African regulatory context, when effectively implemented, supports the transition from extraction to rehabilitation, addressing both environmental and socio-economic dimensions. By integrating adaptive management practices and robust environmental monitoring, ELUPs can play a pivotal role in mitigating the impacts of climate change and promoting sustainable development. This paper contributes to the discourse on sustainable mining by offering a detailed analysis of the regulatory landscape and proposing practical approaches for enhancing compliance and community engagement in mining closure practices.

Keywords: *closure criteria, end land use, climate change, sustainability, rehabilitation, mining, end land use plan, socio-economic*

1 Introduction

Climate change has always been a significant yet often overlooked factor in sustainable development. Historically it was dismissed by some as a fallacy or merely a concern of environmental activists. However, anthropogenic changes, particularly the emission of greenhouse gases, have accelerated climate change at an unprecedented rate (Crowley 2000). Studies by Crowley (2000) indicate that 21st-century global warming projections far exceed the natural variability of the past 1,000 years. Climate is essential for the survival of fauna and flora, and climate studies conducted in major European mountain ranges predict that, based on current trends and anthropogenic changes, floral species in these regions may experience up to an 80% habitat loss between 2070 and 2100 (Engler et al. 2010).

* Corresponding author. Email address: jpotgieter@etekconsulting.co.za

The effects of climate change may seem subtle now but they are profound when examined through specific indicators such as amphibian populations. Amphibians are critical indicators of environmental health due to their ability to absorb water through their skin, making them susceptible to a wide range of factors including drought and pollution (DeGarady & Halbrook 2006). Amphibian populations are rapidly decreasing worldwide, with about 500 species experiencing rapid declines; sometimes leading to extinction due to anthropogenic changes and disease (Skerrett et al. 2007). This trend is a harbinger for humanity; like the analogy of an amphibian in gradually heating water, adapting until it is too late. However, humanity still could preserve the environment and foster environmental stewardship to ensure future generations can enjoy the environment we currently take for granted. Determining the primary cause of climate change is complex as it is the result of multiple factors, including the mining sector.

Mining has been a significant driver of economic growth, sparking colonialism and continuing to be a major economic force. Mining has become industrialised to an unprecedented level over the past 50 years. With this advancement has come the necessity for stringent legislation to regulate the industry, providing guidelines and measures to prevent environmental degradation. In South Africa the legislative framework governing mining and environmental sustainability is robust and aimed at ensuring that mining activities do not compromise environmental and social welfare. The Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA) (Republic of South Africa 2002), for example, requires mining companies to develop and implement social and labour plans and environmental management plans as part of their mining rights application. These plans are essential for promoting sustainable development and ensuring that mining operations contribute to the welfare of the local communities and the environment.

The National Environmental Management Act 107 of 1998 (NEMA) (Republic of South Africa 1998), which provides the legal framework for environmental governance in South Africa, is one of the best written acts that puts the needs of the environment first. The NEMA mandates that all mining projects undergo thorough environmental impact assessments (EIAs) to identify, assess, and manage environmental effects. The EIA process includes public participation, ensuring that the voices of local communities and other stakeholders are heard and considered in the decision-making process. This participatory approach is crucial for ensuring that mining projects are socially inclusive and environmentally sound.

The National Water Act also plays a significant role in regulating the use of water resources in mining activities. It emphasises the need for sustainable water management practices, ensuring that mining operations do not adversely affect water quality and availability. This Act requires mining companies to obtain water use licences and implement measures to prevent water pollution and manage water consumption efficiently.

As mining endeavours continue to extract valuable resources, they must concurrently address their carbon footprint and prepare for a future where the resource may no longer be financially viable to mine. A key strategy in this context is the development of comprehensive plans for post-mining land use, often referred to as end land use plans (ELUPs) in South Africa. These plans are designed to guide the closure of mining activities in a manner that promotes environmental sustainability and meets community needs. They not only help to define the closure criteria for the final stages of mining but also lay the groundwork for a post-mining landscape that is resilient and sustainable.

Environmental monitoring, rehabilitation trials and research, as well as climate assessments, are pivotal components of a successful ELUP. Continuous environmental monitoring allows for the tracking of rehabilitation progress to ensure that all activities align with the agreed success criteria. This involves regular soil, water and air quality assessments, along with biodiversity surveys to monitor the recovery of flora and fauna. Climate assessments, on the other hand, help in understanding the long-term impacts of climate change on the rehabilitation efforts. Mining operations can adapt their rehabilitation strategies to ensure resilience against climate extremes by evaluating temperature and precipitation trends.

The closure phase of mining operations is critical, involving a meticulous and auditable process to ensure that rehabilitation efforts meet both internal and regulatory standards. This evaluation is essential for determining the success of rehabilitation and for achieving a sustainable end land use. By incorporating

climate-conscious land use considerations and stringent site-specific closure criteria, mining operations can fulfill their environmental obligations while also addressing the socio-economic needs of local communities. Through proactive planning, responsible execution and commitment to climate-conscious strategies, mining operations can transform into catalysts for positive environmental and community outcomes.

This paper explores the development and implementation of ELUPs, emphasising their role in achieving sustainable post-mining landscapes. By balancing economic imperatives with ecological mindfulness, mining operations can set an example of resilience and sustainable development in the face of an evolving climate landscape. By integrating the three pillars of sustainability — environmental, social and economic — ELUPs ensure that post-mining landscapes are not only restored but also contribute positively to the community and environment. Through rigorous planning, adaptive strategies, continuous stakeholder engagement, and robust environmental monitoring and climate assessments, mining operations can leave a legacy of environmental stewardship and community wellbeing.

2 Methodology

To develop and implement a successful ELUP for any operation there are various factors that need to be considered. A mining operation can identify a suitable end land use for a specific area by looking at the three pillars of sustainability: environmental, social and economic (Figure 1) (Purvis et al. 2019).

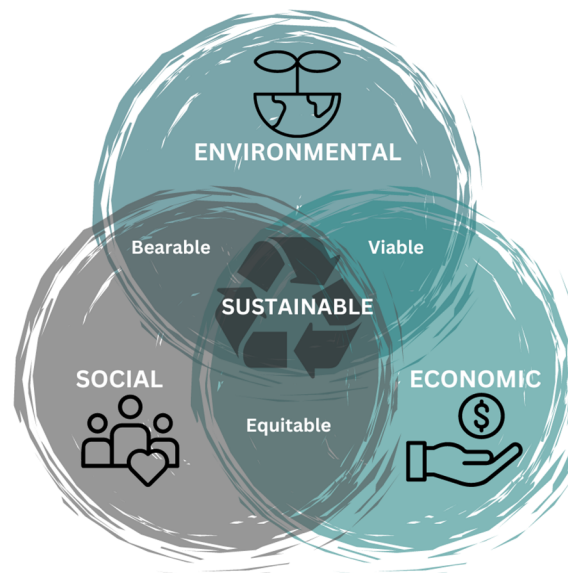


Figure 1 The three pillars of sustainability

2.1 Review of relevant legislation

Sustainability is a key principle within the South African legal system, and explicitly acknowledged in the country's Constitution. Section 24(a) of the Constitution of the Republic of South Africa (1996) provides that everyone has the right to an environment that is not harmful to their health or wellbeing. Section 24(b) asserts that everyone has the right to environmental protection for the benefit of present and future generations. This protection should be achieved through reasonable legislative and other measures that ensure ecologically sustainable development and the responsible use of natural resources, while also supporting justifiable economic and social development.

Section 24 reinforces the concept of sustainable development, which is based on a three-pillar approach encompassing economic, social and environmental dimensions (Figure 1). Each of these pillars must be upheld simultaneously and with equal dedication as they are all equally important (Kidd 2011). This idea of sustainability permeates all legal fields in South Africa as the Constitution is regarded as the highest law in the country; invalidating any conflicting laws or actions and mandating compliance with its obligations, as

outlined in Section 2. Hence it is reasonable to conclude that sustainability is a fundamental principle across all legal domains, including environmental and mining sectors, and that laws governing these industries must encompass sustainability and sustainable development protocols.

The South African Parliament promulgated the MPRDA 28 of 2002 (Republic of South Africa 2002) and the NEMA 107 of 1998 (Republic of South Africa 1998) to uphold the rights established in Section 24. These Acts grant the Minister of Mineral Resources and the Minister of Environmental Affairs, respectively, the authority to impose prohibitions or restrictions on prospecting and mining rights (Vinti 2018).

2.1.1 National Environmental Management Act

The NEMA is a significant legal document for the purposes of mining and sustainable mining practices in South Africa. The NEMA guides sustainable development, imposes legal obligations on mining companies to comply with environmental regulations and regulates EIAs.

Section 1 of the NEMA describes sustainable development as the integration of social, economic and environmental factors into planning, implementation and decision-making processes. This is to ensure that development benefits both current and future generations. Thus sustainable development serves as a blueprint for achieving human development objectives while preserving the ability of natural systems to supply essential resources and ecosystem services needed for the functioning of the economy and society (Vinti 2017).

Moreover, Section 2(3) of the NEMA enshrines the three-pillar approach, asserting that development must be sustainable across social, environmental and economic dimensions. This approach is mandatory for all government entities in South Africa as the NEMA applies to a range of national environmental management principles that must be implemented by all state organs (Kidd 2011).

The NEMA imposes the duty of care and remediation of environmental degradation on any person who causes, has caused or may cause degradation. Section 2 of the NEMA provides specific guidance on the closure of mining operations. It requires a mining right holder to rehabilitate the environment as far as reasonably practicable to its natural state or to a land use that conforms to the generally accepted principle of sustainable development. A rights holder must also set aside a financial provision, which only the state can access, to ensure such rehabilitation and they retain liability for environmental damage even after closure of the operation (Mpanza et al. 2021).

The NEMA is essential for the mining industry in South Africa as it ensures that mining activities are conducted in a manner that respects environmental limits, promotes sustainability and involves stakeholders in decision-making. By providing a legal and procedural framework for environmental management, the NEMA helps to align mining operations with the country's broader environmental and development goals.

2.1.2 Mineral and Petroleum Resources Development Act

The way land is used has an impact upon the environment; therefore, end land use planning is a vital component of environmental management. In the modern day, environmental considerations are often at the forefront of factors considered in end land use decisions. Therefore, the MPRDA will be discussed in terms of the regulation of mining, particularly in respect of its environmental impact.

Mining is regulated by the MPRDA, the preamble of which affirms that the state's obligation is to protect the environment for the benefit of present and future generations, to ensure ecologically sustainable development of mineral and petroleum resources, and to promote economic and social development.

Section 37(1) of the MPRDA states that the national environmental management principles in the NEMA apply to all prospecting and mining operations, and any matter relating to such operations, and serve as guidelines for the interpretation, administration and implementation of the environmental requirements of the MPRDA. Further, Section 37(2) of the MPRDA states that any prospecting or mining operation must be conducted in accordance with generally accepted principles of sustainable development. Thus, integrating social, economic and environmental factors into the planning and implementation of prospecting and mining

projects in order to ensure that exploitation of mineral resources serves present and future generations (Kidd 2011).

Section 43(3) of the MPRDA states that the holder of a mining right or permit must apply for a closure certificate upon cessation of mining operations or on relinquishing any portion of land to which the right or permit relates. Section 43 also mentions closure planning. Until mid-2014 mine closure planning was regulated by the MPRDA. Since then it has been regulated under the NEMA as a sustainable development construct. However, some of the elements of mine closure, such as relinquishment, are still regulated by the MPRDA (Mpanza et al. 2021).

2.2 Mining and sustainable development goals: reaching an international standard

On an international scale, sustainable development has been defined in the 1987 Brundtland Report as the means of 'meeting the needs of the present without compromising the ability of the future generations to meet their own needs' (World Commission on Environment and Development 1987). This closely aligns with the definition of sustainability in the South African legal framework. Therefore, regarding mining, sustainability involves the practice of preserving the environmental, social, biological and economic resources that benefit the planet and its people today, ensuring these resources remain robust and capable of providing the same benefits to future generations (Parra et al. 2021).

Sustainability is important in mining as the mining industry is intricately linked to land restoration, rehabilitation and ELUPs. The United Nations 2030 sustainable development goals (SDGs) acknowledge how the mining sector can contribute to achieving these SDGs, as well as how SDGs can drive transformative changes within the industry (Parra et al. 2021).

The SDGs are a set of 17 interconnected objectives designed to address various global challenges and promote sustainable development by the year 2030 (Figure 2). These goals cover a range of environmental, social and economic issues worldwide, and are regarded by the United Nations as the focus for enhancing global welfare over the coming decade (United Nations 2024). All 193 United Nations Member States, including South Africa, adopted the SDGs in September 2015 as part of the 2030 Agenda for Sustainable Development. Each goal is accompanied by specific targets and indicators to monitor progress towards their achievement (United Nations 2024).



Figure 2 The 17 sustainable development goals of the United Nations

2.2.1 A brief overview on how mining can contribute to sustainable development goals

The mining industry has the potential to become a leading ally in achieving the SDGs. Through operational functions, mines can reduce poverty by generating profits, employment and economic growth in low-income countries like South Africa. Additionally, through partnerships with government and civil society, mines can ensure that the benefits of mining extend beyond the life of the mine itself, so that the mining industry has a positive impact on the environment, climate change and social capital. An example of this involves Rio Tinto, which has implemented biodiversity management plans at several of its operations — such as the QMM ilmenite mine in Madagascar, where efforts include habitat restoration and conservation partnerships with the Government of Madagascar (Rio Tinto 2023). These efforts align with SDG 15 (Life on Land) and SDG 13 (Climate Action).

The benefits that the mining industry can bring to the SDGs was most notably discussed in 2015 by the World Economic Forum, the United Nation Development Programme, the United Nations Sustainable Development Solutions Network and the Columbia Center on Sustainable Investment, and published in the report *Mapping Mining to the SDGs: An Atlas*, which discusses how the mining industry can most effectively contribute to the SDGs. This report helps mining companies navigate where their activities, from exploration through to operations and mine closures, can help the world achieve the SDGs. The main goal that will be discussed is SDG 13, which relates to taking urgent action to combat climate change and its impacts.

2.3 How end land use plans and land restoration can combat climate change

Land restoration is an integral part of an ELUP as it involves detailed planning, regulatory compliance and environmental management. Its successful implementation ensures that mined land can be used sustainably for future generations, aligning with broader environmental and economic goals.

Land restoration offers dual benefits for climate change by helping to reduce carbon dioxide in the atmosphere and strengthening ecosystems against climate-related threats like natural disasters. Restoration improves soil quality and biodiversity, making ecosystems more robust against disturbances. Increasing plant cover through restoration enhances water absorption; reduces the risks of flash floods, landslides and soil erosion; and boosts organic carbon levels in the soil, which further enhances resilience and carbon storage. Using drought- or fire-resistant plants enhances adaptation to these specific hazards. Overall, improved land management through restoration could significantly contribute to necessary carbon reduction efforts to keep global warming below 2 °C by 2030 (Herrick & Abrahamse 2019).

Estimating how much carbon can be captured through land restoration is very uncertain and challenging as it requires many organisations worldwide to change their practices. Despite these challenges, carbon sequestration remains one of the most measurable benefits of land restoration. Focusing on multiple benefits (like soil protection and biodiversity) rather than just one (such as wood production) can make ecosystems more resilient to extreme weather and provide diverse services and income for landowners. Restored areas can also serve as test sites to learn and develop better strategies for adapting to climate change.

Land restoration is crucial for addressing climate change, as it boosts ecosystem resilience and helps communities and governments adapt to climate impacts. Using the right mix of species and techniques, along with assisted and natural regeneration, is vital to combat soil and biodiversity loss and to support human wellbeing. Increasing plant cover and forest carbon through restoration helps reduce carbon emissions and makes natural and human systems more resilient to climate hazards. Therefore, to achieve Sustainable Development Goal 13, land restoration science and practices should be included in climate action policies. (Herrick and Abrahamse 2019)

2.4 Environmental setting

Understanding the environmental setting of a mining area is crucial for the development of effective ELUPs. Surrounding land uses provide insights into potential conflicts and opportunities for land rehabilitation, guiding land use decisions post-mining. Climate data, including temperature, precipitation and seasonal

patterns, informs adaptive rehabilitation strategies to mitigate climate-related risks and ensure ecosystem resilience. Local biodiversity assessments identify sensitive species and habitats, guiding conservation efforts and promoting biodiversity restoration post-mining. Rainfall patterns influence water availability, impacting water resource management strategies in the area. Water and air quality assessments highlight potential environmental risks from mining activities, guiding pollution prevention measures and remediation efforts. Land and soil quality evaluations identify areas requiring soil restoration and stabilisation to support sustainable land use post-mining. Considering these aspects ensures that ELUPs address the environmental challenges and opportunities specific to the mining area, promoting long-term environmental sustainability and ecosystem health.

2.5 Socio-economic aspects

Incorporating socio-economic aspects into ELUPs is essential for fostering sustainable development and community resilience post-mining. The Integrated Development Plan (IDP) serves as a road map for local government development priorities, providing valuable insights into community needs and aspirations. By aligning ELUPs with the IDP, mining operations can contribute to broader development objectives, ensuring that post-mining land use strategies are integrated into local development agendas.

Upskilling initiatives are critical for transitioning the workforce from mining-related employment to alternative livelihoods. By providing training and education opportunities, ELUPs support the development of new skills and capacities, enabling individuals to access diverse employment opportunities beyond the mining sector. This not only enhances economic resilience but also promotes social inclusion and empowerment within the community.

Initiatives to start businesses that are not reliant on the mine are essential for diversifying the local economy and reducing dependency on extractive industries. ELUPs can facilitate the establishment of small and medium-sized enterprises in sectors such as agriculture, tourism and renewable energy, fostering economic diversification and long-term prosperity. By promoting entrepreneurship and innovation, these initiatives create sustainable economic opportunities that endure beyond the life of the mine.

Managing community expectations is paramount for fostering positive relationships between mining companies and local residents. ELUPs must involve meaningful engagement with community members to understand their needs, concerns and aspirations. By incorporating community feedback into decision-making processes, ELUPs can build trust, transparency and mutual respect; mitigating potential conflicts and ensuring that post-mining outcomes align with community expectations.

Addressing socio-economic aspects in ELUPs is crucial for promoting inclusive and sustainable development in mining-affected communities. By integrating IDP priorities, facilitating upskilling initiatives, promoting non-mining business ventures and managing community expectations, ELUPs can create lasting benefits for both local residents and the broader region.

2.6 End land use plans, rehabilitation plans and closure criteria

In South African mining operations the ELUP plays a pivotal role in setting overarching goals for the rehabilitation of mined areas. This plan serves as a strategic framework that guides the formulation of detailed closure criteria aimed at achieving sustainable post-mining landscapes. While the ELUP is crucial in defining the long-term vision for the land post-mining, the closure plan expands on this by detailing the specific steps and processes required to realise that vision. The closure plan not only encompasses the ELUP's vision but also addresses complex scenarios and current site conditions, making both the ELUP and the closure plan dynamic living documents that continuously inform and guide each other.

For clearer context, their respective descriptions are:

- End land use plan
 - The ELUP focuses on the long-term vision for the land post-mining, defining the desired future state of the area.
- Closure plan
 - A closure plan outlines the specific steps and processes required to realise this vision, detailing the practical measures needed to rehabilitate the land in alignment with the ELUP. Central to this process is the integration of environmental, social and economic considerations within the closure criteria.

Under the guidance of the ELUP, the aim of rehabilitation plans is to safeguard ecosystems and biodiversity, enhance resilience against climate-induced stresses and mitigate any adverse environmental impacts caused during the mining process. However, these environmental goals must be balanced with the community's expectations. To achieve this balance the ELUP should ensure that rehabilitation efforts are aligned with broader socio-economic objectives. By integrating community engagement, skills development and the promotion of sustainable livelihoods into the rehabilitation process, environmental restoration may create job opportunities. This can be achieved through activities like native species revegetation programs, soil remediation and sustainable land use practices. This approach not only restores the environment but also provides long-term employment, supports local economies and leaves a positive socio-economic legacy in local communities. Ultimately, this holistic strategy fosters both ecological resilience and community wellbeing, minimising the ecological footprint of mining operations while promoting sustainable development.

Financial provisions within the ELUP play a critical role in supporting the implementation of these rehabilitation plans. They ensure that adequate resources are allocated for the effective execution of closure criteria, encompassing activities such as infrastructure dismantling, ongoing monitoring and adaptive management strategies. By adhering to the goals set forth in the ELUP, South African mining operations can navigate regulatory requirements, uphold their environmental responsibilities and contribute to sustainable development practices that mitigate climate risks and promote long-term environmental stewardship.

3 A discussion on sustainable mining practices in South Africa: balancing environmental responsibility and economic growth

South Africa's mining sector operates under robust legislative frameworks, primarily the MPRDA and the NEMA. These regulations emphasise the need for EIAs, effective rehabilitation and the long-term sustainability of mining operations. The integration of these regulations into mining operations is crucial for ensuring that the industry's activities align with broader sustainability goals and environmental protection standards.

The implementation of ELUPs within this framework demonstrates a proactive approach to managing post-mining landscapes. ELUPs are designed to ensure that mining companies plan for the final use of land once mining activities cease. By incorporating climate considerations into ELUPs, the mining industry can better anticipate and mitigate the impacts of climate change on post-mining environments. This is particularly important in light of increasing global concerns about climate resilience and the need for adaptive management strategies.

However, the practical application of these regulations presents challenges. Despite the strong legal framework, there are often gaps in enforcement and compliance. Mining companies may struggle to fully implement the required rehabilitation measures or adapt their practices in response to evolving climate conditions. This highlights the need for improved monitoring, more robust enforcement mechanisms and greater transparency in reporting.

Aligning South African mining practices with international sustainability standards, such as the United Nations' SDGs, is another critical aspect of ensuring long-term sustainability. International standards provide a benchmark for best practices and can guide the development of more effective regulatory measures.

By adhering to these standards, South Africa can enhance its global reputation as a leader in sustainable mining and contribute to global efforts in environmental protection and social responsibility.

Public participation is a key element in the successful implementation of these regulations. Engaging local communities in the planning and monitoring processes of mining operations ensures that their concerns and needs are addressed. This collaborative approach can lead to more effective and socially acceptable outcomes, fostering a positive relationship between the mining industry and affected communities.

4 Conclusion

In conclusion, the regulatory framework established by the MPRDA and NEMA provides a robust foundation for promoting sustainable mining practices in South Africa. By incorporating climate considerations into ELUPs and establishing clear closure criteria, these regulations reflect a forward-thinking approach to managing post-mining landscapes. This approach is crucial not only for addressing the environmental impacts of mining but also for ensuring that post-mining land use supports broader socio-economic objectives, such as community development and job creation.

However, the successful implementation of these regulations hinges on several critical factors. There is a pressing need to address gaps in enforcement and compliance to ensure that mining companies adhere to both the letter and spirit of the law. Enhanced monitoring, transparency and accountability mechanisms are essential for tracking progress and identifying areas where improvements are needed. Moreover, aligning South African mining practices with international sustainability standards will bolster the country's reputation as a leader in responsible mining.

The discussion also highlights the importance of integrating adaptive management strategies that can respond to the evolving challenges posed by climate change. Engaging local communities in the planning and implementation of closure plans is vital for aligning environmental goals with socio-economic needs, thereby fostering both ecological resilience and social wellbeing. As the mining sector continues to evolve it will be essential to bridge the gap between regulatory intent and practical outcomes.

By focusing on these areas — strengthening regulatory compliance, enhancing community engagement and aligning with global benchmarks — South Africa can ensure that its mining industry not only meets legal requirements but also contributes positively to long-term sustainability, environmental stewardship and the wellbeing of local communities in a changing climate.

References

- Crowley, TJ 2000, 'Causes of climate change over the past 1000 years', *Science*, vol. 289, pp. 270–277, <https://doi.org/10.1126/science.289.5477.270>
- DeGarady, CJ & Halbrook, RS 2006, 'Using Anurans as bioindicators of PCB contaminated streams', *Journal of Herpetology*, vol. 40, no. 1, pp. 95–102.
- Engler, R, Randin, CF, Thuiller, W, Dullinger, S, Zimmermann, NE, Araujo, MB & Pearman, PB 2010, '21st century climate change threatens mountain flora unequally across Europe', *Global Change Biology*, vol. 17, no. 7, pp. 2330–2341, <https://doi.org/10.1111/j.1365-2486.2010.02393.x>
- Herrick, JE, Abrahamse, T 2019, *Land Restoration for Achieving the Sustainable Development Goals: An International Resource Panel Think Piece*, United Nations Environment Programme.
- Kidd, M 2011, *Environmental Law*, 2nd edn, Juta and Company, Cape Town.
- Mpanza, M, Adam, E & Moolla, R 2021, 'A critical review of the impact of South Africa's mine closure policy and the winding-up process of mining companies', *The Journal for Transdisciplinary Research in Southern Africa*, vol. 17, no. 1.
- Parra, C, Lewis, B & Ali, SH 2021, *Mining, Materials, and the Sustainable Development Goals (SDGs): 2030 and Beyond*, CRC Press, Boca Raton.
- Purvis, B, Mao, Yong & Robinson, D 2019, 'Three pillars of sustainability: in search of conceptual origins', *Sustainability Science*, vol. 14, pp. 681–695, <https://doi.org/10.1007/s11625-018-0627-5>
- Republic of South Africa 1996, *Constitution of the Republic of South Africa* 1996.
- Republic of South Africa 1998, *National Environmental Management Act 107 of 1998*.
- Republic of South Africa 2002, *Mineral and Petroleum Resources Development Act 28 of 2002*.

- Rio Tinto 2023, 'Rio Tinto and Government of Madagascar reach agreement supporting the long-term operation of QMM', <https://www.riotinto.com/en/news/releases/2023/rio-tinto-and-government-of-madagascar-reach-agreement-supporting-the-long-term-operation-of-qmm>
- Skerratt, LF, Burger, L, Speare, R, Cashins, S, McDonald, KR, Phillot, AD, ... Kenyon, N 2007, 'Spread of Chytridiomycosis has caused the rapid global decline and extinction in frogs', *EcoHealth*, vol. 4, no. 2, pp. 125–134.
- United Nations 2024, *The 17 Goals*, viewed 12 June 2024, <https://sdgs.un.org/goals#history>
- Vinti, C 2017, 'An analysis of the interplay between the twin provisions of section 48 of the National Environmental Management: Protected Areas Act and section 48 of the Mineral and Petroleum Resources Development Act, in respect of "protected areas"', *Obiter*, vol. 38, no. 2, pp. 394–406.
- Vinti, C 2018, 'The power to declare a prohibition or restriction on prospecting or mining to protect the environment: a critical assessment of section 49 of the Mineral and Petroleum Resources Development Act 28 of 2002 and section 24(2A) of the National Environmental Management Act 107 of 1998', *Journal of Energy and Natural Resources Law*.
- World Commission on Environment and Development 1987, *Our Common Future*, Oxford University Press, Oxford.