

Enhancement of Mineral Resources Governance in the Platinum Group Metals Extractive Industry in Zimbabwe

A Publishable Paper Based on PhD Thesis Research

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Abstract- Poor mineral resource governance (MRG) poses serious challenges for Zimbabwe's extractive industry, particularly the Platinum Group Metals (PGMs) sector. Revenue losses, regulatory inefficiencies, and reductions in transparency and accountability have resulted from overlapping responsibilities, institutional duplication, corruption, and political interference. These challenges are exacerbated by security force involvement in extractive industry investments beyond their compliance enforcement mandate. The sector's potential to contribute effectively to sustainable economic development has been hampered by illicit financial flows, limited institutional capacity, and inadequate community engagement. This paper examines the enhancement of mineral resources governance in Zimbabwe's PGMs sector through a pragmatic research approach combining qualitative and quantitative methods. The study proposes a Digital Integrated Mineral Governance (DIMG) Model, which leverages blockchain technology to improve stakeholder participation, revenue management, interagency cooperation, and regulatory efficiency. Findings reveal significant governance deficiencies including legislative fragmentation, weak institutional capacity, and limited transparency. The DIMG Model offers a transformative pathway for turning Zimbabwe's extractive industry into a driver of sustainable economic growth.

Index Terms- Mineral Resource Governance, Extractive Industry, Platinum Group Metals, Zimbabwe, Transparency, Blockchain, Digital Governance

I. INTRODUCTION

Mineral resources governance (MRG) encompasses the systems of formulating laws and regulations concerning the extraction and utilization of mineral resources (Mattes, Leeds and Matsumura, 2016). Bebbington et al. (2018) describe MRG as the manner in which power is exercised and policies are formulated to manage a country's resources for development. Globally, there is increasing recognition that a well-governed extractive sector

drives broad-based development and facilitates the structural transformation of economies (Ekins, Gupta and Boileau, 2019).

Zimbabwe possesses exceptional mineral wealth, hosting the world's third-largest platinum group metals reserves after South Africa, and the largest known lithium deposits in Africa (SARW, 2021). The Great Dyke contains the second-largest known resources of PGMs globally and the world's largest high-grade chrome ore resources (Dzinomwa et al., 2014). Despite this abundance, Zimbabwe's economy has continued to decline, with a contraction of over 8 percent experienced in 2019, hyperinflation, and marked deterioration in social conditions (Nyoni, 2019).

The paradox between mineral wealth and economic underdevelopment in Zimbabwe underscores significant shortcomings in MRG frameworks. Between 2000 and 2020, Zimbabwe lost over US\$32 billion due to illicit financial flows, largely attributed to weak MRG frameworks (Kurebwa, 2021; Chipindu, 2019). The country continues to lose an estimated US\$1.2–1.9 billion annually through smuggling and artisanal leakages (U.S. International Trade Administration, 2024; World Bank, 2022). These losses represent resources that could have addressed national economic and social challenges, including the country's external debt of approximately US\$20 billion (AFDB, 2024).

The outdated Mines and Minerals Act of 1961, despite multiple amendments, remains inadequate for addressing modern MRG challenges, particularly sophisticated revenue leakages and foreign investor influences (Veritas Zim, 2023). The fragmentation of legal statutes and poor enforcement mechanisms have facilitated corruption and illicit activities, undermining the potential benefits of the country's mineral wealth. According to the Zimbabwe Environmental Law Association (ZELA, 2023), current MRG is associated with high environmental costs, human rights abuses, and social dislocation, particularly in communities directly affected by mining activities.

This paper addresses the critical question: How can mineral resources governance be enhanced in Zimbabwe's PGMs extractive industry? It examines the framing and application of MRG, explores factors influencing governance efficacy, and

proposes a Digital Integrated Mineral Governance (DIMG) Model as a transformative solution. By leveraging technologies such as blockchain, the DIMG Model seeks to improve stakeholder participation, revenue management, interagency cooperation, and regulatory efficiency, aligning with Zimbabwe's broader developmental goals.

II. LITERATURE REVIEW

2.1 Conceptualising Mineral Resources Governance

The scholarly discourse on MRG emphasises both positive and negative impacts of mineral wealth on economic development (Smith, 2017). Developing countries with abundant mineral resources are particularly concerned about governance in the extractive sector (Brown, 2016). The debate has expanded to include more stakeholders, shifting focus from treating minerals as mere commodities controlled by the state to recognising them as valuable assets contributing to national wealth and well-being (Jones, 2018). This shift reflects broader development thinking moving away from the "Washington Consensus" towards poverty reduction, social welfare, and human development (Martin, 2019). Governance assessments conducted by Transparency International Zimbabwe (2018) identify five dimensions of resource governance relevant to the PGMs sector: access to information, public participation, adherence to the law, coherence, and inclusiveness. These dimensions provide a comprehensive framework for evaluating governance effectiveness. Access to information ensures stakeholders have necessary data for informed decisions (Centre for MRG, 2017). Public participation facilitates hearing diverse voices, fostering transparency and accountability (Maguwu, 2016). Adherence to the law guarantees decision-making within legal frameworks, protecting stakeholder rights and interests (Mlambo-Ngcuka, 2017).

Coherence refers to consistency and alignment of policies, regulations, and actions, minimising conflicts and inconsistencies (Zimbabwe Democracy Institute, 2016). Inclusiveness emphasises including all relevant stakeholders in decision-making processes regardless of social or economic status (Chiyaka, 2018). These dimensions are interconnected and influence one another in complex ways, necessitating holistic approaches to understanding governance dynamics in the PGMs sector (African Peer Review Mechanism, 2018).

2.2 Theoretical Underpinnings of MRG

2.2.1 Governance Theory

Stoker (1998) articulates five propositions of governance theory that provide foundational frameworks for understanding MRG. First, governance refers to institutions and actors drawn from within, outside, and beyond governments, challenging formalised constitutional systems and emphasising involvement of organised private sectors and voluntary non-state actors in service delivery and strategic decision-making (Lockwood et al., 2015). Second, governance identifies blurring boundaries and allocates responsibilities for tackling social and economic challenges, shifting responsibilities to private sector, non-state actors, and citizens through decentralisation and deregulation.

Third, governance identifies power dependence in collaborative relationships among institutions engaged in collective action, implying that organisations dedicated to collective action depend on each other and must exchange

resources and collaborate in negotiating shared objectives (Stoker, 1998). Fourth, governance concerns autonomous self-governing networks of actors who gain collective capacity to act by blending material resources, skills, and purposes into long-term strategic alliances. Fifth, governance recognises capacity to get things done does not entirely depend on government power to invoke command or utilise authority, but requires government to utilise new tools, mechanisms, and techniques to lead, steer, and guide. These propositions guide the four thematic areas used to measure MRG in Zimbabwe: legislative and legal institutional environment, extractive sector operating environment, value derivation, and revenue management.

2.2.2 Resource Curse Theory

According to Cater (2023), the resource curse refers to negative development consequences associated with natural resource abundance or dependence. Economists and political scientists have explored links between natural resource abundance and adverse development outcomes including poor economic performance, absence of democracy, low societal welfare, conflict, and corruption (Warner, 2016). Sachs and Warner (2021) demonstrate that resource-rich countries may experience slower economic progress due to over-reliance on extractive industries, corruption, and poor governance.

However, not all resource-rich developing countries experience the resource curse. Country examples such as Chile, Botswana, and Malaysia suggest typical negative impacts can be mitigated through improved governance (Asefa, 2016). This theory helps explain stagnant development in Zimbabwe's economy despite mineral resource abundance, highlighting the centrality of governance in determining resource wealth outcomes.

2.2.3 Institutional Theory

Institutional theory falls under new institutional economics, examining the role of institutions in economic growth and development. Scott (2021) asserts that institutions have cognitive, normative, and regulative forms, transported by various carriers including cultures, structures, and routines, operating at multiple jurisdictional levels. North (2018) defines institutions as formal constraints (rules, laws, routines, constitutions) and informal constraints (norms of behaviour, conventions, self-imposed codes of conduct), together with their enforcement characteristics. In natural resource governance, institutional theorists claim government weaknesses, vice, and corruption are central components of the resource curse phenomenon (Dietz et al., 2017). The theory recognises that a country's formal and informal socio-cultural, socio-political, and socio-economic configuration affects how policies are designed and implemented. Institutional theory is utilized in this study to identify and assess government effectiveness, focusing on how rules and regulations function as formal constraints in Zimbabwe's PGMs sector.

2.2.4 Stakeholder Theory

Stakeholder theory, traced to R. Edward Freeman's landmark work "Strategic Management: A Stakeholder Approach" (1984), posits that stakeholders are individuals or groups who can affect or are affected by achievement of a corporation's purpose (Freeman, 1994). The theory broadens the pool of players from shareholders to employees, environmentalists, vendors,

governmental agencies, and communities, suggesting that company success lies in satisfying all stakeholders, not just those who profit from its stock (Simon, 2023).

The theory posits that corporate managers should consider each stakeholder's interests in governance processes, reducing conflicts between stakeholder interests. At the centre of stakeholder theory is realisation that all stakeholders interact with companies with legitimate expectations that companies shall meet desired, anticipated, or agreed value. In the PGMs sector, stakeholders include government ministries, mining companies, local communities, civil society organisations, and financial institutions, each with distinct expectations regarding dividends, salaries, tax revenue, and community development benefits.

2.3 Global MRG Frameworks and Best Practices

2.3.1 Extractive Industry Transparency Initiative (EITI)

The Extractive Industries Transparency Initiative (EITI), launched in 2002, represents a significant global effort to enhance transparency and accountability in the extractive sector. The initiative is structured around a Multi-Stakeholder Group (MSG) integrating voices of governments, civil society, communities, and private companies. EITI requirements are categorised into seven key areas: MSG oversight, licenses and contracts, monitoring production, revenue collection, revenue allocation, socio-economic contribution, and outcomes and impacts (EITI, 2016). Despite global endorsement, Zimbabwe remains absent from EITI membership. The Zimbabwean government has made pronouncements emphasising transparency in the mining sector, but these have yet to translate into tangible actions toward adopting the EITI framework (ZEPARU, 2018). Rustad et al. (2017) observed that in many instances, governments have not provided sufficient space for civil society to participate meaningfully in EITI processes, limiting the initiative's effectiveness.

2.3.2 African Mining Vision (AMV)

The African Mining Vision (AMV), adopted in 2009 by African Union member states, serves as a comprehensive policy framework aimed at ensuring transparent, accountable, and equitable exploitation of the continent's mineral resources. The vision seeks to transform the mining sector into a driver of sustainable growth and socio-economic development by promoting practices that maximise benefits of mineral wealth for African countries and their citizens (Ushe, 2017). Central to the AMV is emphasis on creating robust regulatory frameworks that enhance governance, reduce corruption, and ensure resource exploitation benefits all stakeholders (UNECA, 2020).

Despite ambitious goals, AMV implementation has been slow and uneven across the continent. As of 2018, only 24 out of 54 African countries had formally committed to the vision's principles (Nwapi et al., 2018). Factors contributing to slow progress include weak governance structures, lack of political will, and inadequate financial and technical resources to enforce required reforms (Chuhan-Pole, 2019).

2.3.3 Botswana's Fiscal and Economic Stability Model

Botswana is among Africa's fastest-growing economies, driven by rich mineral resource endowments (Kaseke et al., 2015). The mining sector contributes about 40% of GDP and 50% of

direct government revenue (Bank of Botswana, 2020). Botswana avoided poor MRG by enhancing fiscal savings, maintaining current account surpluses, and investing heavily in infrastructure and human capital development (Lewin, 2010).

By enacting appropriate macroeconomic policies, Botswana avoided economic problems associated with mineral exploitation. The government passed prudent policies on public sector spending, enjoyed sustained budget surpluses for stable spending during lean periods, and exhibited high transparency in public revenue spending, effectively checking corruption levels. Botswana's model demonstrates that the resource curse hypothesis can be avoided through enhanced fiscal management and institutional integrity.

2.3.4 South Africa's Local Content Regulation

The South African Mining Charter, embedded within the Minerals and Petroleum Resources Development Act (2002), has dominated mining sector discourse since its inception. The charter's vision facilitates the mining industry's long-term transformation, growth, and development, depicting legislative efficacy in MRG. South Africa is a leading economy in mineral resources exploitation, ranked first globally in PGMs production in 2017 (U.S. Geographical Survey, 2017).

However, challenges persist in revenue management. Dechambenoit (2020) showed that many countries have enacted local procurement legislation with thresholds up to 80%, but due to geographical locations of most mining projects in rural and remote areas, limited local capability exists to meet extractive sector operational needs. Local supply chains frequently depend on mining operations with limited life, creating sustainability challenges.

2.3.5 Chile's Public-Private Partnership Model

Chile's MRG model has driven long-term economic stability through strong regulatory institutions, effective revenue management, and sustainable mining policies. As the world's largest copper producer, Chile has balanced state oversight (via Codelco) with private investment, ensuring transparency and investor confidence. The establishment of stabilization funds, such as the Economic and Social Stabilization Fund (ESSF), has helped mitigate commodity price volatility, while environmental regulations and social investments have contributed to sustainable development.

The Chilean government enacted its first Mining Code in 1932, with subsequent reforms reserving state responsibility for strict regulation, exploitation, and commercialisation of strategic minerals. This paradigm of state control aims to prevent transient profit-seeking and protect strategic resources for broader social and economic use. Chile's model demonstrates how rigorous regulatory frameworks and commitment to sustainable development can transform mineral wealth into long-term economic stability.

2.4 MRG in Zimbabwe: Historical Context and Current Challenges

Zimbabwe's mining sector has played a crucial role in the country's economy and development for over a century (Takavarasha, 2018). The Minerals and Mines Policy of 1890 guided exploitation and governance during the colonial era, but

various factors and challenges over time have limited successful policy execution (Mambo, 2019). Upon independence in 1980, high hopes existed for mineral resources to drive economic growth and prosperity, but constraints and bottlenecks have hindered the sector's full potential (Odziyani, 2016).

The Zimbabwean government has implemented reforms to promote local ownership, participation, and benefits from mineral resources (World Bank Group, 2018). The Indigenisation and Economic Empowerment Act of 2008 required 51% local ownership in mining businesses, though this was later altered in 2018 to exempt particular sectors (Chigumira, 2020). Such politically influenced policy amendments create a risky regulatory environment for investors and players in the mining sector (Saunders, 2021).

Current MRG policies fall short of regional counterparts. The Corruption Perceptions Index (CPI) ranks Zimbabwe 158/196 (2021) on perceived corruption levels. Zimbabwe's Anti-Corruption Commission (ZACC) observed rampant corruption sustained by non-competitive bidding procedures in issuing mining licenses and lack of transparency regarding mining claim owners (AFRODAD, 2021). Corruption, smuggling, and other vices have crippled efforts to leverage mineral resources for essential services such as education, health, and water (ZELA, 2020).

III. METHODOLOGY

3.1 Research Paradigm

This study adopted a pragmatist research paradigm, which enabled a flexible combination of methods addressing both subjective and objective aspects of MRG (Kivunja and Kuyini, 2017). Pragmatism was chosen as it focuses on distilling desired results of specific MRG practices, problems, processes, principles, and systems, ultimately leading to developing approaches for obtaining desired outcomes (Cordeiro, 2020). The paradigm maintains that the best research techniques are those contributing to the most effective answer to the research issue (Muzari et al., 2022).

The philosophical roots of pragmatism are grounded in works of classical pragmatists Charles Sanders Peirce, William James, and John Dewey. Pragmatism serves as a metatheoretical paradigm and guiding philosophy for developing, implementing, and evaluating specific studies and research methods (Allemang et al., 2022). The researcher invoked application of relevant theories as tools for practical MRG research because the paradigm helps understand complex and unpredictable MRG phenomena (Lake, 2020).

3.2 Research Approach

The research adopted a mixed methods research approach to explore MRG in Zimbabwe's extractive sector focusing on PGMs. According to Ghambi (2021), a mixed methods approach answers research questions using qualitative information and descriptive and inferential statistics. The researcher considered this approach appropriate as it gathers reliable data, helping answer research questions from both qualitative and quantitative perspectives (Siedlecki, 2020).

The study employed a sequential exploratory mixed-methods approach, which enhanced the study by first conducting

an in-depth qualitative phase to explore key governance challenges and stakeholder perspectives. The researcher interviewed key informant stakeholders in government, mining companies, civil society, and communities to identify critical issues influencing MRG. Qualitative insights gathered from these stakeholders informed a follow-up stage using a targeted quantitative instrument to measure prevalence and intensity of these issues across different mining regions and stakeholder groups.

3.3 Research Design

The study followed a case study design focusing on governance of mineral resources using the PGMs sector comprising extractive industry entities, including those under the Platinum Producers Association (PPA) and the Chamber of Mines Zimbabwe (COMZ). This design is contextual as it searched and probed for the precise nature of the problem. The study adopted descriptive statistics which provided a full description of the MRG phenomenon within its context (Urbina et al., 2023), helping summarize and clarify quantitative data guided by initial qualitative findings.

The study opted for mixed methods sequential exploration as a specific research design. Qualitative exploration was used with the objective of gaining in-depth understanding of experiences, perspectives, and challenges related to mineral resources governance from viewpoints of various stakeholders in the PGMs sector. The researcher coordinated Focus Group Discussions (FGDs) to reach respondents outside the key informant group. Document analysis included insights from literature review, reviewing existing policies, laws, regulations, and reports related to MRG in Zimbabwe.

3.4 Population and Sample Size

The study population comprised all stakeholders actively involved in PGMs MRG in three provinces: Harare, Midlands, Mashonaland East, and Mashonaland West. This set included government ministries, quasi-government agencies, policymakers, private-sector actors, CSOs, NSAs, local communities, and other interest groups. A sampling frame was developed representing 2000 elements from government ministries, labour unions, civil society organisations, mining companies, financial institutions, and parliament of Zimbabwe.

For qualitative sampling, the researcher used purposive sampling targeting key stakeholders with relevant information and capacity to respond to MRG framing and application. Snowball sampling complemented purposive sampling through referrals facilitating access to other capable key respondents until data saturation at 31 responses.

For quantitative sampling, the researcher employed the Cochran sampling method to determine required sample size:

$$n_0 = Z^2 pq / e^2 \text{ (Equation 1)}$$

Where:

- n_0 is the Cochran sample size
- Z is the Z-score (1.96 for 95% confidence level)
- e is desired margin of error (0.05)
- p is estimated proportion of population (0.5)
- q is $1-p$ (0.5)

Using modified Cochran formula due to small sampling frame:

$$n = n_0 / [1 + ((n_0 - 1)/N)] \text{ (Equation 2)}$$

Where N is population size (2000). The calculated sample size was 323 participants. Stratified random sampling was applied across ten strata, with sample size from each stratum proportionate to stratum size relative to total population.

3.5 Data Collection Methods

Qualitative data collection employed key informant interviews aimed at gaining in-depth insights into stakeholder experiences, perceptions, and roles in mineral resources governance. The researcher interviewed officials from academia, business associations, civil society organisations, financial institutions, government ministries, labour unions, local authorities, mining companies, parliament of Zimbabwe, and state regulatory bodies. Focus group discussions involved facilitated discussions among small groups in mining areas to elicit collective views and explore diverse perspectives on governance issues. Document analysis involved systematic review of existing texts, including policies, laws, reports, and archival data.

Quantitative data collection employed a structured questionnaire focusing on collecting numerical data to measure participant perceptions, behaviours, and governance indicators across four thematic areas: legislative and legal institutional environment, extractive sector operating environment, value derivation, and revenue management.

3.6 Data Analysis Methods

Qualitative data analysis employed thematic analysis, a methodical approach to identifying, analysing, and interpreting patterns and themes within qualitative data sets. The researcher used Delve and NVIVO data analysis software to facilitate thematic analysis, leveraging core functionalities to effectively organise and visualise qualitative data. Coding processes involved systematic tagging of data with predetermined codes based on research framework and emerging inductive MRG data.

Quantitative data analysis employed Stata statistical software for data management, analysis, and visualisation. Frequencies were calculated to generate descriptive statistics, and inferential analysis applied appropriate statistical regressions including logistic regression and multinomial logistic regression. Control variables were included to address confounding factors.

3.7 Data Validity and Reliability

Data reliability was ensured through systematic and replicable approaches to data collection and analysis. Data validity was ensured through member checking (respondent validation) and methodological triangulation. Member checking involved sharing research findings, interpretations, and data summaries with key informants to ensure accurate reflection of their perspectives. Methodological triangulation involved using multiple methods and data sources including key informant interviews, FGDs, document analysis, and literature search.

For quantitative reliability, internal consistency of the research instrument was evaluated using Cronbach's alpha coefficient, which yielded 0.85, indicating high internal consistency among items. Expert review, content congruence with

relevant legislation, and construct validity checks using response patterns further validated the instrument.

3.8 Ethical Considerations

The research was conducted in line with rules and regulations of the Mines and Minerals Act in Zimbabwe. Permission was requested from institutions before conducting research. The researcher obtained ethical clearance from Africa University's Ethics Committee. Informed consent was obtained from all participants, with clear explanation of study purpose, methods, and potential risks and benefits. Confidentiality and anonymity were safeguarded through use of pseudonyms (SH1–SH31) and secure data storage. Respondents were assured participation was voluntary and had no bearing on access to services and benefits.

IV. FINDINGS AND DISCUSSION

4.1 Framing and Application of MRG in the PGMs Sector

4.1.1 Constitutional and Legislative Frameworks

The study found that Zimbabwe's mining regime does not fully address fundamental challenges in mining laws and regulations. SH27 (International Law and Business) noted issues including acquisition and possession of rights, ownership patterns, requirements and restrictions, transfer and encumbrance, environmental considerations, indigenous title, and general land rights. A disorganised allocation of institutional mandates and poorly structured regulatory framework complicates application of procedures and systems.

SH19 revealed that the national constitution aims to enhance MRG through several key provisions. Section 315(2) explicitly requires that negotiation and execution of State contracts, including concessions of mineral rights, guarantee transparency, integrity, cost-effectiveness, and competitiveness. Section 298(1)(b)(ii) stipulates that revenue generated at national level should be distributed fairly and equitably among central government, provincial and local levels. Section 301(3) requires that minimum of approximately five percent of national revenues be allocated to provinces and local authorities as annual share. Section 298 delineates principles of public financial management encompassing transparency, accountability, and equitable resource distribution. Section 73 establishes the right to an optimal environment and mandates State implementation of reasonable legislation to prevent pollution and ecological degradation.

However, respondents confirmed that the current situation is inconsistent with constitutional aspirations, making provisions irrelevant for implementation. SH28 stated that coherence of MRG frameworks is fundamentally within the President's constitutional mandate, requiring resolution of legislative and legal conflicts through established structures and processes.

4.1.2 Regulatory Fragmentation

The study revealed that governance frameworks for mineral resources in Zimbabwe's PGMs sector are fragmented. Although a formal legal framework exists through the Mines and Minerals Act (Chapter 21:05), collective embracing and application of established governance principles remains inconsistent. Interviews with SH6 and SH7 indicated that the existing governance structure exhibits insufficient coordination among

regulatory bodies, resulting in inefficiencies in MRG and frequently leading to conflicting policies. SH7 from the Ministry of Mines remarked that the regulatory landscape is characterised by overlapping mandates from multiple agencies, complicating effective governance and rendering adherence to set procedures near impossible.

This finding aligns with prior research by Moyo and Chigumira (2023), who contended that Zimbabwe's extractive industry experiences deficiency in policy coherence, especially within the PGMs sector. Industry respondents identified fragmentation and silo approaches to MRG as major obstacles to enhancing transparency and accountability. SH3 from a platinum mine in Selous stated that government can reduce business operating costs and eliminate arbitrage opportunities and corruption, remarking that there is no political will to enforce even existing weak governance requirements.

4.1.3 Transparency and Accountability Deficits

A significant finding pertains to absence of transparency and accountability in PGMs sector governance. SH8 expressed concerns regarding lack of transparency in contracts and revenue flows between government and mining companies, particularly given varied enabling statutes and discretion afforded to different government portfolios. SH8 further noted that access to information about mining deals is limited, complicating efforts to hold companies or government accountable for resource mismanagement.

Lack of transparency has been associated with corrupt practices in the sector. Ncube and Tafirenyika (2022) observed that lack of transparency in mining agreements creates environment conducive to illicit financial flows and tax evasion. This study validated these concerns, with key informants supporting adoption of the Extractive Industries Transparency Initiative (EITI) and similar measures to enhance governance. Zimbabwe has not yet signed the EITI, complicating efforts to enhance transparency.

Conflation and duplication of roles and responsibilities contribute to deficit of transparency and accountability, diminishing ethical standards. SH5 from a regional mining business association stated that vested interests are potentially facilitators of illicit financial flows. Addison (2024) argues that politicisation of public institutions creates institutional constraints serving as significant obstacles to enhanced management and oversight of extractive industries.

SH20 noted that persistent veil of secrecy surrounding extractive industry operations has restricted both public and legislative access to information regarding mining sectors. Concealment of corrupt practices within high-level government has been significant, and industry opacity has contributed to deficiency in technical knowledge, hindering government's capacity to implement effective internal control frameworks.

4.1.4 Parliamentary Oversight Limitations

SH2 from a significant parliamentary portfolio committee expressed concerns that parliament functions as a weak legislative body lacking capacity to act as counterbalance to more dominant executive authority. Parliamentarians experience marginalisation in critical decision-making processes and face discouragement in performing oversight functions because of the parliamentary

whipping system. Zimbabwe is often perceived as a nation dominated by a ruling party exercising extensive control, where parliamentarians typically endorse executive policy frameworks with minimal or no substantive debate.

This leads to constitutional and legislative shortcomings, resulting in various procedural rules frequently granting substantial legal and other powers to the executive branch. Effectiveness of Parliament is reduced, compromising its capacity to legislate with optimal oversight in the mining sector.

4.1.5 Policy Inconsistency and Regulatory Instability

The study found that inconsistencies in Zimbabwe's regulatory framework pose a challenge to effective governance of mineral resources. Frequent amendments to the Indigenisation and Economic Empowerment Act have generated uncertainty within the industry. The law persists in statutes of Zimbabwe, characterised by inherent weaknesses affecting investor confidence. Research indicated that Zimbabwe has modified various legislative measures via statutory instruments, particularly those related to fiscal and monetary policy, which mining companies identify as source of uncertainty.

Statutory instruments are inherently reactive, undermining companies' medium to long-term strategies, adversely impacting production levels and profitability. Veritas (2024) reports that Zimbabwe implemented over 300 statutory instruments to address various socio-economic issues from January 2023 to June 2024. SH3 remarked that regulatory environment is unpredictable, with frequent changes in laws and regulations rendering long-term planning nearly unfeasible.

Policy inconsistency directly affects operational efficiency and investment climate within the PGMs sector. Chigumira (2021) found that policy volatility negatively impacts foreign direct investment in Zimbabwe's extractive industry, especially in capital-intensive sectors such as PGMs. This study extends previous findings by demonstrating that regulatory instability impacts not only investments but also disrupts daily operations of mining firms, resulting in inefficiencies in production, profitability, and price competitiveness.

4.2 Environmental Governance Frameworks

The study revealed several frameworks governing environmental management and sustainability in the PGMs sector. The constitution guarantees every individual the right to a clean and healthy environment. Mining corporations are required to adhere to environmental regulations delineated in the Mines and Minerals Act (Chapter 21:05), Water Act (Chapter 20:24), Environment Management Act (Chapter 20:27), Explosives Act (Chapter 10:08), Forestry Act (Chapter 19:05), Hazardous Substances and Articles Act (Chapter 20:03), Atmospheric Pollution Prevention Act (Chapter 20:03), and Parks and Wildlife Act (Chapter 20:14).

The Environmental Management Act (Chapter 20:27) serves as the cornerstone of Zimbabwe's environmental legislation, establishing the Environmental Management Agency (EMA) to regulate, monitor, and promote sustainable environmental practices. Statutory Instrument 134 of 2019 requires companies listed on the Zimbabwe Stock Exchange to submit ESG reports outlining approaches to social, economic, and environmental issues.

However, concerns have increased regarding difficulties in acquiring ESG information from Chinese investors, especially those engaged in Joint Venture Agreements with the Zimbabwean government. SH18 from Chinhoi Town Council indicated that increasing presence of Chinese miners has led to significant workplace abuses and deterioration of environmental conditions, attributed to "Chinese Impunity." A study by ZELA (2024) endorsed this viewpoint, referring to it as a "Chinese Curse"—negative consequences associated with unregulated or poorly monitored Chinese investments in Zimbabwe's mining sector. Environmental governance has become a significant factor in MRG. Members of environmental advocacy organisations expressed apprehensions regarding environmental degradation resulting from PGMs mining activities. One respondent observed that oversight regarding environmental impact of mining activities is minimal, and enforcement of environmental regulations is inadequate. Community members residing near mining sites expressed similar concerns, noting pollution of water sources and degradation of air quality.

Research conducted by Dube et al. (2022) indicates that environmental governance within Zimbabwe's mining sector is inadequately developed, characterised by limited compliance with environmental impact assessments and other sustainability standards. Although EMA has responsibility for ensuring compliance, its enforcement capabilities are constrained. Mining companies often prioritise economic benefits at expense of environmental protection, resulting in minimal motivation to implement sustainable practices.

4.3 Community Engagement and Benefit-Sharing

The research indicated that community engagement and corporate social responsibility within the PGMs sector are insufficiently addressed. Interviews with community leaders in proximity to significant mining operations, particularly in the Great Dyke region, indicated that despite assertions from mining companies regarding investments in local communities, actual impact on livelihoods has been negligible. A community leader remarked that benefits promised by mining companies seldom reach local population, with challenges persisting regarding inadequate infrastructure and restricted access to essential services.

This finding aligns with ZELA (2021) report emphasising gap between CSR initiatives and genuine community development. Inadequate engagement with local communities can result in tensions and social unrest, as evidenced in various mining regions worldwide. Communities largely lack consensus on procedures and systems for economic empowerment and benefit sharing frameworks derived from mining revenues.

SH26 emphasised necessity of glocalisation, indigenisation, and legally mandated local participation, highlighting importance of balancing investment promotion, enhancing business environment, and ensuring stakeholder satisfaction. A participant in an FGD in Ngezi articulated preference for community insurance for local economy to be responsibility of mining investors, emphasising that communities no longer favour community social responsibility but rather community social partnerships, with distinction lying in degrees of benefit sharing and participation.

The study also focused on indigenisation policies designed to enhance local ownership and participation. The Indigenisation and Economic Empowerment Act requires 51% of shares in mining companies be held by indigenous Zimbabweans, but stakeholder interviews indicate varied perspectives on its efficacy. SH2 from the Chamber of Mines stated that although policy aims to empower local communities, it frequently results in ownership structures more symbolic than substantive, with indigenous stakeholders receiving nominal shares lacking genuine decision-making authority. SH24 from ZNCC opposed equity indigenisation, advocating instead for local procurement by mining companies, arguing that localising procurement expenditure leads to more equitable distribution of benefits, establishes industrial linkages, fosters gainful employment, promotes edu-skill development, facilitates industrialisation, and contributes to poverty alleviation.

4.4 Factors Affecting MRG Efficacy

4.4.1 Institutional Capacity Constraints

Limited institutional capacity of regulatory bodies is a significant factor affecting MRG framework efficacy. SH7 from the Ministry of Mines and Mining Development indicated that insufficient human and financial resources significantly hinder capacity to effectively oversee mining operations, stating that outdated tools and inadequate staffing impact capacity to monitor compliance. This observation aligns with Wellmer (2017), who highlighted necessity of robust institutional capacities for effective governance in the mining sector.

SH9 from Ngezi Rural District Council emphasised that enhancing institutional capacity in the PGMs sector, adequately resourcing and equipping regulatory institutions with necessary skills and funding, would significantly improve enforcement of regulations and overall governance effectiveness. Insufficient training and restricted access to resources result in regulatory deficiencies exploited, undermining MRG. The study acknowledges these weaknesses but further exposes deliberate institutional weakening to engender weak MRG as a ploy to exploit these weaknesses for individual and sectorial gain.

SH11 and SH17 believed a fair and efficient judiciary is crucial for enforcement of mining laws, enabling effective enforcement of penalties for illegal mining and contract violations, thereby safeguarding integrity of governance frameworks (Murombo, 2016). SH5 of African Development Bank emphasised glaring influence of inadequate institutional capacities on compliance enforcement within mining sector. Mkodzongi (2022) indicates that African countries with weak institutions frequently encounter challenges in regulating complex industries such as mining.

4.4.2 Security Sector Involvement

The study found that the security sector plays a vital role in MRG in the PGMs sector. The security sector, through the police service, has delegated government agency responsibility for combating illegal mining and minerals smuggling, maintaining security in mining areas, supporting enforcement of mining laws, and mediating conflicts among stakeholders. However, its effectiveness is constrained by institutional, human, and operational challenges.

The study found that the security sector through ZRP faces monumental capacity constraints. SH20 from Chinhoyi University highlighted constraints including inadequate funding, insufficient staffing, and limited access to essential tools and equipment. SH20 further noted general lack of interest in adopting and using digital technology and lethargy in demanding technological tools from government. SH7 pointed out that outside skills and training gaps, culture of honesty and hard honest work has long been eroded in the police service, with weak interagency coordination and corruption exacerbating these challenges.

Significantly, Zimbabwe's security sector evolution into active economic players, directly and indirectly investing in mineral extraction particularly in platinum, diamonds, and gold, has undermined regulatory and enforcement roles. SH10 disclosed that some security entities have running partnerships with foreign investors across all mineral categories, making this crucial sector both a player and enforcer. SH10 further notes with concern that this dual involvement creates opaque enforcement regime facilitating illicit financial flows, fostering security sector corruption, discouraging credible foreign investment, and hindering long-term EI reform.

4.4.3 Revenue Collection Capacity Gaps

The study acknowledges the pivotal role played by Zimbabwe Revenue Authority (ZIMRA) as delegated government tax collecting agent, collecting taxes, monitoring compliance, curbing illicit financial flows, and ensuring proper valuation of exports. Research established that ZIMRA's effectiveness is hindered by several capacity constraints: acute shortage of skilled personnel to address complexities of PGMs taxation, limited technological tools and digital infrastructure for real-time mineral resources monitoring, insufficient funding for essential activities like field audits, inadequate data integration systems, and weak enforcement mechanisms particularly when dealing with multinational corporations engaging in sophisticated tax avoidance strategies.

SH18 points out that institutional capacity constraints also stem from broader systemic issues and resistance to institutionalisation of technologically driven systems. SH3 states fragmented collaboration between ZIMRA and other key state agencies not only creates economy-wide inefficiencies but discourages creativity and innovation in solving absence of regulations tailored to deal with unique aspects of effective PGMs sector governance. The study noted that institutionalised corruption undermines efforts to ensure compliance.

4.4.4 Illicit Financial Flows

The issue of illicit financial flows was frequently mentioned by respondents, particularly in relation to the PGMs sector. Several interviewees from civil society organisations noted that IFFs, including underreporting of production and smuggling of PGMs, were rampant. SH5 stated that significant amount of platinum and other precious metals leave the country illegally, depriving government of much-needed revenue. MMCZ acknowledged widespread smuggling and emphasised need for advanced monitoring systems like drones to curb illegal exports. Southern Africa Resource Watch (SARW, 2025) reported that Zimbabwe loses approximately US\$100 million monthly due to illicit trade in critical battery metals, exacerbated by weak

regulatory enforcement. Between 2000 and 2023, it is estimated that IFFs and mineral resources smuggling siphoned off approximately US\$32 billion from Zimbabwe, significantly curtailing state capacity to finance social protection initiatives and other development projects (Global Financial Integrity and United Nations, 2023). This finding is consistent with Global Witness (2022) highlighting Zimbabwe as a hotspot for IFFs in mining industry.

4.4.5 Regulatory Ecosystem Fragmentation

Regulatory fragmentation, marked by overlapping responsibilities among multiple institutions, has become a critical issue undermining governance in the PGMs sector. SH14 and SH21 from ZIMRA noted that conflicting mandates among agencies often lead to operational inefficiencies. A respondent observed that unclear role definitions lead to delays in decision-making and policy implementation. Literature, particularly Nhamo and Mukonza (2020), identifies regulatory overlaps in African mining sectors resulting in insufficient coordination and conflicting policies.

This fragmentation creates loopholes utilised by companies and regulatory bodies, consequently affecting accountability and transparency. SH18, 22, and 24 from Transparency International Zimbabwe highlighted that insufficient inter-agency coordination exacerbates corruption and mismanagement. The findings support Besada and Martin (2016) assertion that institutional clarity is crucial for fostering transparent and efficient governance in resource-rich nations.

V. THE DIGITAL INTEGRATED MINERAL GOVERNANCE (DIMG) MODEL

5.1 Overview of the Proposed Model

The study proposes a seamless integration of digital and technological tools with traditional governance mechanisms for enhancing MRG in Zimbabwe. The DIMG Model presents an ecosystem of multi-stakeholder governance incorporating local community participation, productivity and investment strategies, corporate profitability, environmental accountability, and technological innovations. At the centre, the model seeks to enhance transparency and equal distribution of benefits in the PGMs industry.

[Insert Figure 25: Digital Integrated Mineral Governance (DIMG) Model for Zimbabwe (Page 277 of source document)]
Source: Researcher's own illustration

The model encompasses critical elements including Multi-Stakeholder Integration (MSI), Environmental Accountability Framework (EAF), Leveraging Technology for Transparency (LTT), Policy Recommendations for Benefit-Sharing Mechanisms (BSM), and Institutional Capacity Building (ICB).

5.2 Blockchain Foundation of DIMG

DIMG is a blockchain-based model functioning as a distributed ledger system disseminating and storing information over several nodes within a defined EI network. It is developed to provide fundamental digital properties covering mining industry administration: decentralisation, immutability, and mineral

resources security. These properties render it effective in dealing with various MRG gaps including mechanisms to detect opaque transactions, smuggling, conflicts around mineral rights, and insufficient accountability (Kim and Lee, 2021). At the centre of the model is opportunity to establish technology-based transparent record of all EI actions, from extraction of PGMs to income distribution (mine to market), guaranteeing that all stakeholders can authenticate data authenticity and integrity.

5.3 DIMG Model Components

5.3.1 Natural Endowments Availability (NEA)

The model starts with enabling establishment of immutable digital blockchain records of natural endowments in Zimbabwe, particularly mineral resources. The model defines these endowments across all required categories across all minerals, typically classified into three categories: indicative, probable, and proven resources. Indicative resources are early estimates based on preliminary geological exploration data suggesting potential mineralisation. Probable resources are determined through more detailed exploration presenting higher confidence threshold regarding endowment economic viability. Proven resources are those rigorously evaluated and confirmed through extensive testing to be economically extractable (Brown and Lee, 2018; Nassar et al., 2020).

The model brings technological blockchain advancements in digital mineral exploration, identification, and measurement, allowing blockchain to guarantee secure and immutable recording of geological data throughout mineral exploration process, safeguarding against data manipulation and enhancing integrity of geological data classification (Kumar et al., 2019; Global Mining Review, 2021).

5.3.2 Multi-Stakeholder Integration System (MIS)

Current MRG frameworks demonstrated lack of and ineffective integration of diverse stakeholders, particularly with marginalised local communities. The second stage provides unique contribution ensuring meaningful participation of local communities in decision-making processes at micro-level, addressing grievances, potential conflicts, and broadly managing stakeholder expectations. The focus is on how community inclusivity can promote socio-economic empowerment while reducing resource-based conflicts (Maddaloni, 2022).

By actively engaging local stakeholders, this model aims to align EI activities with community development priorities, fostering lasting, sustainable relationships between mining companies and communities. Globally, communities no longer prefer community social responsibility but are demanding community social partnership arrangements, making the proposed framework ideal.

The model unlocks opportunity to base mining sector knowledge economy driven by community involvement in mining title administration and management. Through integration of multi-stakeholder councils, communities can track mining claims, understand nature and form of claims, ensure that beneficiaries and companies comply with agreements, and have input into decisions regarding new permits.

This stage enhances use of blockchain technology, moving from conventional physical paper-based data management formats, facilitating entrenchment of trust and confidence among

public-private partners. The model creates transparent digital records of extractive industry agreements including license issuances and permit terms and conditions, promoting collaboration, confidence building, and accountability, reducing risk of manipulation and corruption.

5.3.3 Mining Title Management System (MTMS)

The model introduces the Mining Title Management System, pertaining to integration of mining title administration procedures, processes, and systems related to EI allocation, management, administration, and revocation of mining rights. Incorporation of blockchain technology into mining title management ultimately improves mineral value chain administration efficiency, mitigates recurring incidences of fraud, and fosters industry and government-wide transparency.

[Insert Figure 26: Diagrammatical Illustration of Blockchain Technology for Mining Title Administration (Page 282 of source document)]

Source: Researcher's own works

Built on blockchain technology, a safe, permanent ledger keeping all mining titles and associated transactions, the model will have a digital mining title registry ensuring advanced, auditable data management and information, fostering responsibility and openness. This registry guarantees that once a transaction is entered and documented, it cannot be modified or erased without collective express agreement of concerned stakeholders, diminishing likelihood of fraudulent alterations and system abuse (Peters and Panayi, 2016).

The model includes a module on transfer of mining titles using digital title transfer and smart contracts, fitted with automated verification procedures ensuring adherence to licensing regulations, minimising delays and potential corruption (Zheng et al., 2017). The model rectifies and prevents multiple allocations, a current prevalent problem in MRG in Zimbabwe. The model allows public access guaranteeing that specific information on mining titles, including ownership, geographic limits, and compliance status, is available for public scrutiny to enhance stakeholders' capacity to validate ownership and oversee compliance adherence.

5.3.4 Minerals Supply Chain Traceability (MSCT)

The model incorporates Mineral Resources Supply Chain Traceability, a module involving tracking and documenting minerals value chain from point of extraction through several processing stages and export. Technology-based blockchain system enables real-time mineral monitoring, ensuring each step from mine to market is recorded. The module contains robust reporting and auditing features ensuring all mineral transactions are easily traceable, reducing arbitrage opportunities.

The extractive industry order book supports extractive industry supply chain requirements and influences local procurement initiatives, industrialisation, value addition, and beneficiation. With entire value chain stored on blockchain, regulatory bodies and stakeholders can easily access information to verify compliance.

5.3.5 Institutional Strengthening and Royalty Payment Systems (RPS)

The model includes a framework for efficient licensing and royalty collection. Blockchain's unique smart contract capabilities can streamline processes of royalty collection in relation to requirements of terms of agreements of related mining titles and permits. The module possesses intelligent software extracting data from its system, including incidences where mining company extracts certain volume of PGMs with pending penalties accruing from errors of commission or omission, triggering smart contract to automatically calculate and initiate royalty-dedicated payments due to government accounts.

This automation prevents delays, under-reporting, double invoicing, and general non-compliance, ensuring steady incremental minerals revenue stream for government. It also cuts out duplication processes and entities in value chain such as ZMDC and MMCZ whose functions serve to increase bureaucracy and operational costs.

The model requires enhanced capacity building for blockchain administration and management at institutional levels, assisting in strengthening governance efforts. Focus can be invested in developing capacity of big data storage and management, central particularly in government regulatory and oversight bodies which periodically interact with these processes. There is deliberate need for training officials on navigating blockchain platforms for better monitoring and ensuring robust cyber threat identification and protection.

5.3.6 Environmental Sustainability and Blockchain Regulation

The model possesses blockchain technology with Global Information Systems (GIS) for environmental surveillance, enabling real-time digitisation of mining areas monitoring, allowing instant tracking of violations of environmental governance predominantly caused by mineral extraction, such as accelerated deforestation, uncontrolled pollution, chemical waste disposal, and improper water usage.

Data is gathered using advanced computer-aided remote sensing and cross-verified with blockchain records to ensure corporate adherence to environmental rules. If environmental monitoring system detects pollution, it documents and makes available on blockchain, necessitating governmental involvement. Technology may encompass applicable punishments for disobedience and incentives for voluntary compliance.

Blockchain records ensure mining businesses employ cleaner, contemporary mining and extraction technology while adhering to established environmental regulations, allowing local authorities, NGOs, NSAs, and individuals to hold mining businesses accountable by providing evidence of compliance or violations. The amalgamation of blockchain technology with GIS-based monitoring systems ensures perpetual oversight of environmental impacts, facilitating tracking and comparison with historical data and global best practices.

5.3.7 Equitable Distribution of Benefits and Decentralised Record Maintenance

Blockchain in the model can improve transparency of administering initiatives like Community Development Funds and community share ownership trusts. Innovations such as revenue-

sharing systems, programmed to allocate percentage of collected royalties to affected communities, are equally recorded on model. Technology provides for community structures to verify distribution of financial resources to ensure they are obtaining commensurate intended benefits.

The model provides for lucidity and accessibility. Blockchain's decentralised records management capability allows entities such as governments, communities, mining companies, and NGOs to easily access relevant information concerning extractive sector operations, permits, payments, and community investments, ensuring equitable and optimal allocation of benefits while reducing risk of exploitation.

5.3.8 Company Profitability and MRG

Incorporation of corporate profitability within the framework underscores importance of aligning economic incentives with responsible governance. Extractive industry firms must comply with regulations and adopt sustainable practices, enhancing profitability through: cost savings achieved through optimised procedures, reduced bureaucratic obstacles, automated payment methods, and lower environmental fines; adherence to ESG principles and responsible sourcing standards enhancing company reputation and broadening market accessibility; operational stability achieved through transparent benefit-sharing, community involvement, and consistent regulatory frameworks.

5.3.9 Monitoring, Evaluation, and Feedback Mechanisms

The model has inbuilt monitoring, evaluation, and feedback mechanisms essential for ensuring optimal governance monitoring and evaluation particularly transparency and continuous improvement. The model has capacity to digitally coordinate independent oversight bodies tasked with periodically reviewing EI operations and regulatory compliance. Digital stakeholder feedback portals enable stakeholders to directly report MRG issues and provide related input, fostering more accountable governance environment. Blockchain-supported MRG audits create immutable EI records of transactions and operations, enhancing integrity of evaluation processes. The model produces comprehensive reports and is fitted with digital public disclosure mechanisms ensuring stakeholders remain informed.

5.4 Justification for DIMG Model

Augmented Trust and Transparency: The transparency and irreversible nature of blockchain cultivate trust among all stakeholders, including political bodies, local communities, and worldwide buyers. Integration ensures each participant has access to accurate and up-to-date information.

Mitigated Corruption and Illicit Activities: Blockchain technology prevents alteration or deletion of records, reducing likelihood of corruption and data manipulation in allocation of mining titles, royalty payments, corporate profits, and community fund distributions.

Enhanced Environmental Compliance: Integration of blockchain with GIS enables real-time monitoring of environmental impacts and documents instances of non-compliance, facilitating timely enforcement measures.

Optimised Processes and Cost Reduction: Smart contracts reduce administrative burden linked to license issuance, royalty payments, and environmental compliance verification,

leading to cost savings and improved efficiency. The approach eradicates bureaucracy and reduces role duplication across regulatory agencies.

Community Empowerment and Benefit Distribution: Communities gain advantages through transparent benefit initiatives including Community Development Funds and community share ownership trusts, allowing them to monitor financial transactions and ensure mineral wealth contributes to wider socio-economic advancements.

Data-Driven Decision Making: Comprehensive reports furnish decision-makers with precise and real-time information, facilitating informed policy formulation matching sustainability and community development objectives.

Enhanced Public Trust: Public transparency and community access to data cultivate trust among stakeholders. Local communities may acquire detailed information on extractive industry activities, royalty distributions, and environmental compliance, ensuring equitable benefit-sharing.

5.5 Anticipated Challenges and Mitigation Strategies

Digital Infrastructure Constraints: Inadequate technological setup in rural mining sites might impede efficient adoption of blockchain. Government and private stakeholders should invest in enhancing digital infrastructure including internet and energy access.

Resistance from Stakeholders: Resistance to blockchain adoption may be due to increased transparency exposing powerful corrupt practices. Early involvement, education, and demonstrating blockchain advantages will help lower resistance. Deep ingrained patriarchal attitudes and organisational resistance to change could make DIMG projects less adopted. Early stakeholder involvement builds trust, training clarifies technology, and demonstrating successful results helps redefine transparency as approach for enhancing responsibility and fairness.

Top Management Commitment: DIMG projects may fail without strong commitment from top management due to strategic alignment with general organisational goals lacking.

VI. POLICY RECOMMENDATIONS

6.1 Integrated Revenue Integrity Framework (IRIF)

The study established endemic weaknesses in management and governance of extractive industry revenues. It requires deliberate reforms of revenue management frameworks, laws, institutions, systems, and practices in entire financial management process. The reform process must not only seek to accommodate other stakeholders in mining value chain but eliminate duplicity in both national institutions and their mandates.

[Insert Figure 27: Integrated Revenue Integrity Framework (Page 290 of source document)]

Source: Researcher's own works

The IRIF structure aims at preventing revenue losses through transparency and disclosure measures ensuring all mining information (contracts, concession details, open data portals for revenue flows and production statistics) is publicly accessible. Robust institutional capacity emphasises government, regulatory bodies, and NGOs not only to oversee and audit but present user-

friendly compliance architecture. A sophisticated supporting whistle-blower framework is integral, performing whistle-blower protection functions encouraging voluntary reporting of illegal activities.

The framework also recommends efficient and simplified tax and royalty collection where revenues are properly calculated, collected, and recorded using modern digital systems such as blockchain technology. Inclusive oversight and participation by communities, NSAs, and CSOs monitoring to keep stakeholders accountable is key. Harmonisation with global standards aligns local reforms with global best practices to foster framework integrity, credibility, and investor trust.

6.2 Inter-Agency Collaboration

To address coordination challenges among regulatory and administrative bodies, the study recommends establishing a centralised, blockchain-based digital platform facilitating real-time information sharing and joint decision-making, harmonising policies and compliance efforts across agencies. The study proposes streamlining agencies by removing some from register regulatory bodies, including Ministry of Mines and Mining Development (policy formulation and mining rights administration), Environmental Management Agency (environmental compliance and EIAs), Minerals Marketing Corporation of Zimbabwe (mineral sales regulation), Zimbabwe Mining Development Corporation (state-owned mining assets), Ministry of Environment, Climate, Tourism and Hospitality Industry (environmental policy), Zimbabwe Revenue Authority (taxation and royalty collection), Ministry of Finance and Economic Development (fiscal oversight), Zimbabwe Parks and Wildlife Management Authority (protected areas), and Ministry of Local Government and Public Works (local development planning).

6.3 Political Will and Commitment

The findings indicate that weak political commitment undermines effective governance. It is recommended that government leaders, particularly the President through delegated officials, actively champion reforms by establishing clear performance benchmarks and anti-corruption measures. This commitment is vital to ensuring policy reforms are implemented and sustained over time. The President has constitutional responsibility for investment negotiations and protection to avoid investor negative perceptions of inadequacies in investment protection, property rights, and law consistency.

6.4 Separation of Politics and Administration

To minimise political interference, the study suggests separating and decoupling government work from political party influence through implementing meritocracy-based recruitments and appointments on specific terms of engagement. Integrating smart contracts through digital technology can further insulate administrative processes from political manipulation by automating compliance checks and royalty payments.

6.5 Enhanced Access to Reliable Geological Data

The responsibility for investing in relevant modern geological surveys and digital technologies lies primarily with the President of Zimbabwe through delegated authority of Ministry of

Mines and Mining Development, supported by its Geological Survey Department. Locating this responsibility in the Presidency ensures that the Geological Survey Department, the best-placed delegated agency, leads advanced digital mapping using GIS and remote sensing technologies, ensuring mineral resources are accurately classified and managed. Significant investments should be made in modern geological surveys, remote sensing, and blockchain-based data management to enhance transparency and support informed decision-making.

Delegated agencies must further collaboration with academic and research institutions, international partners with expertise in digital technologies and geosciences experts, supporting sector capacity building, digital innovation in data collection, analysis, and management for effective MRG.

6.6 Digitalisation and Modernisation of Mining Administration

It is essential to incorporate blockchain technology and digital solutions into management of Zimbabwe's mineral resources to improve transparency, efficiency, accountability, and sustainability. By embracing these innovations, Zimbabwe can modernise its mineral industry, reduce corruption, enhance revenue collection, and guarantee fair distribution of resource wealth. Complementary online tools for disclosing mineral processes, such as 'Towards Sustainable Mining' initiative created by Canada's Mining Association adopted by Botswana, should be considered.

The study recommends developing a comprehensive digital framework leveraging digital technologies for real-time monitoring of mineral supply chain, smart contracts for automated processes, and integrated reporting systems, strengthening data integrity and accountability from extraction to export.

6.7 Stakeholder Engagement and Involvement

To ensure inclusive governance, the study recommends establishing blockchain-enabled stakeholder engagement systems facilitating transparent interactions among government agencies, private sector players, local communities, and civil society. Enhancing these platforms supports public-private partnerships and ensures local communities directly benefit from mineral resource exploitation.

6.8 Employment Creation in the Extractive Sector

The study proposes an EI employment policy including Local Content and Skills Development Frameworks to afford the EI relevant human capital capacities. At the core is need to increase number and quality of formal, gainful jobs in Zimbabwe's extractive sector by strengthening local workforce participation, enhancing skill levels, and improving regulatory oversight.

The policy proposal will embrace mandated local hiring quotas requiring EI companies to hire specified percentages of Zimbabwean nationals at various skill levels, gradually increasing local employment targets over time. Training and technical education in EI-related skills through initiatives such as on-job training, scholarships, and specialisation will support workforce integration.

6.9 Strengthening Oversight and Enforcement

ZIMRA Capacity Building: ZIMRA should prioritise capacity-building to improve PGM tax expertise and implement integrated, technologically driven systems for export and production monitoring, aligning with global monitoring organisations. Reducing regulatory overlap through stronger inter-agency cooperation and data-sharing, closing existing gaps, and promoting clear, investor-friendly environment through policy changes will support sustainable PGMs governance.

ZRP Enforcement Enhancement: Improving institutional capacity through better funding, contemporary equipment, and focused training in mining laws and anti-smuggling policies is important. Strengthening enforcement through increased staff in remote mining sites and enhancing coordination with other agencies, alongside strong internal control systems, will support integrity and responsibility in ZRP operations.

Parliamentary Oversight Strengthening: Deeper cooperation with regulatory authorities, more funding for monitoring, and focused training for legislators and officials will strengthen Parliament's position. Transparency rules such as required public disclosure of mining agreements will improve accountability. Investments in modern monitoring tools and strategic alliances with civil society and international bodies, alongside institutional reforms increasing independence of parliamentary departments, will support effective PGMs sector governance.

6.10 Strengthening Legal and Institutional Foundations

To tackle deficiencies in transparency and accountability, government must implement a strong public financial management system effectively monitoring collection and use of extractive revenues. Zimbabwe's involvement in EITI necessitates not only adoption of its standards domestically but active implementation and enforcement of corresponding disclosure requirements.

The study proposes digitalized legal and institutional framework for optimum resource governance leading to coherent resource governance and revenue optimisation legislation, with potential to remove archaic legislation and duplicity while strengthening legal and institutional frameworks through digitalisation.

6.11 Zimbabwe Local Equity and Empowerment Framework (ZLEEF)

A deliberate policy is necessary in form of Zimbabwe Local Equity and Empowerment Framework, whose tenets involve creation of robust legal and digital framework guaranteeing local equity participation, inclusive empowerment, and sustainable benefits for communities. The proposed policy will ensure sustainable and local inclusive resource governance while leveraging technology for transparency and efficiency.

6.12 Equity-Driven Models for Stakeholder and Investor Collaboration

There is need for an equitable framework balancing interests of stakeholders including government, investors, local communities, and environmental entities, which can be added to ZLEEF. Communities and non-state actors argue optimal value realisation can only be achieved if there are homogenised avenues

for their direct involvement in decision-making processes, increasing community oversight and ensuring benefits are shared equitably.

6.13 Enhancing Property Rights and Security

The study suggests adoption of blockchain to assist in solving information asymmetries and grant individuals digital proof of ownership. This tool minimises mining rights granted in secretiveness, leaving citizens oblivious about scope, term, and value of concessions.

6.14 Promoting Gender, Diversity, and Inclusion

There is need for gender equality, diversity, and inclusion in proposed policies. Gender mainstreaming programs can help amend structural imbalances and enhance women's participation and leadership in industry. Diversity and inclusion in mineral resource sector are pivotal for promoting sustainable growth and equity. Binha (2021) argues that persistent gender stereotypes, structural barriers, and limited access to credit hinder participation of women and marginalised groups in mining.

6.15 Building a Knowledge Economy

There is need to transform extractive sector by harnessing knowledge, innovation, and technology to improve MRG, moving from traditional resource extraction to knowledge-driven economy optimising value of mineral resources, promoting sustainable development, and stimulating economic diversification. This can be accomplished by establishing specialised research institutions focused on mining technologies, mineral exploration, and sustainable mining methods; investing in EI educational initiatives across all levels supporting mining engineering, geology, environmental science, and technology; promoting innovation through incorporation of digital technologies such as data analysis, artificial intelligence, Internet of Things, and blockchain to improve operational efficiency, transparency, and security.

VII. CONCLUSION

This paper has examined the enhancement of mineral resources governance in Zimbabwe's platinum group metals extractive industry, revealing significant governance deficiencies including legislative fragmentation, weak institutional capacity, limited transparency, and inadequate community engagement. The study's findings demonstrate that current MRG frameworks are characterised by overlapping responsibilities, institutional duplication, corruption, and political interference, resulting in substantial revenue leakages estimated at US\$32 billion over two decades and continued losses of US\$1.2–1.9 billion annually. The proposed Digital Integrated Mineral Governance (DIMG) Model offers a transformative pathway for addressing these challenges through blockchain technology. By creating immutable digital records of natural endowments, mining titles, supply chains, royalty payments, and environmental compliance, the model enhances transparency, reduces corruption, and ensures equitable benefit distribution. The integration of multi-stakeholder participation mechanisms ensures local communities, civil society, and other stakeholders have meaningful involvement in governance processes.

The study's contributions to knowledge include identification of security sector involvement as a unique governance challenge, documentation of regulatory fragmentation across investment facilitation entities, analysis of institutional incapacity constraints, and exposure of power-politics and political interference dynamics. The DIMG Model represents a novel contribution providing practical, technology-enabled solutions for enhancing MRG in resource-rich developing countries.

Policy recommendations encompassing Integrated Revenue Integrity Framework, inter-agency collaboration strengthening, political will enhancement, administrative depoliticisation, geological data modernisation, digitalisation, stakeholder engagement, employment creation, oversight strengthening, and gender mainstreaming provide comprehensive pathways for transforming Zimbabwe's extractive sector from a source of economic leakage to a driver of sustainable development.

As Zimbabwe pursues Vision 2030 aiming for upper-middle-income country status, enhanced mineral resources governance through the DIMG Model offers opportunity to leverage the nation's significant mineral wealth for broad-based economic transformation, poverty reduction, and sustainable development. The successful implementation of these recommendations requires sustained political commitment, institutional capacity building, stakeholder collaboration, and adoption of digital technologies ensuring transparency, accountability, and inclusive benefit sharing.

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