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Regime Complexities in the Political Economy of Cobalt Mining in the DRC

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1 ABSTRACT

The surge in global demand for cobalt, driven by the growth of lithium-ion battery markets, has ignited a mining boom in the Democratic Republic of the Congo (DRC). However, the extractive industries in the DRC are entangled in complex power dynamics, murky governance structures, and severe social and environmental degradation. This article employs the regime complex theory to dissect the intricate political economy of cobalt mining in the DRC. Our meta-synthesis of content analysis, integrating findings from diverse sources, exposes how the cobalt mining regime complex, characterised by intersecting international trade agreements, national mining codes, and informal artisanal mining networks, perpetuates inequality, fuels conflict and undermines sustainable development in the region. This research underlines the imperative for a nuanced understanding of the transnational governance arrangements that shape the political economy of cobalt mining.

Keywords: Democratic Republic of Congo, regime complex theory, cobalt mining, governance, sustainability

2 INTRODUCTION

As a key ingredient in lithium-ion batteries, cobalt will play a critical role in low-carbon transition and be pivotal in decarbonising the power and transport industries globally. The World Bank noted that the global consumption of cobalt is projected to reach 200 500 tonnes and 344 000 tonnes in 2025 and 2030, respectively, with an annual growth rate of 9.6% between 2017 and 2030 (World Bank, 2021). The demand for cobalt in lithium-ion-based batteries is estimated to increase 17–19 times from 2020 to 2050, requiring a drastic expansion of supply chains (Xu et al., 2020). The DRC supplies 70% of the cobalt mined globally (Calvão et al., 2021; Shengo et al., 2019; US Geological Survey, 2021), with 30% mined artisanally (Warneck, 2024). According to Alves Dias et al. (2018), approximately 55% (10 million tonnes) of global cobalt resources are in the DRC. As such, the country has a large opportunity to reduce poverty, contribute to low-carbon economies, and develop its economy by leveraging cobalt supplies. According to the International Monetary Fund (IMF, 2019), nearly a third of state revenue in the DRC comes from natural resource extraction. Table 1 shows the total cobalt production in the DRC from 2016 to 2020.

Year	DRC production	Global contribution from DRC
2016	64	58.2%
2017	90	57.1%
2018	73	71.4%
2019	100	69.4%
2020	95	67.9%

Table 1: DRC: Global cobalt contributions (thousand tons). Source: World Bank (2021)

In 2018, cobalt contributed to 35% of total mining exports and 10% of the country's gross domestic product (IMF, 2019. China dominates the refined cobalt sector, recording a market share of 67% in 2019, up from 53% in 2015, and owning 8 of the 14 largest cobalt miners in the DRC. The most refined cobalt supplied by China is specifically for cobalt chemical products (Organisation for Economic Co-operation and Development (OECD), 2019). However, artisanal and small-scale mining (ASM) own a significant share of the mineral production in the DRC, contributing 10% to 20% of the total supply. Despite their contribution, ASM miners only get meagre wages. In 2019, a lawsuit was filed in courts in the United States against many major automotive and technology companies, accusing them of aiding and abetting the exploitation of child miners in the DRC to source cobalt. This could negatively impact the country's comparative advantage in the projected supplies from 2025 (World Bank, 2021).

There is a need for the DRC to come up with a policy that protects the ASM to take advantage of the predictable window of opportunity in the global market. This should be drafted with care considering consumer concerns, promote economic opportunities for artisanal miners, provide legal security for miners'

work and increase access to legitimate supply chains. These issues, including poor working conditions in mining sites, protection of human rights, child labour, and corruption, need a closer look in the sector. Cobalt mining in the DRC has provided poverty reduction, community development, and regional stability, but it also poses risks such as accidents, environmental pollution, and violent conflict (Sovacool, 2019).

This paper employed the regime complex theory to dissect the intricate political economy of cobalt mining in the DRC. This research will shed light on the transnational governance arrangements shaping the cobalt mining sector in the DRC by examining the intersecting international trade agreements, national mining codes, and informal artisanal mining networks. This paper sought to contribute to a nuanced understanding of the complex power dynamics and governance structures that underpin the extractive industries in the DRC and to inform policy interventions that promote more equitable, sustainable, and responsible mining practices in the region.

The introduction provides an overview of the research context and objectives. The literature review examines the regime complex theory and its application to the study of global governance and extractive industries, as well as existing research on the political economy of cobalt mining in the DRC. The section on the cobalt mining regime complex in the DRC analyses the intersecting international trade agreements, national mining codes, and informal artisanal mining networks that govern the sector. The impacts of the cobalt mining regime complex on the economy, environment, and society in the DRC are then examined. Key findings are presented, followed by a discussion. Finally, the conclusion summarises the key findings and implications of the research and provides recommendations for improving the governance of the cobalt mining sector in the DRC.

3 LITERATURE REVIEW

3.1 Regime complex theory and governance in the cobalt mining sector in the DRC

As conceptualised by scholars such as Keohane and Victor, the regime complex theory explores the interconnected network of formal institutions, informal norms, and overlapping rules that govern specific policy domains. These regimes are often fragmented, resulting in legal inconsistencies and governance gaps, yet they also provide opportunities for powerful actors to manoeuvre strategically (Alter and Raustiala, 2018). The regime complexes are particularly relevant in extractive industries such as cobalt mining. The DRC exemplifies this complexity with its vast cobalt reserves. As the global leader in cobalt production, the DRC operates within a governance framework shaped by international agreements, corporate interests, and local norms. However, the overlapping nature of these structures often leads to fragmented decision-making and regulatory gaps, which can hinder effective resource management (Raustiala and Victor, 2004).

Power dynamics further complicate the governance of cobalt mining in the DRC. Major global powers such as the United States and China heavily influence the regime complex, shaping international rules and decisions that impact local governance (Jho and Kim, 2021). At the same time, the DRC government wields significant authority as the custodian of most global cobalt reserves, playing a crucial role in market supply (Alves Dias et al., 2018; World Bank, 2021). Nevertheless, the lack of coordinated governance mechanisms often exacerbates inequalities and creates uncertainty in policy implementation. Analysing the regime complex of the DRC's cobalt sector reveals challenges and opportunities, emphasising the need for collaborative governance approaches that balance international influence with local needs and sustainability goals.

3.2 Political economy of cobalt mining in the Democratic Republic of Congo

The interplay between global demand, local governance, and artisanal mining practices shapes the DRC. China's dominance in the cobalt value chain is evident, controlling 50% of the DRC's production and refining processes while also leading global electric vehicle production, an industry that heavily relies on cobalt (Gulley, 2023). The dependency raises concerns about market risks, environmental degradation, and ethical supply chains. Meanwhile, the artisanal mining sector remains central to the DRC's cobalt output, providing livelihoods but often operating under poor labour conditions and informal economies. Studies such as that by Sovacool (2020) argued that integrating artisanal mining into formal supply chains could enhance social sustainability and stabilise the sector, particularly as global markets push for a low-carbon transition.

Local governance and political instability further complicate the sector. Revising the Mining Code 2018 increased royalty rates and heightened investor risks due to governance challenges, corruption, and reputational concerns (Zeuner, 2018). Weak institutions and elite control over resources exacerbate inequalities, limiting community benefits. Nevertheless, the sector has contributed to poverty reduction and regional development. However, researchers like Anderson (2023) and Schleich (2024) underscored the need for policy reforms to address child labour, low wages, and human rights abuses. By fostering accountability and innovation, the DRC can leverage its cobalt reserves for sustainable development while addressing the pressing social and environmental issues tied to mining practices.

3.3 Reputational risks and governance challenges in artisanal cobalt mining in the DRC

In the DRC, ASM presents significant reputational risks for global supply chains due to its association with child labour, poor working conditions, and environmental degradation (Umpula and Dummett, 2024). Cobalt, a critical mineral for the global transition to green energy, has become a symbol of human rights abuses in the region. The lack of transparency and traceability in the cobalt supply chain has prompted many companies to exclude ASM cobalt from their value chains. This decision threatens the economic well-being of thousands of miners and communities reliant on this sector. According to Sovacool (2020), artisanal cobalt mining, despite its challenges, could be reformed to empower miners and drive socio-economic development if integrated into formalised systems. Efforts to address these issues, such as the 2019 decrees passed by the DRC government, Decree No. 19/15 and Decree No. 19/16, seek to end child labour and improve working conditions in the cobalt mining industry, involving collaborative efforts between the government, civil society, and small-scale producers (Umpula and Dummett, 2024).

The governance of cobalt mining in the DRC is deeply intertwined with national policies, international trade agreements, and the informal nature of artisanal mining networks. Informality, as Geenen (2012) explained, is exacerbated by conflict, poverty, and a weak state control, making formalisation efforts highly challenging. Economic and security considerations significantly shape decision-making in regions like the eastern DRC, where insecurity drives migration to artisanal mining sites (Maclin et al., 2017). The formalisation of ASM often places additional strain on miners, creating what Vogel et al. (2017) termed. the "miner's canary" effect, as livelihoods become increasingly precarious. However, researchers have highlighted that mutual benefit-sharing and negotiation between artisanal miners and state-sanctioned systems can enhance access to mineral wealth, underscoring the importance of inclusive reforms (Verbrugge et al., 2015). Schwartz et al. (2021) further emphasised the need for interventions to address health risks to children and communities associated with ASM, demonstrating that targeted policies can mitigate the sector's broader social and environmental impacts.

3.4 International trade agreements shaping the mining sector of the DRC

The DRC's mining sector is deeply intertwined with international trade agreements, shaping its governance, economic landscape, and resource management. These agreements influence the inclusion of Congolese artisanal cobalt in global supply chains, with considerations of bargaining power, resource dependency, and political stability at their core (Zeuner, 2018). The complex dynamics of corporate enforcement and overlapping property rights further exacerbate conflicts in the cobalt mining sector (Katz-Lavigne, 2020). In this section, the role of key trade agreements and their implications for the DRC are explored under specific themes.

The DRC is a signatory to significant trade agreements, including the World Trade Organization's Agreement on trade-related aspects of intellectual property rights (TRIPS), the African continental free trade area (AfCFTA), and the protocol on mining of the Southern African Development Community (SADC). These frameworks collectively aim to liberalise mineral trade, attract foreign investment, and foster regional cooperation. For example, the AfCFTA, established to create a single market for goods and services across Africa, holds transformative potential for the DRC's mining sector by boosting mineral exports and promoting economic growth (Abrego et al., 2019). However, while broader economic implications are widely documented, sector-specific impacts on mining remain underexplored in the literature. Similarly, the focus of the SADC on regional development initiatives, such as renewable energy adoption, could indirectly influence mining operations by addressing critical energy challenges in the region (Jadhav et al., 2017).

International legislation, such as the U.S. Dodd-Frank Act, has directly impacted the governance of the mining sector in the DRC. This law mandates companies to disclose the origins of minerals, including tin, tungsten, tantalum, and gold (3TG), to reduce the trade in conflict minerals (Byemba, 2020). Although well-intentioned, this regulation has inadvertently marginalised artisanal and small-scale miners, who often struggle to meet compliance requirements. Similarly, the Kimberley Process, designed to curb the trade of conflict diamonds, has improved the diamond mining sector but faces criticism for limited scope and inadequate implementation (Byemba, 2020; Mthembu-Salter, 2009). These measures underscore the challenges of balancing regulatory objectives with the realities faced by artisanal miners.

The TRIPS agreement has set minimum standards for intellectual property protection, impacting technology access in developing countries such as the DRC (Khor, 2002). Although TRIPS aimed to boost exports from developing nations, evidence suggests that it has predominantly benefited developed countries, particularly in the pharmaceutical sector (Lanoszka, 2003; Smith et al., 2009). It raises concerns about its applicability to the mining sector, where access to cutting-edge technologies is crucial for efficient and sustainable operations. China's involvement in the copper and cobalt mining of the DRC illustrates a dualistic approach combining developmentalist and extractivist strategies. While such engagements have supported infrastructure development and economic gains, they have also faced challenges tied to political instability and regime changes (Shen and Fu, 2024). These dynamics highlighted the need for a nuanced understanding of how trade agreements intersect with global partnerships in shaping the DRC's resource governance.

3.5 Impact of the DRC mining code revisions on governance and investment

In 2018, the DRC introduced significant revisions to its national mining code, seeking to address long-standing governance, transparency, and resource exploitation issues. The revision was seen as an attempt to rejuvenate the national mining sector while promoting sustainable development. However, as Zeuner (2018) highlighted, these changes triggered cautious investment decisions from mining companies, reflecting a growing concern about the balance between resource governance and economic exploitation. The increased premium risk introduced by the revised code underscores the tension between attracting foreign investment and ensuring equitable benefits for the Congolese population. While the code mandates that companies pay royalties and taxes and comply with environmental regulations, it has been criticised for its lack of transparency, limited state control, and insufficient social and environmental safeguards (Michel and Kime, 2021).

Despite the ambition of the 2018 revision, the code has yet to address many of its predecessor's weaknesses, leaving the DRC mining sector vulnerable to exploitation. Lisumbu (2020) argues that while the revised code was intended to stimulate national production alongside foreign private ventures, the increased tax burdens, such as the 10% royalty on strategic substances and a 50% super-profits tax, may undermine the country's competitiveness in the global mining market (Radley et al., 2017). As Radley (2018) observed, mining executives often view the taxes as manageable, expecting significant rewards from the country's vast resource wealth. However, the code's lack of effective enforcement mechanisms, particularly in treating ASM, could result in a missed opportunity for inclusive growth. Buraye (2017) pointed out that there are too few artisanal exploitation zones to accommodate many artisanal miners, exacerbating the sector's informality and perpetuating exploitation.

The World Bank's influence on mining regimes in Africa, including the DRC, further complicates the effectiveness of the mining code. Bush (2010) critiqued the World Bank's mining policies, arguing that they often undermine the development goals of African states by promoting policies that prioritise resource extraction over long-term socio-economic development. This challenge is evident in the DRC, where the mining code's focus on attracting foreign investment may not necessarily translate into tangible benefits for the Congolese people. Moreover, Renzi (2021) underscored the importance of enforcing environmental laws and mining codes in the DRC and neighbouring countries like South Sudan and Rwanda to create sustainable, high-quality environments. Effective enforcement is crucial to prevent environmental degradation, a persistent issue in the DRC's mining sector.

3.6 Social and environmental impacts of cobalt mining

Cobalt mining has led to widespread environmental degradation, with far-reaching consequences for ecosystems and communities. Deforestation, water pollution, and soil degradation are prominent concerns

tied to mining activities. For instance, cobalt extraction in the DRC has resulted in significant land cover changes, affecting water resources, trees, shrubs, grasses, and cultivated lands, ultimately threatening vulnerable populations (Brown et al., 2022). Mining operations contribute significantly to eutrophication and global warming, with activities such as medium-voltage electricity use and blasting identified as major contributors (Farjana et al., 2019). Additionally, the contamination of water bodies with toxic substances from mining poses serious risks to both environmental and human health, as noted by Sharma (2023). Alarmingly, 70% of global cobalt resources are situated in high-risk environments, exacerbating the potential for environmental damage (Lèbre et al., 2020). While the energy transition might offset some environmental impacts by 2050, as Meide et al. (2022) suggested, the immediate ecological harm remains concerning. Moreover, weak environmental oversight further amplifies the challenges, with mining practices releasing harmful contaminants into surrounding ecosystems and communities (Sovacool, 2020).

The social dimensions of cobalt mining are equally troubling, with issues such as child labour, forced labour, and human rights abuses dominating the sector. Artisanal mining in the DRC exposes vulnerable communities to toxic substances, resulting in severe health risks, particularly for children (Nkulu et al., 2018). The lack of transparency in the mining supply chain perpetuates corruption, undermines trust in government institutions, and fails to channel revenues into economic diversification or community development projects (Michel and Kime, 2021). The exploitation of labour, poor working conditions, and displacement of communities are common in cobalt mining regions. Schleich (2024) highlighted the destruction of land, homes, and farms, alongside physical and verbal abuse, non-liveable wages, and child labour, as grim realities for Congolese residents. Additionally, conflicts surrounding mining activities emerge both upstream and downstream in the supply chain, reflecting tensions in governance and resource management (Prause, 2020). Despite these challenges, Sovacool (2020) pointed out that cobalt mining, in certain situations, has also empowered communities, demonstrating its dual-edged impact.

The overlap of social and environmental challenges creates a compounded burden on affected communities. Environmental pollution from mining activities exacerbates health issues, while the absence of socio-economic investments leaves communities trapped in cycles of poverty and exploitation. Shen and Fu (2024) critiqued developmental and extractivist approaches in China's engagement with the DRC's mining sector, highlighting the socio-economic ramifications of the country's development trajectory. Meanwhile, Umpula and Dummett (2024) proposed a roadmap for addressing child labour and improving working conditions, emphasising the need for collaborative governance among the government, civil society, and small-scale producers.

4 METHODOLOGY

This study employed a qualitative methodology, using a desk review to explore the complexities of cobalt mining in the DRC's political economy. Data were sourced from various published materials, including books, peer-reviewed journal articles, and policy documents accessed through databases such as Google Scholar and Scopus. The approach ensured comprehensive coverage of relevant scholarly and institutional perspectives. Textual analysis was employed to interpret and examine the data, focusing on patterns, themes, and insights related to regime complexities. This method facilitated a nuanced understanding of the political and economic dimensions of cobalt mining governance..

5 FINDINGS

5.1 Fragmented governance in cobalt mining

The DRC's cobalt mining sector is governed by a regime complex characterised by overlapping formal and informal rules and fragmented decision-making processes. This complexity often results in governance gaps hindering resource management and legal inconsistencies. Despite this, the regime structure provides avenues for strategic manoeuvres by powerful global and local actors, further complicating regulatory oversight.

5.2 Global power dynamics and local challenges

Major global players such as the United States and China significantly influence the governance landscape of the DRC's cobalt sector. China, for instance, dominates the cobalt value chain, controlling production,

refining, and supplying electric vehicle manufacturing. Meanwhile, weak local governance, political instability, and elite resource control exacerbate inequalities and limit the benefits for local communities. In the DRC, the 2018 revision of the mining code, aimed at increasing state revenue, created tensions by raising investor risks while failing to address core governance challenges.

5.3 Artisanal and small-scale mining

ASM is vital in cobalt production but is plagued by poor labour conditions, child labour, and environmental degradation. While the sector provides livelihoods for many, its informal nature and lack of transparency pose reputational risks for global supply chains. Efforts to formalise ASM have faced significant challenges, often marginalising miners and creating economic insecurity.

5.4 Impact of international trade agreements

Trade agreements such as AfCFTA, SADC's mining protocols, and the US Section 1502 of the Dodd-Frank Act of 2010 shape the DRC's mining sector governance. While these frameworks aim to enhance economic growth and transparency, they often have unintended consequences, such as marginalising artisanal miners or creating compliance burdens. The DRC's integration into global supply chains remains constrained by the misalignment of these agreements with local realities.

5.5 Revised mining code and its implications

The 2018 mining code revisions introduced higher royalties and taxes on cobalt production, aiming to secure equitable national benefits. However, the changes increased investment risks and reduced the sector's competitiveness in global markets. Although the code includes environmental and social safeguards, it has been criticised for insufficient implementation and transparency, leaving the sector vulnerable to exploitation.

5.6 Opportunities for reform

Despite the challenges, the DRC's cobalt sector holds significant potential for sustainable development. Integrating artisanal mining into formal supply chains, improving transparency, and fostering collaborative governance could address the sector's social and environmental issues. International partnerships and targeted reforms can be pivotal in leveraging cobalt resources to promote economic growth and reduce inequalities.

6 DISCUSSION

The study revealed significant findings that aligned with existing literature on governance and the political economy of extractive industries. The research underscored the complexities of the regime complex theory, as articulated by Keohane and Victor (2011), highlighting the fragmented nature of governance structures in the DRC. This fragmentation leads to inconsistencies in regulatory frameworks, creating opportunities for powerful actors to exploit resources while undermining local communities. The findings suggested that the potential for sustainable development remains severely compromised without a cohesive governance strategy that integrates international agreements and local regulations.

Moreover, the study emphasised the role of artisanal mining in the DRC's cobalt sector, echoing Sovacool's (2020) assertions regarding the socio-economic implications of informal mining practices. Artisanal miners contribute significantly to cobalt production, yet face dire working conditions and limited economic benefits. The findings indicated that integrating these miners into formal supply chains could mitigate some challenges, promoting better wages and working conditions. It aligns with Anderson's (2023) and Schleich's (2024) calls for policy reforms that address human rights abuses and enhance accountability within the mining sector, suggesting that reforming artisanal mining practices could lead to broader community development.

The influence of international trade agreements on the DRC's mining landscape is another critical finding of this research. The study illustrated how agreements such as AfCFTA and the TRIPS framework shaped resource management and economic opportunities in the region. Zeuner (2018) highlighted similar themes, noting that while these agreements aim to liberalise trade and attract investment, they often overlook the

specific needs of artisanal miners. The findings suggested that a more nuanced approach to trade agreements is necessary to ensure they benefit local communities rather than exacerbate existing inequalities.

Finally, governance challenges related to child labour and poor working conditions in cobalt mining are underscored in this study, resonating with Umpula and Dummett's (2024) analysis of reputational risks associated with artisanal mining. The findings revealed that despite efforts by the DRC government to improve conditions through recent decrees, significant gaps remained in implementation and enforcement. It indicated a pressing need for collaborative efforts among stakeholders, including civil society and international organisations, to develop effective strategies for addressing these issues. These key findings highlighted the intricate interplay between local practices, international influences, and governance structures in shaping the future of cobalt mining in the DRC.

7 CONCLUSION

The cobalt mining regime complex in the DRC is characterised by a lack of transparency, accountability, and governance, which perpetuates negative social, environmental, and economic impacts. The fragmented governance structures exacerbate inequalities and hinder sustainable development as powerful actors exploit regulatory gaps. While crucial for local livelihoods, artisanal mining often operates under dire conditions, with miners receiving minimal economic benefits. Additionally, international trade agreements shape the mining landscape, influencing local practices and global supply chains. The findings underscored the urgent need for cohesive governance strategies that address human rights issues and promote equitable resource management. This study recommends that the DRC establish a unified regulatory framework integrating international agreements with local laws to enhance accountability and transparency in cobalt mining operations. It should involve collaboration between the DRC government, international organisations, and civil society.

Moreover, it should implement policies that support the formalisation of artisanal mining, ensuring that miners receive legal recognition and access to legitimate supply chains. It could improve working conditions and provide better economic opportunities for local communities. In addition, the country should strengthen enforcement of existing laws to eradicate child labour in the mining sector. It should include targeted interventions to support affected families through education and alternative livelihood programmes. The mining sector should encourage companies to adopt sustainable practices that minimise environmental degradation and support community development. It could involve investments in clean technologies and rehabilitating mined areas to restore ecosystems. Finally, there is a need to foster inclusive dialogue among all stakeholders – government, industry, local communities – as well as non-governmental organisations to ensure that the voices of those most affected by mining activities are heard in policy-making processes. Engagement can help build trust and facilitate more equitable resource management

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