

CHAPTER 8

Coltan, global resource nexus and the struggle of control in the Democratic Republic of the Congo

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Abstract: This chapter examines the complexities of coltan mining in the Democratic Republic of the Congo (DRC), emphasising how global demand shapes local political instability and environmental degradation. Despite housing 60–80% of the world's coltan reserves, the DRC remains mired in poverty and conflict, largely due to ineffective governance and external market pressures. The interactions between local armed groups, state complicity and multinational corporations exacerbate these challenges, resulting in severe social and ecological consequences. The analysis highlights the urgent need for cooperative governance and ethical sourcing practices to mitigate the detrimental impacts of resource exploitation. It calls for further research into institutional reforms and technological innovations that could foster transparency and sustainability in mineral supply chains, ultimately contributing to a more equitable resource nexus in an increasingly constrained world.

Keywords: Coltan, Democratic Republic of the Congo, resource governance, political instability, environmental degradation, ethical sourcing, global demand.

INTRODUCTION

Coltan (columbite-tantalite) is a critical mineral embedded in virtually every high-tech device produced today, from smartphones and tablets to electric vehicles and renewable energy technologies. Its significance

extends beyond technological innovation, as it serves as a vital component in tantalum capacitors, which are essential for the functionality and performance of electronic devices. A substantial portion of the world's coltan is sourced from the Democratic Republic of the Congo (DRC), particularly from its eastern provinces, where local artisanal mining operations operate in often conflict-prone and unregulated environments. The increasing global demand for coltan has not only elevated its strategic importance on the international market but has also intensified local struggles over control and access to this valuable resource.

In the DRC, the dynamics of coltan extraction are deeply intertwined with political instability, governance challenges and environmental degradation. The extraction process is frequently marred by violence, with armed groups exerting control over mining operations and financing their activities through the coltan trade. This situation exacerbates existing socio-economic inequalities and fuels ongoing conflicts, highlighting the complexities of resource governance in a country rich in natural resources but characterised by weak institutional frameworks.

This chapter addresses the central question: how does the global demand for coltan shape political instability and environmental degradation in the DRC, and what does this reveal about the broader global resource nexus? To unpack these issues, the chapter employs a case study approach, incorporating secondary data analysis, policy reports, academic literature and findings from non-governmental organisations (NGOs) to assess both local and global dynamics affecting coltan mining in the DRC. The subsequent sections provide background on the DRC's coltan sector, detailing the various actors involved in its extraction and the competing global interests at play. This is followed by a thorough analysis of the coltan-related conflict and its environmental outcomes, emphasising the interplay between resource extraction and socio-political unrest. The discussion then engages with broader implications for global governance and sustainability, while the conclusion reflects on the findings and offers recommendations aimed at fostering more equitable and sustainable practices in the global resource landscape. Through this comprehensive

examination, the chapter seeks to illuminate the critical linkages between local resource struggles and global consumption patterns, ultimately calling for enhanced cooperation and ethical governance in order to address the multifaceted challenges posed by coltan extraction in the DRC.

GEOPOLITICAL SIGNIFICANCE AND STRUCTURAL DYNAMICS OF COLTAN MINING IN THE DRC

Coltan, short for columbite-tantalite, is a vital mineral used predominantly in the production of tantalum capacitors, essential components in consumer electronics like smartphones, tablets, and computers. The growth in demand for these technologies from the late 1990s onward significantly raised the importance of coltan on the global market. It is estimated that 60% to 80% of the world's coltan reserves are concentrated in the DRC, particularly in the eastern provinces such as North Kivu and South Kivu. Despite this abundance, the DRC's inability to exert effective governance in these regions has empowered local militias and armed groups to take control of coltan mining operations. These groups often finance their military activities through profits from the coltan trade, as evidenced by the involvement of the Democratic Forces for the Liberation of Rwanda (FDLR), M23 and various Mai-Mai militias (International Peace Information Service, 2020, p. 15)

The relationship between armed groups and state actors in the DRC is multifaceted. On one hand, local militias operate autonomously, leveraging the lack of effective regulatory authority to monopolise resource extraction. On the other hand, state actors often exhibit complicity, either through corruption or incompetence, thereby facilitating the informal networks that dominate the coltan trade (Wood, 2018). The DRC government has struggled to impose law and order across vast regions; external actors have sometimes exacerbated the situation by providing resources or military support to these groups, leading to further entrenchment of conflicts (Global Witness, 2020).

International companies play a pivotal role in the coltan trade, often benefiting from tax regulations while inadvertently supporting conflict. Many electronics manufacturers maintain supply chains that are inadequately scrutinised for ethical sourcing practices. For instance, companies like Apple and Samsung have faced scrutiny over their supply chains, with concerns raised about sourcing coltan from conflict-affected areas (Kauffman, 2023). Even with due diligence obligations such as those stipulated by the Dodd-Frank Act, many corporations struggle to trace their raw materials back to compliant sources, given the complexity and opacity involved in the supply chains (Barrow, 2020).

Some firms have increased efforts to ensure ethical sourcing through initiatives such as the Responsible Business Alliance (RBA) and the Organization for Economic Co-operation and Development (OECD) Due Diligence Guidance for Responsible Supply Chains. However, the effectiveness of these initiatives is questioned due to weak enforcement and inconsistencies in reporting practices among companies. Additionally, third-party auditing processes often come under scrutiny, raising concerns about the reliability of figures that report compliance with conflict-free claims (McGrow, 2021, p. 160).

The geopolitical stakes surrounding coltan have implications extending beyond the immediate conflict zones. Nations like China, the United States and countries in the European Union rely heavily on a continuous supply of critical minerals that support technological development and transitions to renewable energy sources. The DRC's strategic importance has led these nations to engage in partnerships with local leaders, often at the cost of perpetuating systemic injustices in the region. Recent trends indicate that the demand for coltan is projected to increase, particularly as electric vehicles and renewable energy technologies become more mainstream, thereby ensuring continued global reliance on minerals sourced from conflict-prone areas such as the DRC.

Section 1502 of the Dodd-Frank Act was a pioneering effort aimed at addressing conflict minerals by mandating transparency and due diligence for companies sourcing materials. However, these regulations face

significant challenges. While some mining operations have been scrutinised, studies indicate that many groups have adapted by shifting operations or exploiting loopholes in the system (Wood, 2018). Moreover, the implementation of such policies has proven difficult; evidence suggests that the Act may have inadvertently intensified violence as armed groups sought alternative revenue streams amidst heightened scrutiny.

Organisations such as the OECD have developed additional frameworks to improve due diligence and promote responsible sourcing (OECD, 2022). However, the effectiveness of such guidelines remains inconsistent across the industry, and many companies continue to report difficulty in assuring consumers of the ethical provenance of their products (McGrow, 2021).

COLTAN EXTRACTION, CONFLICT AND ENVIRONMENTAL DEGRADATION IN THE DRC

The Democratic Republic of the Congo serves as a compelling case study in the examination of how global economic forces intersect with local governance failures to produce widespread political instability, environmental degradation, and human suffering. This analysis focuses on the DRC's coltan sector – particularly in the eastern provinces of North Kivu and South Kivu – as a critical example of the “resource curse”, wherein countries endowed with abundant natural resources experience heightened conflict, corruption and underdevelopment rather than prosperity.

The DRC possesses a significant share of the world's coltan reserves, a critical mineral essential for the manufacture of tantalum capacitors used in mobile devices, electric vehicles and renewable energy systems. As global demand for digital devices and green technologies accelerates, the pressure on coltan-rich regions within the DRC has intensified. Artisanal and small-scale mining has proliferated in response to these global market dynamics, yet it operates largely within informal, unregulated frameworks

that expose miners to severe labour abuses, environmental hazards and economic exploitation (Nkulu et al., 2018; Landrigan et al., 2022).

At the local level, weak institutional structures have significantly exacerbated the challenges posed by international demand. Corruption, regulatory gaps and an absence of state enforcement have allowed criminal networks and armed factions to dominate the coltan trade. State actors frequently demonstrate complicity or incompetence, failing to regulate extraction activities or ensure the equitable distribution of revenues (Wakenge et al., 2018). These conditions have allowed militias such as the FDLR, Mai-Mai groups and the M23 rebel movement to establish control over key mining sites. During the early 2000s, amid a global electronics boom, armed groups generated up to \$3 million per month from coltan exploitation (Mantz, 2008, p.45).

Since 2021, the re-emergence of the M23 rebel group has reaffirmed the close link between mineral extraction and conflict financing, with recent estimates indicating monthly earnings of approximately \$2.5 million from illicit coltan activities (Mirera, 2022; Berr et al., 2023). These armed factions not only perpetuate cycles of violence but also impose severe burdens on local miners, including forced taxation that can amount to 30% of individual earnings (Krauser, 2020, p. 1975).

The human cost of this unregulated mining economy is deeply troubling. Investigations by humanitarian organisations and the U.S. Department of Labor reveal that as much as 40% of the workforce in some artisanal mining sites consists of children (Rodríguez et al., 2024). These children often labour under dangerous conditions, including long hours, physical strain, inadequate protective equipment and exposure to toxic substances. Such practices are among the worst forms of child labour as defined by the International Labour Organization (Brusselen et al., 2020; Godelive et al., 2023). The persistence of child labour and hazardous working environments underscores the absence of social protection and viable economic alternatives in mining communities, conditions that are further entrenched by governance failures and the prioritisation of short-term profits over long-term welfare.

Environmental degradation represents another critical dimension of the coltan crisis. Artisanal mining, often carried out with rudimentary tools and without ecological safeguards, has led to widespread deforestation, soil erosion and contamination of water sources. Protected ecosystems, such as Kahuzi-Biega National Park – a UNESCO World Heritage Site – have experienced significant habitat destruction, placing endangered species such as mountain gorillas at serious risk. (Spira et al., 2017, p. 728) The extraction process generates mining waste and releases heavy metals that pollute surrounding landscapes, with serious consequences for both biodiversity and human health (Isah et al., 2019). The degradation of these natural resources, which are vital for local subsistence and ecological stability, not only undermines community resilience but also triggers population displacement and broader regional insecurity (Erusani & Aji, 2022).

Despite the DRC's vast mineral wealth, mining communities remain deeply impoverished. They frequently lack access to basic services such as healthcare, education and clean water (Kimengsi et al., 2022). This disjuncture between resource abundance and widespread poverty reflects a broader pattern of “elite capture”, whereby revenues from coltan extraction are monopolised by a small group of politically connected actors. Meanwhile, local populations – whose lands and labour sustain the mining economy – receive minimal benefits and bear the brunt of environmental and social harm. These dynamics are further compounded by the complicity of multinational corporations, many of which source coltan without adequate verification of its ethical provenance. Regulatory frameworks such as Section 1502 of the Dodd-Frank Act and the OECD Due Diligence Guidance have attempted to improve transparency and ethical sourcing, yet their implementation has been inconsistent and often circumvented through smuggling and fraud (Barrow, 2020; McGrow, 2021). Auditing mechanisms and third-party verifications are frequently unreliable, rendering “conflict-free” claims suspect.

Emerging technologies, such as blockchain-based traceability systems, offer potential solutions to improve transparency in mineral

supply chains. These technologies could enable consumers and corporations to track the origin of minerals more reliably and ensure compliance with ethical standards (Tayebi-Khorami et al., 2019; Mirera, 2022). However, the adoption of such innovations remains limited, particularly in regions plagued by conflict and infrastructural deficits. A sustainable resolution to the coltan crisis therefore requires a multifaceted and integrated strategy. Strengthening local governance structures, enforcing labour and environmental protections, and empowering local communities through participatory development models are essential. International efforts must go beyond technical solutions and address the deeper political economy of mineral extraction, including the demilitarisation of mining zones and the creation of viable alternative livelihoods for mining-dependent populations.

The analysis yields several key findings and insights. First, the DRC's coltan sector epitomises the paradox of resource wealth coexisting with pervasive poverty and conflict. The extraction of a globally valuable mineral has not translated into local development but has instead reinforced systems of violence, exploitation and underdevelopment. Second, the commodification of coltan has entrenched armed conflict by providing a lucrative revenue stream for rebel groups and militias, further destabilising the region. Third, the unregulated nature of the mining industry has enabled widespread human rights abuses, particularly the use of child labour, and has caused profound ecological damage with long-term consequences for both people and wildlife. Fourth, international supply chains remain deeply implicated in sustaining these harmful practices due to insufficient oversight and enforcement of ethical sourcing standards. Finally, while traceability technologies and international guidelines represent steps in the right direction, they must be part of a broader strategy that addresses systemic governance failures and promotes inclusive, community-centred development. Only through such a comprehensive approach can the DRC move toward a future where its mineral wealth serves as a foundation for peace, equity and sustainability.

IMPLICATIONS FOR GLOBAL GOVERNANCE AND SUSTAINABLE RESOURCE MANAGEMENT

The case of coltan extraction in the DRC offers profound insights into the broader themes addressed in the Dresden Nexus Conference: The Future of Resources – Resources for the Future (8–10 April 2025). At its core, the coltan trade reveals a fundamental paradox: vast resource wealth co-exists with entrenched poverty, conflict and environmental degradation. This paradox underscores the global inequalities embedded within resource governance structures and highlights the urgent need for more equitable and sustainable frameworks. The implications extend well beyond the confines of the DRC, touching upon global power dynamics, ethical consumption and environmental responsibility in an increasingly interconnected world.

The findings illustrate how the dynamics of global consumption are intimately linked to local extraction practices. The supply chains for high-tech devices are not merely technical or logistical frameworks but are embedded in broader socio-political contexts that influence and are influenced by local communities. Resource extraction, especially under weak governance conditions, generates complex feedback loops, where environmental degradation, social dislocation and political instability exacerbate each other. In the DRC, the degradation of land and water resources due to artisanal coltan mining has led to ecological harm and forced migration, thereby contributing to regional insecurity (Isah et al., 2019; Nsengiyumva et al., 2023). These outcomes challenge the notion that resource development inherently leads to economic progress, revealing instead the vulnerability of communities situated within exploitative extractive regimes.

A key challenge illuminated by this analysis is the weakness of institutional and regulatory frameworks in resource-rich, governance-poor states. In the DRC, pervasive corruption and limited state capacity have allowed informal networks and armed groups to monopolise mineral

wealth, fuelling violence and undermining efforts to establish the rule of law (Wakenge et al., 2018). This institutional fragility not only facilitates environmental harm and labour abuses but also inhibits the possibility of redistributing resource benefits more equitably. Moreover, global supply chains often lack the transparency necessary to ensure that minerals like coltan are ethically sourced. While some corporations have adopted due diligence standards, inconsistencies in implementation and enforcement continue to limit their efficacy.

At the same time, the case study also reveals significant opportunities. Technological innovations such as blockchain-based traceability systems offer promising avenues for enhancing transparency and accountability in mineral supply chains. These tools could empower consumers to make ethical purchasing decisions, while holding corporations accountable for the sourcing practices embedded in their products (Tayebi-Khorami et al., 2019). Additionally, the promotion of regional cooperation and the strengthening of local governance institutions present viable pathways towards more inclusive and sustainable management of natural resources. When local communities are empowered to participate in decision-making processes and to share in the benefits of extraction, the potential for conflict diminishes and the prospects for sustainable development improve (Wakenge et al., 2018; Antoci et al., 2019).

Policy recommendations emerging from this analysis emphasise the need for a multi-level governance approach that integrates local, national and international actors. At the international level, multilateral agreements and certification schemes should be strengthened to monitor and enforce ethical sourcing practices. These mechanisms must go beyond technical compliance to address structural inequalities and power imbalances that shape the resource nexus. At the national level, capacity-building efforts should focus on regulatory reforms, anti-corruption measures and the development of inclusive institutions that prioritise environmental and social justice. Locally, benefit-sharing frameworks and community engagement strategies should be institutionalised to ensure that mining activities support – not undermine – local development.

In conclusion, the DRC's coltan sector exemplifies the interdependencies that define today's global resource landscape. It illustrates how local resource extraction is entangled with global consumption patterns, geopolitical interests and institutional asymmetries. Addressing the challenges identified in this case requires more than technical solutions; it necessitates a fundamental rethinking of how resources are governed, who benefits from them and at what cost. By aligning resource governance with principles of justice, sustainability and cooperation, the international community can begin to transform the resource nexus from a site of competition and exploitation into one of shared benefit and collective responsibility.

CONCLUSION

This chapter elucidates how the strategic value of coltan situates the Democratic Republic of the Congo at the nexus of a global resource crisis characterised by local instability, environmental degradation and fierce international competition. The findings underscore the paradox of resource wealth coexisting with entrenched poverty and conflict, revealing that despite the DRC's extensive mineral endowments, the country continues to suffer from systemic governance failures and the pressures of external market demands.

Given the complexities surrounding coltan extraction, further research should focus on the potential for long-term institutional reforms that could enhance governance and accountability within the mining sector. Additionally, an exploration of how emerging global powers influence the mineral trade dynamics and the effectiveness of innovative technological solutions, such as digital traceability systems, could provide valuable insights into enhancing fair practices in resource management.

This chapter contributes to the overarching theme of the monograph, "The Resource Nexus: Competition and Cooperation in a Resource-Constrained World", by illustrating the intricate ties between

local extraction practices and global consumption behaviour. It highlights the urgent need for cooperative governance frameworks that prioritise sustainable development and justice in resource management, especially in contexts marked by political instability and environmental consequences. As such, the case of coltan in the DRC serves not only as a critical example of the challenges posed by resource exploitation but also as a call to action for collaborative efforts in addressing these pressing global issues.

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