

Lubumbashi (DR Congo): Navigating the socio-ecological complexities of a vital mining hub

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ABSTRACT

Lubumbashi, the economic hub of the Democratic Republic of the Congo, thrives on its mining sector but faces challenges from rapid, unregulated population growth and urban expansion. This has led to a dichotomous urban landscape, combining well-planned colonial districts with haphazardly developed areas lacking infrastructure. This study examines Lubumbashi's urban evolution and related challenges through a desktop survey, contributing to literature on urbanization, economic development, environmental sustainability, and resource extraction in sub-Saharan Africa. It also introduces theoretical frameworks such as "resource urbanism."

Key challenges include disorderly land governance, natural vegetation degradation, transport privatization, electrification issues, sanitation deficiencies, and pollution. Although provincial and city governments are working to improve urban organization, their efforts often lack comprehensive consultation and cohesive strategy, focusing primarily on the city center.

The study highlights the complex interplay between historical legacies and contemporary issues, emphasizing the urgent need for integrated urban planning. Addressing socio-spatial disparities, environmental concerns, and community resilience requires collaboration among government entities, local communities, and stakeholders to ensure sustainable and equitable development for Lubumbashi.

1. Introduction

Analyzing Lubumbashi's development requires a broader understanding within the global urbanization context. The world's population surged by 220 % from 1950 to 2022, reaching nearly 8 billion. Since 2014, over half of the global population has lived in urban areas, a trend projected to rise to 68 % by 2050 (United Nations Department of Economic and Social Affairs, Population Division, 2022). In Africa, urbanization levels vary; 44 % of Africa's population resided in urban areas in 2022, with the Democratic Republic of the Congo (DRC) urbanizing rapidly, having 42 % of its population in urban areas (UN Habitat, 2022). Lubumbashi, in the southeastern Upper Katanga province, is a major driver of urban growth in the DRC (Fig. 1). As the second-largest city in the DRC, Lubumbashi has been crucial historically and

economically. Originating as a mining enclave during the colonial era, it became key for copper and mineral extraction. Despite political and socio-economic challenges, Lubumbashi remains a vital commercial and industrial hub, significantly contributing to the global cobalt supply chain, essential for lithium-ion batteries used in electric vehicles (UN Habitat, 2022).

Lubumbashi's economic vitality has led to rapid demographic growth, with a population exceeding 3 million and an annual urbanization rate above 5 % (Remon and Nkuku, 2006). This growth has increased housing demand, leading to unplanned settlements and higher density in planned areas (Useni et al., 2018). The city faces challenges related to rapid urbanization, including incomplete building occupancy, electricity shortages, pollution, loss of green spaces, traffic congestion, and inadequate sewer systems. Public service deficiencies and land

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control issues exacerbate these problems (Groupe Huit, 2009).

Historically, Lubumbashi was the capital of the short-lived State of Katanga (1960–1963) under Moïse Tshombe and later of the Katanga province until 2015, when it became the capital of Upper Katanga. Efforts to modernize the city since the establishment of provincial institutions in 2006 and 2015 have been slow, focusing primarily on planned neighborhoods, while marginalized areas lack adequate state services. Despite its rich history and rapid population growth, Lubumbashi's identity remains tied to its colonial past and mining activities. As a city governed by both a mayor and the provincial administration, Lubumbashi manages local governance, infrastructure development, and regional policy implementation, facing challenges in balancing the city's needs with provincial interests.

This study aims to analyze Lubumbashi's recent urban expansion and associated challenges through a desktop survey, contributing to the literature on urbanization, economic development, environmental sustainability, and resource extraction in sub-Saharan Africa. It examines how Lubumbashi's socio-ecological challenges, driven by rapid urbanization and mining growth, shape the city's landscape, infrastructure,

and social dynamics. The study proposes theoretical frameworks such as “resource urbanism,” which explores how resource-rich cities develop in response to natural resource extraction and how this influences urban form and socio-economic conditions (Rode et al., 2020; Agudelo-Vera et al., 2011). The city's growth and economic significance are well-documented, highlighting its role in the mining industry and global mineral supply chain. The rapid population increase and resultant urban pressures reflect challenges related to infrastructure and public services. However, there is a gap in comprehensive analyses of Lubumbashi's urban expansion and its interaction with socio-economic and environmental factors. Existing studies often address specific aspects of urbanization or mining impacts but lack a holistic view of the city's development. Furthermore, there is a deficiency in theoretical frameworks, like “resource urbanism,” that explain how cities like Lubumbashi evolve in response to resource extraction and how this affects urban form and socio-economic conditions (Rhode et al., 2020; Agudelo-Vera et al., 2011).

This study aims to fill these gaps by providing a detailed analysis of Lubumbashi's urban expansion and associated challenges. By using a

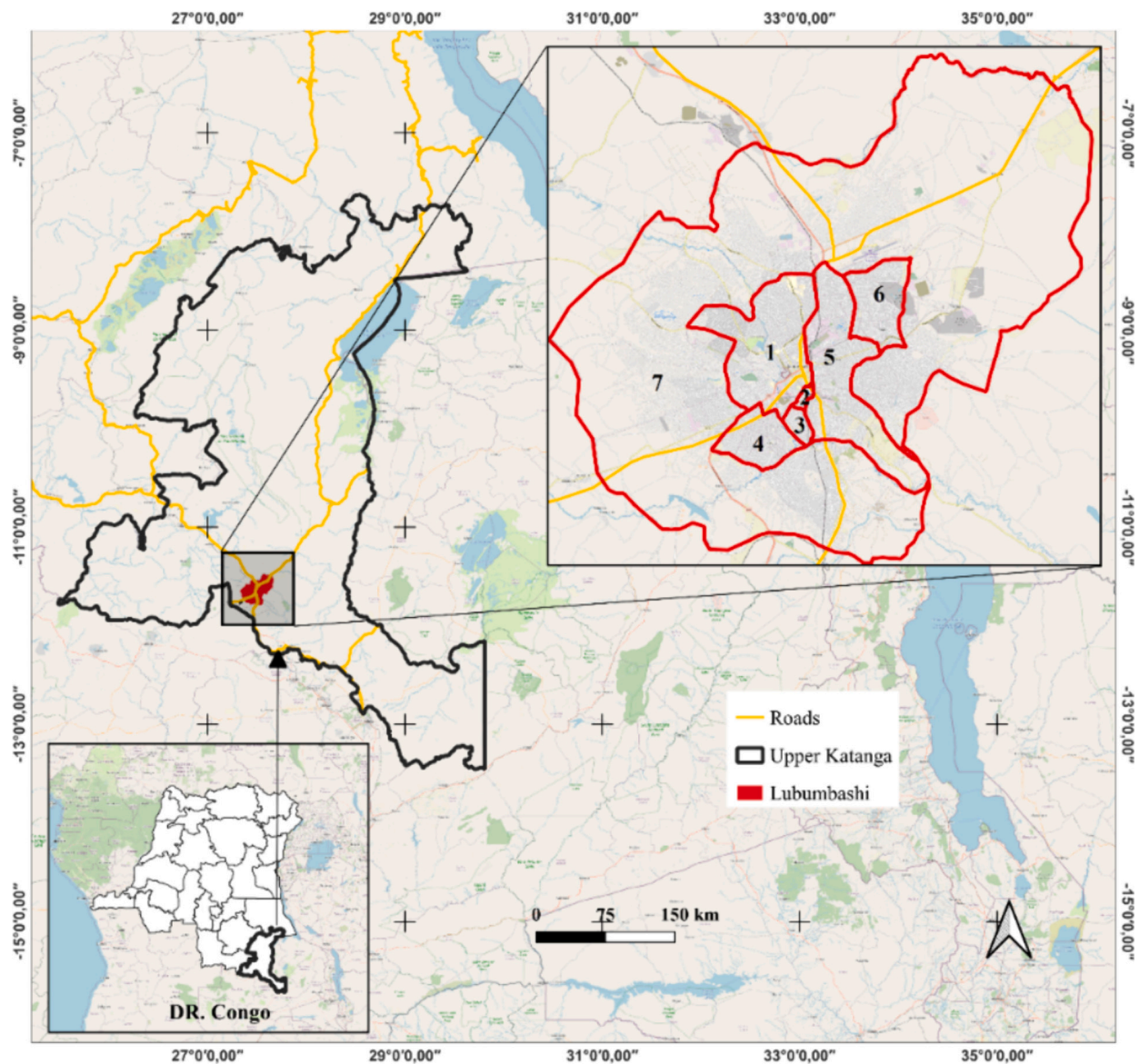


Fig. 1. Geographic location and administrative divisions of Lubumbashi city in Upper Katanga province, Southeastern Democratic Republic of the Congo. Lubumbashi is characterized by its extensive administrative structure. It encompasses over 80 districts distributed across 7 municipalities, spanning a total area of 747 km². These municipalities include Lubumbashi (1), Kamalondo (2), Kenya (3), Katuba (4), Kampemba (5), Ruashi (6), and Annexe (7).

desktop survey, it integrates insights on urbanization, economic development, and environmental sustainability and proposes theoretical frameworks like “resource urbanism” to understand the unique characteristics of resource-rich urban centers. The research seeks to enrich discussions on African urbanization, address socio-economic stratification, and propose strategies for sustainable urban development in resource-dependent cities. Resource urbanism helps understand the challenges of cities influenced by resource extraction, including impacts on urbanization patterns, economic opportunities, and environmental conditions (Colsaet et al., 2018; Henderson, 2004). The study explores the nexus between mining activities and urban development in Lubumbashi by examining: (i) the impact of mining on physical and spatial development; (ii) influences on population dynamics; (iii) ecological consequences like pollution and land degradation; (iv) socio-economic factors including wealth distribution and access to services; and (v) unique urbanization patterns. Previous research highlights both the benefits and challenges of resource extraction, such as inequality and environmental degradation. This study aims to integrate urban and environmental sciences, offering new insights into Lubumbashi’s urban evolution and proposing strategies for sustainable development.

2. Methodology

This study utilizes a desktop survey methodology to analyze the contemporary urban evolution of Lubumbashi. The desktop survey involves the systematic review and synthesis of existing literature, reports, policy documents, and data related to urbanization, economic development, environmental sustainability, and resource extraction in Lubumbashi and sub-Saharan Africa. Key sources include academic journals, government publications, and reports from international organizations. These sources provide a comprehensive overview of the city’s historical context, socio-economic dynamics, and environmental challenges. The data gathered covers various aspects, such as demographic trends, land use changes, infrastructure development, and environmental impact assessments.

To understand the rapid and unregulated population growth, the survey examines census data and urban demographic studies. These sources highlight the migration patterns, population density, and the socio-economic factors driving urban expansion. Additionally, land cover changes maps of the city were reviewed to analyze the spatial development of the city, identifying areas of planned and unplanned growth.

The mining sector’s influence on Lubumbashi’s economy and urban landscape is assessed through industry reports, economic analyses, and case studies of mining activities. These documents provide insights into the economic benefits and environmental costs associated with resource extraction, contributing to the theoretical framework of “resource urbanism.”

Environmental sustainability is explored by reviewing environmental impact assessments, ecological studies, and sustainability reports. These sources discuss the degradation of natural vegetation, pollution levels, and the impact of urban expansion on local ecosystems. Reports from NGOs and environmental organizations offer additional perspectives on conservation efforts and sustainability initiatives.

Policy documents and government reports are analyzed to understand the regulatory framework governing urban development. These documents reveal gaps in land governance, infrastructure planning, and public service provision. Evaluations of past and current urban planning efforts provide context for the challenges faced by local authorities.

Finally, the survey incorporates perspectives from community stakeholders through secondary sources, including news articles, community reports, and social media analysis. These sources provide a grassroots view of urban issues, highlighting the lived experiences of Lubumbashi’s residents and their responses to urban challenges. This comprehensive desktop survey forms the basis for analyzing Lubumbashi’s urban evolution and the implications for sustainable development.

3. Site presentation

3.1. Historical urban development

Lubumbashi’s Odyssey: from colonial outpost to economic hub.

Lubumbashi, formerly known as Elisabethville from 1910 to 1966, has undergone significant and rapid expansion attributed to its dual role as a prominent mining center, exploiting abundant copper and cobalt deposits, and a pivotal transportation hub due to its strategic geographical positioning. Its contemporary resurgence can be attributed to historical events such as the nationalization of the mining sector in the late 19th century followed by its subsequent liberalization in the early 20th century.

Preceding European colonization, indigenous peoples inhabited the region, although documentation of this period is limited. Situated in the southeastern expanse of the DRC between coordinates 11°27′–11°47′S and 27°19′–27°40′E, Lubumbashi’s narrative unfolds with historical significance, as highlighted by Rémon & Nkuku (2006) and UN Habitat (2014). As the second most populous city in the DRC after Kinshasa, Lubumbashi’s story intricately weaves together historical nuances, economic transformations, and global implications. Before Belgian colonization, the Lubumbashi region, formerly part of the Lunda Kingdom, was inhabited by various ethnic groups, including the Luba, Lunda, Songye, Hemba, and Tetela. The copper croisettes (Fig. 2), integrated into the city’s emblem, were valuable objects used in regional trade (Rademkers et al., 2019). The city’s inception traces back to the late 19th century amid European imperial ventures across Africa for untapped resources (Anonymous, 1961). Lubumbashi emerged as a pivotal player in this colonial narrative, with its formal establishment in 1900 through the Comité Spécial du Katanga (CSK). This laid the groundwork for transformative developments (Fig. 3), leading to the establishment of Elisabethville in 1910 after the creation of the Union Minière du Haut-Katanga (UMHK) in 1906, marking Belgium’s expansion into the Katangese territory (Bruneau & Pain, 1990). Despite its economic origins prioritizing resource extraction over local welfare during King Leopold II’s era, Lubumbashi’s colonial past reached its zenith with the construction of the Benguela railway (Fig. 4). This railway link to the Atlantic Ocean solidified Lubumbashi’s position as a crucial node in the global economic network, yielding numerous benefits domestically and regionally, enhancing trade, investment flows, economic growth, and job creation while promoting political and economic integration with neighboring countries like Zambia and Angola. Due to its strategic geographical location, Lubumbashi emerged as a central hub for the Congo’s railway network, facilitating the movement of goods and people across the region. Its well-developed rail infrastructure positioned it as a vital point for trade and connectivity within the country. As the mining industry burgeoned, Lubumbashi witnessed rapid urban expansion, evolving into a multicultural melting pot. However, rigid racial segregation imposed by colonial authorities led to spatial divisions within Lubumbashi’s urban fabric.

Between 1910 and 1927, Lubumbashi experienced significant development, characterized by the establishment of acclimatization camps for UMHK recruits and workers. The European city, embellished with green spaces like the zoological garden and the arboretum de l’Etoile, contrasted sharply with the emerging “indigenous cities” (Dibwe, 2002). Post-1945, Elisabethville grappled with a housing crisis due to substantial African labor immigration, resulting in the creation of indigenous cities (Fig. 5)—Kamalondo and Kenya in 1929, and Katuba and Ruashi from 1954—according to the Grevisse system, as documented by Chapelier (1957).

The historical evolution of Lubumbashi underscores the city’s intricate socio-economic dynamics, shaped by colonial legacies, urban development policies, and demographic shifts. Exploring Lubumbashi’s history unveils not only past struggles and achievements but also a lasting legacy that continues to influence the contemporary urban landscape.



Fig. 2. Diverse copper croissettes types manufactured in the Copperbelt and employed in northern Copperbelt regions from the 9th to the 19th centuries (left; Rademakers et al., 2019). Source: N. Nikis, 2018. The emblem of Lubumbashi: the letter L adorned with three copper croissettes (right).



Fig. 3. Historical photograph contrasting work conditions at the Mine de l'Étoile (Left) and urban development for indigenous workers in Lubumbashi region, as documented by Union Minière du Haut Katanga (1956).



Fig. 4. Arrival of the railway in Lubumbashi. The exploitation of copper began in 1910 in Lubumbashi soon after a railway was established, connecting the city to the Southern African network, thereby allowing the transportation of copper to the ports of South Africa (East London, Port Elizabeth).

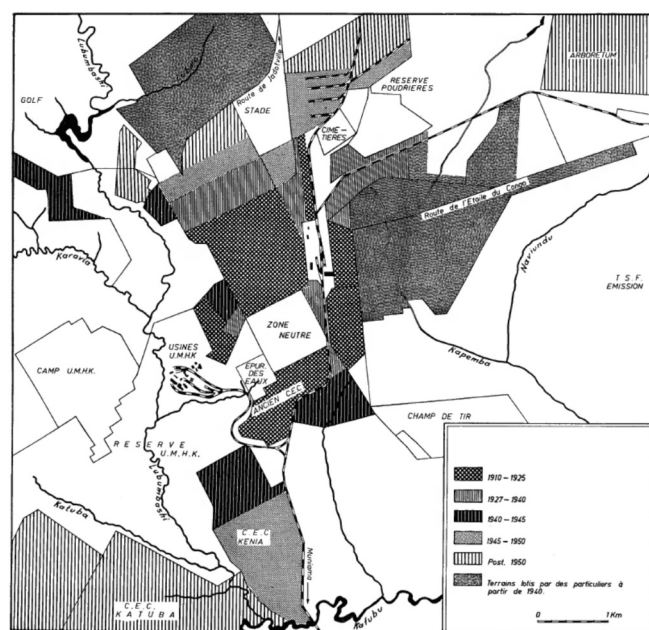


Fig. 5. Chronological evolution of Elisabethville (1910–1955): insights from the map by Chapelier (1957).

Post-independence challenges and opportunities.

This section explores Lubumbashi's trajectory post-independence, highlighting its pivotal role within the DR Congo. The city's metamorphosis amidst political turbulence and economic challenges reflects broader national narratives, shaping its identity and leaving a lasting

legacy. A nuanced understanding of Lubumbashi's history is imperative for navigating the complexities of the DRC's socio-economic landscape. Following its declaration of independence from Belgian rule on June 30,

1960, Lubumbashi entered a period of profound political flux, mirroring the broader challenges confronting the DRC (Rémon & Nkuku, 2006; Rich, 2019). The initial post-independence era witnessed intricate political maneuvers, secession attempts, and external interventions, significantly impacting Lubumbashi politically and economically (Dibwe, 2002). As the primary economic hub of the region, the city bore witness to violent clashes and political turmoil during the Katangese secession period (1960–1963). This instability hampered mining and commercial activities, resulting in considerable economic and social disruptions. Furthermore, the political divisions exacerbated ethnic and social tensions within the populace. Nonetheless, the post-colonial era witnessed deliberate efforts to reshape Lubumbashi's urban identity, epitomized by the renaming of Élisabethville to Lubumbashi in 1966. This symbolic gesture marked a conscious departure from colonial nomenclature, aligning with broader endeavors to assert a distinct Congolese identity (Rosoux, 2014). Consequently, the city's cultural and social fabric underwent redefinition, fostering a sense of unity and shared national identity while honoring the influential leader Patrice Lumumba. During this period, the city experienced rapid expansion, absorbing most of the peripheral villages along its trajectory (Fig. 6).

During the country's renaming to Zaïre (1971–1997), the Congolese government strategically pursued nationalization, particularly within the crucial mining sector, resulting in the establishment of la Générale des Carrières et des Mines (Gécamines) under President Mobutu Sese Seko's rule. This state-owned enterprise became the largest employer in Lubumbashi, employing 33,000 individuals in the 1980s. However, its subsequent decline, accelerated from the 1990s, was attributed to fluctuating copper prices, mismanagement, and decreased production due to inadequate investments in facilities. Indeed, the policy of nationalization and Zairianization in the DRC, initiated by President Mobutu in the 1970s, aimed to transfer control of key enterprises and resources from foreign entities to Congolese citizens to promote economic independence and national sovereignty. However, it also led to managerial

issues and economic inefficiencies. This transformative measure left a lasting impact on Lubumbashi's economic trajectory, initiating processes that would shape the city's economic direction for years to come (Houyoux & Lecoanet, 1975). Numerous companies were expropriated or compelled to cede a portion of their shares to Zairian citizens, resulting in significant disruptions in the city's economic sector, impacting foreign investments and the confidence of international businesses. Foreign companies had to adapt to new regulations and commercial conditions, sometimes resulting in reduced activities or complete withdrawal from the region. The reorganization of ownership and economic policies ushered in a period of uncertainty and adaptation for Lubumbashi's residents and businesses. Despite the challenges posed by political turmoil and the push for nationalization, Lubumbashi demonstrated remarkable resilience, with its mining sector emerging as a cornerstone of economic sustenance. The city's entrepreneurial vigor played a central role in navigating the complexities of the post-independence era, positioning Lubumbashi as a significant player in the global mining market and solidifying its reputation as the mining capital of the DRC (Kilondo, 2010). In response to the obstacles presented by political instability and the imperative for economic diversification, Lubumbashi embarked on a journey of economic diversification, aiming to reduce its reliance on a single industry. Commerce, services, and education emerged as complementary pillars alongside the mining sector, shaping a more diversified economic landscape. The proliferation of educational institutions not only bolstered economic resilience but also positioned Lubumbashi as an intellectual and cultural center, enriching the city's overall vitality (Dibwe, 2012).

The period from 1990 to 1997, marked by the democratization of the country, was characterized by major political and economic upheavals in Lubumbashi. Following the end of Mobutu's rule, protest movements and democratic demands emerged in the city, reflecting the social and political changes on a national scale. Concurrently, the deterioration of

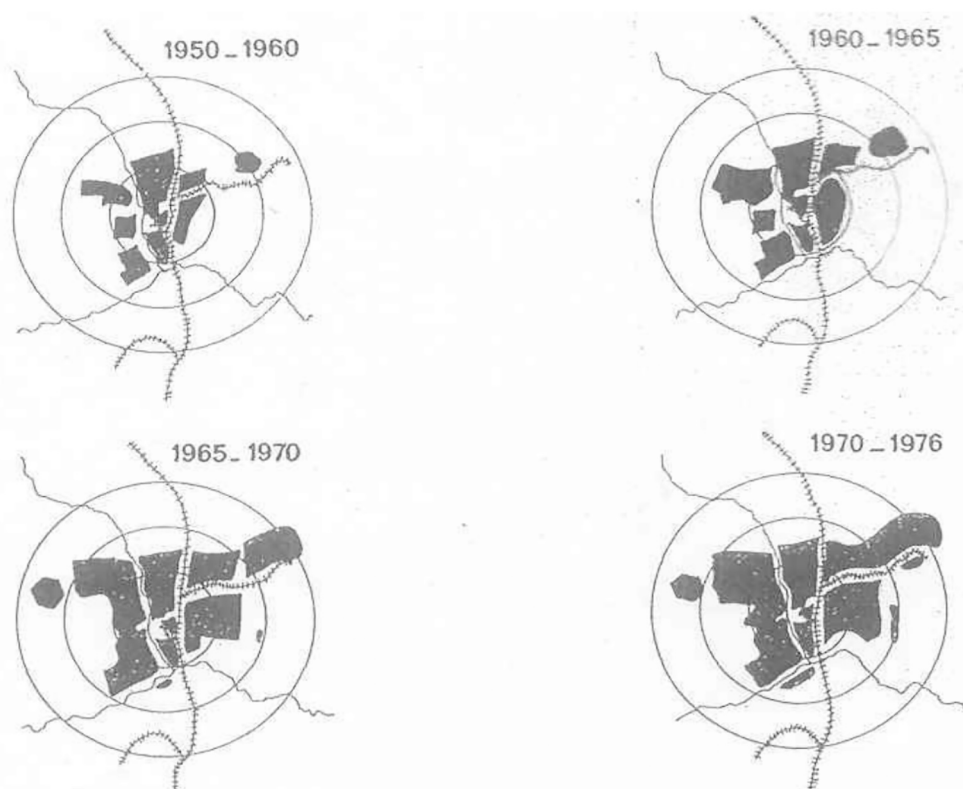


Fig. 6. Growth of the urban area (in black) of Lubumbashi between 1950 and 1976 (Leblanc & Malaisse, 1978). The three concentric circles are respectively located at distances of 3, 6, and 9 km from the city center (*Place de la Poste*). A road network and a railway crosses the city from north to south and from east to west.

infrastructure and public services exacerbated the daily challenges faced by residents. Economically, the crisis led to a decline in the mining industry, once the cornerstone of Lubumbashi's economy. These years laid the groundwork for a tumultuous political transition and significant economic changes in the region. Throughout political transitions, economic shifts, and social transformations, Lubumbashi experienced profound changes in its social fabric and urban landscape during the post-independence era. Efforts were made to address historical inequalities and promote a more inclusive urban environment as the city navigated the multifaceted challenges and opportunities of its evolving post-independence history (Bruneau & Pain, 1990; Leblanc & Malaisse, 1978). In essence, Lubumbashi's journey from colonialism to independence, its economic resilience amidst nationalization policies, and its efforts toward urban development and cultural redefinition underscore the city's significance within the broader narrative of the DRC. These historical trajectories not only shape Lubumbashi's identity but also contribute to its enduring legacy as a pivotal city in the heart of Africa.

Contemporary landscape and global connections.

Lubumbashi, the pulsating heart of the DRC, epitomizes the confluence of historical legacy and contemporary dynamism. From its colonial heritage to its pivotal role in global mining, Lubumbashi's narrative interweaves economic resilience, cultural diversity, and political dynamics. This segment elucidates Lubumbashi's trajectory, accentuating its significance in shaping regional and global landscapes. The inception of the DRC in May 1997 heralded a new developmental phase for Lubumbashi. In the unfolding narrative of the 21st century, Lubumbashi stands at the nexus of historical legacy and modernity. This thriving urban center, grappling with imbalances inherited from the colonial era, embarks on a journey to harmonize economic progress with social equity (Useni et al., 2018). At its core, Lubumbashi is a city molded by historical legacies and contemporary dynamics—an interplay that delineates its trajectory. The reverberations of the colonial past persist, presenting enduring challenges necessitating resolution (Lagae, 2008). The city's landscape, characterized by economic resilience, cultural diversity, and an emerging global presence, unfolds as a captivating narrative.

Economically, Lubumbashi's mining sector emerges as a vibrant thread, intricately weaving prosperity and distinction into the city's tapestry. Designated as the "mining capital" of the DRC, Lubumbashi's strategic location in the resource-rich Katanga region solidifies its pivotal role in global copper and cobalt production. The liberalization of the mining sector in 2002 attracts international corporations, positioning Lubumbashi as a vital hub for mineral extraction, processing, and exportation on a global scale (Rémon & Nkuku, 2006). The Five Pillars of the DRC project, inaugurated by President Joseph Kabila in 2006, aimed to catalyze the socio-economic development of the country. In Lubumbashi, this initiative encompassed significant endeavors such as the rehabilitation of road infrastructure, construction and modernization of educational and healthcare facilities, enhancement of access to clean water and electricity, as well as endeavors to promote employment and entrepreneurship. While these initiatives yielded considerable advancements in certain domains, their implementation encountered logistical, financial, and political impediments, thereby constraining their full impact in Lubumbashi.

Nonetheless, since its centennial celebrations in 2010, Lubumbashi has experienced a renaissance, with the revitalization of mining activities attracting new investors across both industrial and service sectors. This surge has culminated in a tenfold increase in the province's revenues, contributing nearly 50 % to the country's GDP. The provincial budget escalated from \$113 million in 2007 to \$658 million in 2012, facilitating infrastructural upgrades in Katanga, particularly in Lubumbashi, which serves as the headquarters for almost all mining companies in the region. Beyond mining, Lubumbashi strategically diversifies its economic horizons, embracing expansion into commerce, services, and education (Dibwe, 2012; Kilondo, 2010). This deliberate pivot underscores Lubumbashi's commitment to economic resilience,

transforming it into a multifaceted economic hub adept at navigating the complexities of the global economic landscape.

Culturally, Lubumbashi emerges as a melting pot where ethnicities, languages, and traditions converge to forge a distinctive and vibrant social fabric. Cultural institutions and festivals enrich Lubumbashi's local identity, projecting it onto the global stage (Fig. 7). Events like the Lubumbashi Biennale garner international acclaim, fostering global collaboration (Dolff-Bonekämper et al., 2014). The celebration of the "Mangeurs de cuivre" at Gécamines, an iconic tradition, reflects local pride in the mining industry and prompts reflection on Lubumbashi's economic future (Jewsiewicki, 2010). Boasting a rich tradition of craftsmanship, Lubumbashi harbors a plethora of skilled artisans specializing in the creation of captivating paintings and monuments through the meticulous process of copper beating. Passed down through generations, this revered art form transcends formal training, with expertise transmitted from father to son. Delve into the cultural heritage and artistic legacy of this time-honored craft at the exhibition, where each piece narrates a tale of tradition, skill, and creativity (Fig. 8). Additionally, the Lubumbashi slag heap, a byproduct of mining activity, symbolizes the urban landscape, evoking the mining legacy and environmental repercussions while offering a haven for natural rejuvenation (Fig. 9).

The Lubumbashi International Airport assumes paramount significance in regional and international connectivity (Fig. 10). Its evolution mirrors economic dynamics and shifts in the transportation sector. Enhanced national and international connections foster local economic development, catalyzing tourism, trade, foreign investments, and cultural exchanges. Lubumbashi's global reach transcends cultural dimensions, permeating economic and diplomatic realms. The city emerges as a magnet for international investments, facilitating infrastructure development, technological advancements, and job creation (Ngoie, 2018). Diplomatically, Lubumbashi actively engages with international partners, forging collaborations that position it as a pivotal player in global economic and diplomatic spheres (Fig. 11).

The partitioning of Katanga province into four new provinces in 2015 wrought significant repercussions on Lubumbashi. The establishment of these new administrative entities precipitated a political, economic, and social reconfiguration of the region. As the erstwhile capital of Katanga province, Lubumbashi relinquished some of its political and economic sway to the newfound provincial capitals. The transition to this novel administrative framework was fraught with challenges and adaptations for the city. The electoral cycles of 2006, 2011, 2018, and 2023 in the DRC exerted substantial influence on Lubumbashi. These junctures were punctuated by political tensions and protests, engendering social and economic disruptions in the city. While elections in Lubumbashi sparked aspirations for political transformation and improved governance, contested outcomes and post-electoral strife occasionally led to instability, impacting investment and economic progress. Lubumbashi's narrative is a blend of historical significance, economic resilience, and cultural richness, positioning it as a dynamic urban center poised to influence the future trajectory of the DRC and have a global impact.

3.2. Planning and urban development: do-it-yourself and wait-and-see approach

In 1950, Lubumbashi was home to a modest population of 96,000 inhabitants, a stark contrast to the bustling metropolis it has evolved into by 2020, accommodating nearly 2.5 million people (see Table 1). Across this transformative century, the cityscape underwent a profound metamorphosis, expanding in response to exponential population growth (Useni et al., 2017). A nuanced narrative emerges as we delve into Lubumbashi's demographic evolution. Fluctuating household sizes, ranging from 6 in 1973 to 6.8 in 1985 and further to 7.5 in 2000, not only reflect statistical variations but also mirror the pulse of population densification, evident in the urban fabric of certain neighborhoods



Fig. 7. Composed of two concepts, “toxic” and “city,” the Lubumbashi Biennale 2022 reflected on the connection between contemporary life in the postcolonial urban setting of Lubumbashi, and more broadly in the global South. It explored the impact of various industrial, economic, ecological, social, and cultural processes that have historically shaped, for better or worse, the form and dynamics of urban life in this region and other parts of the world nowadays (Source: Authors).



Fig. 8. Exhibition of artworks at a market in the city of Lubumbashi. The region is home to numerous artists whose crafts involves smelting copper to create decorative paintings or monuments. Due to a lack of formal training, the art of copper beating is passed down from father to son (<https://arts.cd/haut-katanga-le-marche-des-arts-de-lubumbashi-dans-le-tourment/> accessed on 13.01.2024).

(Petit, 2000). Lubumbashi’s urban sprawl now encompasses over 80 districts across 7 municipalities, sprawling over 747 km², with each district bearing the imprint of the city’s rich history and socio-economic intricacies (Rémon & Nkuku, 2006).

The origins of Lubumbashi’s urban planning can be traced back to its colonial past, where economic imperatives linked to mineral extraction shaped the city’s initial layout. The echoes of Belgian colonial rule resonate in spatial divisions and architectural aesthetics, which continue to influence contemporary urban challenges (see Fig. 12). Spatial inequalities persist as a legacy, even as post-independence initiatives strive to foster an inclusive urban identity (Lagae, 2008). The 1960s ushered in a new vision for urban development, aiming to expand residential, commercial, and industrial areas to redress colonial spatial inequities. However, challenges persisted, reflecting the complexities inherent in periods of rapid growth (Leblanc & Malaisse, 1978).

Lubumbashi’s identity as a mining hub, shaped by global demands, deeply influenced urban planning strategies. The Master Plan of 2000 envisioned Lubumbashi’s trajectory, yet challenges such as influxes of war-displaced individuals and a shortage of housing impeded its full implementation (Groupe Huit, 2009), leaving the city’s future uncertain (see Fig. 13).

Lubumbashi’s architectural landscape serves as a testament to its historical trajectory, economic prominence, and a narrative interwoven with threads of national identity, colonial legacies, and global aspirations. The architectural heritage of the colonial era stands as a landmark, grounding residents in the city’s historical identity (Boonen & Lagae, 2015; Lagae, 2008). Post-independence, a quest for a distinct architectural identity emerged, blending modernity with tradition (see Fig. 14). Lubumbashi, attracting international investments, assimilates global architectural influences, erecting state-of-the-art facilities. The



Fig. 9. The Lubumbashi slag heap, a result of mining activity, and the iconic chimney are key elements of the urban landscape. They recall the mining history of the region and bear witness to environmental challenges (Source: Authors).

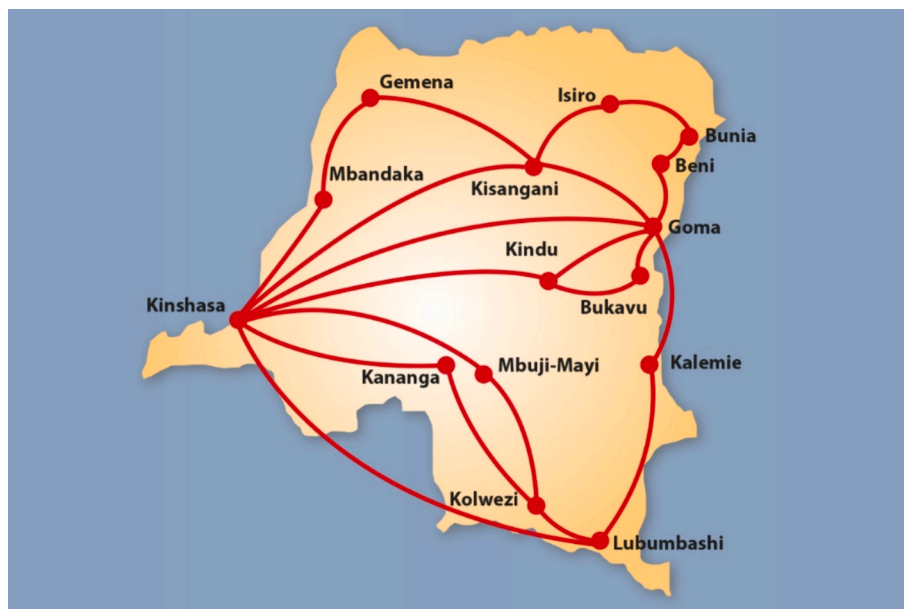


Fig. 10. Connexion of Lubumbashi to other important cities in the DRC (Source: Compagnie africaine d'aviation).

challenge lies in harmonizing these global influences with the preservation of local identity. As Lubumbashi charts its course forward, the preservation of architectural heritage, integration of sustainable practices, and cultivation of a distinctive identity within the global context will shape its future narratives. The architectural tapestry serves as a living testament to Lubumbashi's capacity to reconcile diverse influences, ensuring its evolving story resonates uniquely within the broader tapestry of global urban narratives.

Lubumbashi's journey from a modest colonial outpost to a vibrant urban center, deeply intertwined with mining and global economic dynamics, underscores the city's resilience and adaptability. Its demographic, spatial, and architectural transformations not only mirror its historical trajectory but also signify its ongoing pursuit of sustainable growth and cultural preservation. By acknowledging Lubumbashi's history, addressing contemporary challenges, and envisioning future prospects, stakeholders can collaboratively shape a more equitable,

prosperous, and culturally enriched urban landscape. This endeavor transcends local benefits to position Lubumbashi as a beacon within the broader global urban discourse.

4. Challenges ahead

Lubumbashi's recent rapid ascent poses significant challenges. First, the intricacies of land governance in Lubumbashi are deeply rooted in historical colonial spatial divisions, compounded by the accelerating pace of urbanization driven primarily by the mining sector. This phenomenon engenders competing land uses that necessitate astute management strategies (Groupe Huit, 2009). However, the absence of transparent land tenure systems poses formidable obstacles to equitable governance, precipitating disputes, encumbrances on property rights, and spatial disparities (Mushinge, 2020). Moreover, endemic corruption within the governance framework further complicates these challenges,



Fig. 11. At a square near the city center, a poster announcing the arrival of the Belgian royal couple in Lubumbashi in June 2022 (Source: The université de Lubumbashi Press).

Table 1
Population statistics (in thousands) for the five largest cities in the DR Congo from 1950 to 2020, along with the total population of the DR Congo over the 70-year period.

City/country	Year							
	1950	1960	1970	1980	1990	2000	2010	2020
Kananga	24	136	424	330	348	533	846	1293
Kinshasa	202	443	1070	2050	3520	5414	8415	12,322
Kisangani	38	134	235	291	358	516	783	1192
Lubumbashi	96	194	325	482	647	960	1496	2242
Mbuji Mayi	70	139	262	407	573	891	1433	2172
DR Congo	12,184	15,368	20,267	27,019	36,406	49,626	65,966	85,054

thwarting Lubumbashi’s aspirations for sustainable development amidst its rapid expansion (Fig. 15). Despite uncoordinated grassroots initiatives and community-led efforts to address urban challenges independently or through local networks, there are delayed responses to infrastructure development or land governance reforms until external pressures or crises force action. These issues mirror trends observed in other swiftly urbanizing cities within the DRC and globally. Metropolitan centers like Kinshasa in DRC grapple with analogous challenges in overseeing urban growth and harmonizing land utilization. Lubumbashi’s pivotal role in the global copper and cobalt supply chain introduces an additional layer of complexity to its land governance conundrum. Its economic significance attracts both investment and migration, intensifying pressure on land resources and exacerbating governance deficiencies. To effectively address these challenges, a comprehensive and inclusive approach is essential. Implementing transparent land tenure systems that clearly define property rights and land use regulations fosters equitable governance through accessible land registration, mapping, and adjudication. This foundation enables local communities, stakeholders, and civil society to engage in decision-making processes about land use and urban development, aligning with residents’ needs and enhancing community resilience. Robust anti-corruption measures within the governance framework promote transparency,

accountability, and integrity in land management, reducing malfeasance and improving outcomes. Integrated urban planning strategies prioritize equitable access to services, green spaces, and infrastructure, addressing socio-spatial disparities and environmental concerns through thoughtful zoning regulations and resource allocation. Supporting these efforts, investing in capacity building and institutional strengthening for local authorities in land management, urban planning, and governance enhances decision-making through training programs, knowledge-sharing platforms, and technical assistance.

Second, the ramifications of vegetation depletion in Lubumbashi necessitate a nuanced examination of the intricate equilibrium between accommodating population growth and conserving the city’s natural heritage. Rapid urbanization has precipitated the relentless degradation of natural vegetation, exacerbated by inadequate planning strategies that fuel unplanned urban sprawl, thereby exacerbating this ecological challenge (Fig. 16). Lubumbashi’s position within national and international contexts amplifies these concerns, as similar patterns of rapid urbanization and environmental degradation manifest in other cities across the Global South. These observations underscore common challenges stemming from urbanization while also revealing unique characteristics influenced by local geography, politics, and socio-economic factors. Limited environmental consciousness further complicates the



Fig. 12. Comparative analysis of urban development: evolution of building densification in a colonial planned neighborhood (top) versus leapfrog urbanization in a suburban area (bottom). Source: Google Earth 2023.

issue, necessitating a comprehensive, evidence-based approach to sustainable urban planning that aligns with Lubumbashi's natural legacy. In some few cases, there are do-it-yourself initiatives, such as community-led reforestation efforts or local conservation projects, that contribute positively to mitigating vegetation depletion and promoting environmental awareness at the grassroots level. However, without broader policy frameworks and institutional support, these efforts may remain limited in their impact and scalability. In the broader international context, Lubumbashi's predicaments resonate with global deliberations on sustainable development and natural resource conservation. The city's struggles epitomize broader trends in urbanization and environmental degradation observed worldwide, emphasizing the interdependence of local actions with global phenomena such as biodiversity loss. To reverse this trend, it is imperative to enact zoning regulations that safeguard natural vegetation and encourage the development of green spaces while minimizing infrastructure projects' environmental impact. Engaging local communities through awareness campaigns, educational initiatives, and participatory decision-making processes fosters environmental consciousness, promotes sustainable behaviors, and strengthens community resilience against ecological challenges. Overcoming constraints of limited financial resources and expertise requires establishing robust partnerships with environmental organizations, academic institutions, and government agencies. These partnerships leverage expertise, resources, and funding for conservation efforts, facilitating initiatives such as reforestation projects, biodiversity conservation programs, and habitat restoration. Stringent environmental regulations and policies governing land use, deforestation, and ecosystem protection must be rigorously enforced, including incentivizing sustainable practices, penalizing environmental violations, and advocating responsible resource management for long-term sustainability and community well-being.

Third, the demand for electrical energy in Lubumbashi is steadily increasing, driven primarily by the mining industry and urban growth. However, the supply struggles to keep pace, leading to frequent shortages and power outages (Kabulu et al., 2018). The deficiencies within the electricity infrastructure wield significant ramifications on daily life, industrial operations, and overall economic productivity, as evidenced by research conducted by Banza et al. (2016; Fig. 17). In unplanned neighborhoods where the National Electricity Company invests minimally and where most residents struggle to obtain electricity regularly, new approaches are emerging for the distribution and access to this energy resource. On one hand, the leaders and local agents of this company have developed various strategies to optimize the electrical grid and create additional sources of income. On the other hand, with often irregular electricity supply, it is common to observe power exchanges between neighbors. These exchanges allow many households not connected to the electrical grid, disconnected due to unpaid bills, or temporarily deprived of electricity during load shedding, to benefit from free electricity provided by their neighbors. These challenges transcend the city's boundaries, impacting businesses and households nationwide, reflecting systemic issues within the DRC's energy sector. Analogous infrastructural inadequacies prevail in urban centers across Sub-Saharan Africa, where rapid urbanization often surpasses infrastructure development. Compounded by the energy-intensive mining industry (Banza et al., 2018), Lubumbashi's infrastructure strains echo trends observed in resource-rich regions globally. The alignment of strategies with energy policies at the national level poses a significant obstacle, indicative of the common challenge faced by developing nations striving to harmonize economic growth with sustainable development goals. The reliance on charcoal during electricity load shedding parallels energy crises witnessed worldwide. Furthermore, the Congolese mining sector, particularly in Katanga, is grappling with an electricity deficit that hampers its expansion. Currently, the Katanga region imports 110 MW from Zambia, which it makes available to miners, yet this remains inadequate. In essence, Lubumbashi's electricity challenges signify not only local governance and infrastructure deficiencies but also broader regional and international trends in energy management and resource dependency. The rising demand for electrical energy in Lubumbashi necessitates implementing decentralized renewable energy systems, such as solar, wind, and mini-hydropower, to supplement the existing grid and reduce reliance on imported electricity. Developing and promoting energy efficiency programs across households, businesses, and industries is critical, involving retrofitting buildings with energy-efficient technologies, promoting energy-saving appliances, and implementing demand-side management practices. Engaging local communities in energy planning and decision-making is crucial, achievable by establishing community-based energy cooperatives to align energy solutions with local needs. Public-private partnerships are essential for investing in the modernization and expansion of electricity infrastructure. Diversifying energy sources, particularly in sectors like mining with high energy demand, is crucial to reduce dependency on a single source. Exploring alternative energy sources, such as bioenergy from agricultural waste, is one avenue. Investing in capacity building involves training and support for local authorities, energy providers, and community organizations to effectively implement and manage energy solutions, including technical training, knowledge sharing, and developing skills for maintaining and operating energy infrastructure.

Fourth, in the city of Lubumbashi, constant demands for housing have led to rapid and uncontrolled urban expansion, while urban management authorities fail to anticipate or rigorously manage urban zoning (Useni et al., 2020). Consequently, mining sites are juxtaposed with residential areas (Fig. 18). However, around these sites, soil pollution resulting from mining activities has led to the formation of barren areas with abnormally high concentrations of heavy metals, but their management is not properly implemented. In many neighborhoods adjacent to mining companies, local populations erect makeshift dwellings on the concession lands. Often, these constructions are carried

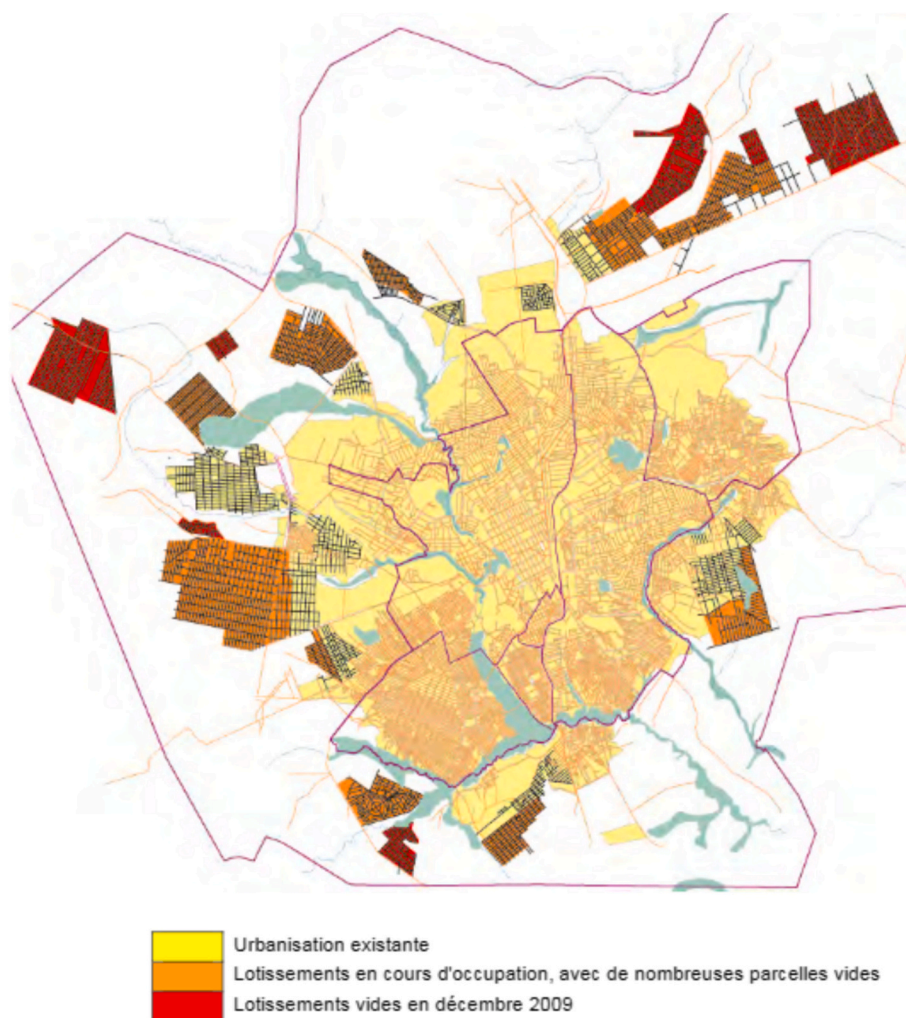


Fig. 13. Land use situation in the city of Lubumbashi in December 2009 (Groupe Huit, 2009). In yellow, existing urbanization, while orange colour indicates subdivisions in the process of being urbanized, with several empty plots still observed. In red, subdivisions created but not urbanized. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

out with the complicity of certain public service agents, in the hope of obtaining financial compensation during relocation operations. Unfortunately, these operations frequently end in cases of embezzlement or underpayment of the promised compensations. Additionally, some communities exploit the rubble present in the mining waste heaps to produce construction materials such as gravel or rubble for their own projects. While this practice is economically beneficial in the short term, it exposes these populations to increased risks of contamination by toxic metals present in the mining waste. The environmental ramifications of the city's mineral extraction industry extend far beyond its immediate vicinity, echoing global concerns regarding sustainability and ecological preservation (Fig. 19). Studies by Amisi et al. (2018) and Mwitwa et al. (2012) underscore the devastating effects of mining on local ecosystems, encompassing deforestation, loss of biodiversity, and habitat destruction. These issues transcend Lubumbashi's borders; cities worldwide encounter analogous challenges as they navigate resource extraction within fragile ecological contexts. However, Lubumbashi's role as a pivotal player in the global copper and cobalt trade magnifies the gravity of these challenges, attracting international attention to the urgent need for sustainable mining practices. Comparative analyses further illuminate Lubumbashi's environmental plight. For instance, research comparing soil compositions between Lubumbashi and Sudbury reveals stark disparities, with Lubumbashi exhibiting alarmingly high levels of copper, cobalt, and zinc (Narendrula et al., 2012). These

findings underscore the severity of environmental pollution in Lubumbashi and accentuate the city's unique challenges in managing its resource-rich yet environmentally vulnerable landscape. While other mining regions may encounter similar issues, Lubumbashi's classification as one of the world's ten most contaminated areas serves as a stark reminder of the imperative for concerted action to mitigate environmental degradation and safeguard public health (Banza et al., 2009). Implementing solutions for sustainable urban development and mining practices involves a structured approach. Rigorous urban zoning is necessary to establish buffer zones, mitigate soil pollution, and create safer living environments. Enforcing sustainable mining practices through stringent environmental regulations, regular monitoring, and adopting cleaner technologies reduces heavy metal contamination. Utilizing phytoremediation techniques to leverage plants for absorbing heavy metals and restoring polluted soils is an effective strategy. Engaging local communities, stakeholders, and civil society organizations in these efforts is essential. Collaborative partnerships with environmental NGOs and international entities can provide expertise and funding support. Reducing environmental impact also requires pollution control measures, such as upgrading industrial waste management systems and conducting regular health screenings for populations exposed to environmental toxins. Public health campaigns can raise awareness about the risks of living near mining sites, enhancing community understanding and response.



Fig. 14. Colonial architectural style for the construction of a church in the city center (bottom of the photo). Behind the church stands the modern glass-covered building of the governorate of the Haut-Katanga province, a symbol of modernization (top of the photo).

Fifth, Lubumbashi encapsulates the multifaceted challenges confronting numerous African cities in the 21st century. Its geographical location, both nationally and internationally, profoundly shapes its trajectory as it contends with issues ranging from road infrastructure deficiencies and traffic congestion to connectivity gaps (Fig. 20). These challenges not only impact public health and economic vitality but also resonate across regional and global networks. The historical reliance on road transport, stemming from colonial-era planning, underscores Lubumbashi's struggle with traffic congestion and road accidents (Banza & Ndjeko, 2016; Chenge et al., 2020; Kandolo et al., 2014), mirroring trends observed in other African urban centers. However, what distinguishes Lubumbashi is its pivotal role as a cross-border trade hub, particularly with neighboring countries. This dynamic adds complexity to its transportation challenges, as trade barriers and border inefficiencies exacerbate logistical hurdles and impede economic growth. Lubumbashi contends with the legacy of colonial infrastructure and rapid urbanization, which strain its transportation networks. The bottom-up privatization of public transportation, meaning the development of private transport services that are more expensive but less reliable than traditional public transit, impacts urban mobility. This bottom-up privatization leads to a fragmentation of transport services, with numerous small operators offering limited routes. This makes the transportation system less coherent and less convenient for users, often requiring them to use multiple modes of transport to reach their destinations. Furthermore, as cities rapidly expand, new neighborhoods develop on the periphery, sometimes far from existing public transport networks. Households moving to these areas become dependent on private cars for their daily commutes due to the lack of accessible and efficient transport alternatives. Consequently, private vehicle use increases in these situations, leading to issues such as road congestion, air quality deterioration, and negative impacts on the urban environment overall. Yet, its status as a regional trade nexus sets it apart from inland cities facing similar issues, such as Kinshasa in the DRC. Recognizing these nuances is essential for crafting tailored solutions that address Lubumbashi's specific needs while drawing insights from analogous

contexts. The shortage of adequate parking facilities in Lubumbashi underscores the interconnected nature of urban planning, economic activities, and transportation dynamics. Lubumbashi's challenges epitomize the complexities inherent in managing urban growth and development in the Global South. By acknowledging its connections to broader regional and international trends, stakeholders can pursue holistic solutions that address immediate transportation concerns while fostering sustainable economic development and bolstering the city's resilience in an increasingly interconnected world. Investing in capacity building for local authorities, transportation agencies, and community groups enhances their understanding of sustainable urban planning and transportation management. Public-private partnerships, alongside community engagement, play a pivotal role in facilitating this capacity building. Embracing innovative technologies and best practices in transportation management, such as adopting intelligent transportation systems and multimodal transport options, is essential. Developing and enforcing robust policy and regulatory frameworks promote sustainable transportation practices, address traffic congestion, improve road safety, and support economic activities. Key components include traffic management policies and incentives for adopting clean transport solutions. Public awareness campaigns and advocacy efforts educate the public about the benefits of sustainable transport, encouraging behavioral changes that reduce reliance on private vehicles and contribute to a more sustainable urban environment.

Finally, in Lubumbashi, the intricate interplay between rapid urbanization and sanitation underscores the city's significance within both national and international contexts. As one of the DRC's pivotal urban centers, Lubumbashi serves as a microcosm of broader trends observed across swiftly growing cities in Africa and beyond. The city's exponential expansion strains existing sanitation infrastructure and services (Mukemo et al., 2020), reflecting not only local demographic shifts but also global patterns of urban migration and development (Fig. 21). Like many urban areas in sub-Saharan Africa, Lubumbashi grapples with the challenges of informal settlements and inadequate waste management systems (Mukuku et al., 2018). However, its unique economic profile,



Fig. 15. Assessing the escalation of land prices and real estate trends in Lubumbashi: insights from La Guardia Magazine of 27 November 2022 (<https://magazine.laguardia.info/2022/11/27/lubumbashi-ruée-vers-le-secteur-de-limmobilier/#:~:text=A%20Lubumbashi%2C%20des%20villas%20de,l'ouest%20de%20la%20ville.>). According to the publication, the burgeoning involvement of politicians and expatriates in real estate, as a means of circumventing financial regulations, has led to a surge in land prices devoid of formal structure. This unregulated market dynamic has propelled prices upward, promising continued growth in Lubumbashi's real estate sector amidst sustained high demand.

primarily driven by mining and trade, sets it apart. This economic vibrancy brings both prosperity and specific challenges, such as the influx of imported manufactured goods, which further exacerbates issues related to waste management and environmental sustainability. Due to the persistent malfunctions of the public waste collection service, households are forced to find alternative solutions to manage their garbage. In many neighborhoods, residents identify informal sites where waste is temporarily stored. These sites, often located in unregulated areas, quickly become makeshift collection points, creating public health issues and environmental pollution. In response to this situation, informal entrepreneurship has emerged to fill the gap left by the failing public services. Individuals or small businesses now offer household waste collection services in exchange for a fee. Although this solution provides some relief to residents, the final destination of the collected waste often remains unknown. Frequently, this waste is merely relocated to other informal areas or illegally dumped, further exacerbating waste management problems. Moreover, recycling initiatives are still rare. Efforts to promote sorting and recycling within communities are hindered by a lack of awareness, resources, and adequate infrastructure. Recycling programs, when they do exist, are generally small-scale and struggle to expand significantly. As a result, most recyclable waste ends up in landfills or informal storage sites, worsening the waste crisis and its associated environmental impacts. Moreover, Lubumbashi's susceptibility to the impacts of climate change emphasizes its interconnectedness with broader global phenomena. The city faces the prospect of

more frequent extreme weather events and altered precipitation patterns, which can exacerbate existing sanitation challenges. The implications of climate change on water sources and availability resonate with broader discussions surrounding water security and resilience in urban areas, transcending local boundaries to intersect with global debates on environmental sustainability. The presence of informal waste collection and recycling practices, while addressing immediate needs, also underscores the city's adaptation to global economic forces. These practices, operating within a fragmented and unregulated framework, reflect not only local coping mechanisms but also broader dynamics of informal economies prevalent in urban areas across the Global South. Lubumbashi's experience encapsulates the intricate interplay between urbanization, economic development, and environmental sustainability within both national and international contexts. To address sanitation challenges in Lubumbashi inclusively, engaging local communities, stakeholders, and civil society organizations in decision-making processes about sanitation infrastructure development and waste management practices is crucial. Investing in capacity building for local authorities, sanitation agencies, and community groups enhances their understanding of sustainable sanitation principles and practices through training programs and workshops. Fostering collaborative partnerships between government agencies, private companies, and international organizations is vital for joint investment initiatives, knowledge exchange programs, and technology transfers. Embracing innovative technologies such as waste-to-energy solutions, decentralized sanitation

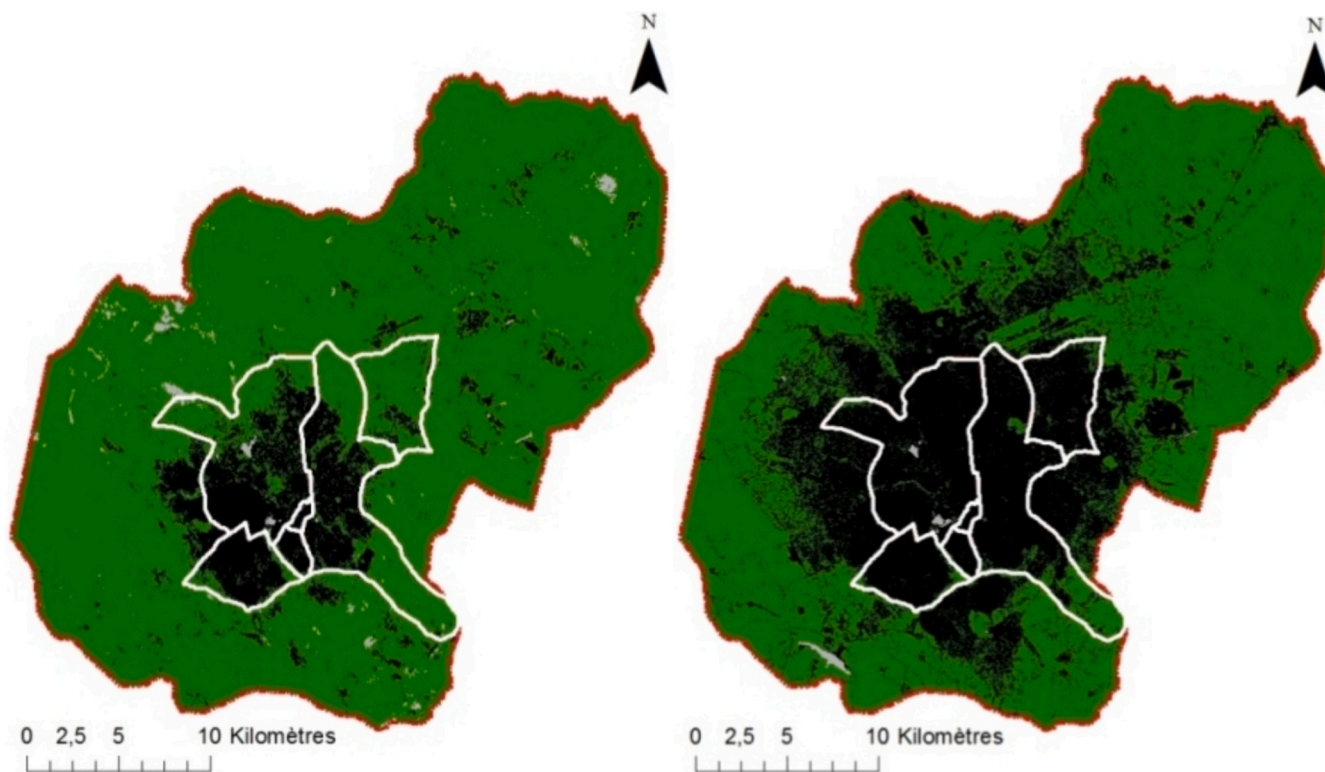


Fig. 16. Regression of green space coverage (in green on the map) as influenced by the rapid urban spatial expansion of Lubumbashi (in black on the map) between 1989 (left) and 2014 (right) (Useni et al., 2017). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

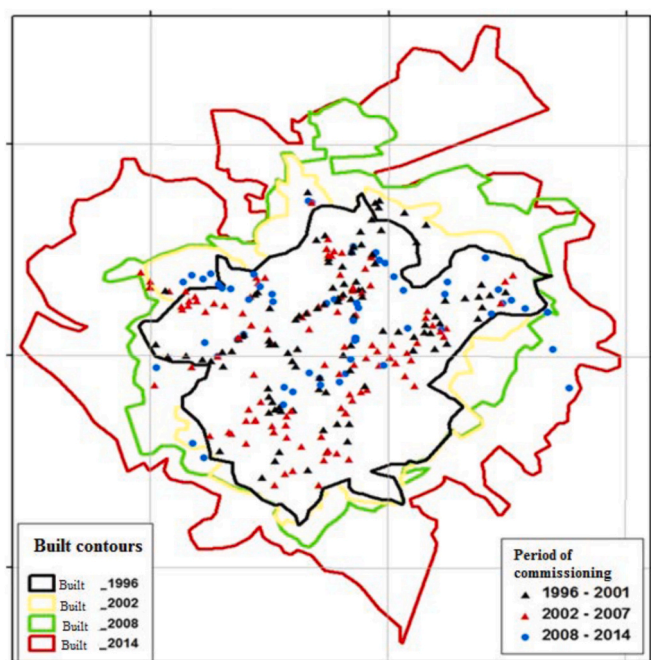


Fig. 17. Built-up area expansion and supply of transformers in the city of Lubumbashi from 1996 to 2014. The electrical transformers are concentrated in the central part of the city, with the unplanned expansion area between 2008 and 2014 receiving only two transformers (Banza et al., 2016). Consequently, charcoal emerges as the primary source of energy for cooking in households.

systems, and recycling programs is another key aspect. Enforcing policy and regulatory frameworks that promote sustainable sanitation practices and address waste management challenges includes measures to promote waste segregation, recycling, and water conservation.

5. Conclusion

Strategically located in the southeastern region of the DRC, Lubumbashi stands as a pivotal mining city, intricately woven into a historical tapestry with complex socio-ecological dynamics. Formally created during the Belgian colonial era, its significance is such that it is becoming a crucial hub for mining exploration and exploitation, particularly in the extraction of valuable minerals including copper and cobalt. The city's architectural landscape and urban planning bear enduring imprints of colonial influence, shaping its historical identity with distinctive features. Culturally, Lubumbashi serves as a melting pot where diverse cultures and ethnicities converge, fueled by migration patterns driven by economic opportunities. The social fabric intricately weaves together languages, traditions, and lifestyles, fostering a dynamic and cosmopolitan atmosphere. While this cultural diversity acts as a source of resilience, it also poses challenges regarding the building cohesive social bonds. Economically, Lubumbashi revolves around the extraction and export of minerals, playing a pivotal role in national revenue. The mining industry acts as a magnet, attracting a diverse population seeking employment opportunities, thereby intensifying cultural diversity and urbanization. However, this rapid urbanization has catalyzed transformations in the city's infrastructure, bringing about challenges in road networks, public transportation, and housing, thus emphasizing the critical need for strategic urban planning. Lubumbashi finds itself at a crossroads, confronted by the intricacies of its historical legacy and contemporary dynamics, it. Although the mining industry propels economic growth, it also presents complex socio-ecological challenges at the same time, and the city of Lubumbashi grapples with



Fig. 18. Comparative analysis of spatial urban expansion and agricultural development around the Etoile and Ruashi Mining companies between June 2006 and December 2023, in the Northern part of the city.



Fig. 19. View of the chimney of the STL company (Société de Terril de Lubumbashi). Smoke emitted through the chimney is considered a source of human exposure to toxic metals (Credit Hibrahim Bukasa, 18.02.2015).



Fig. 20. Coming from southern Africa, a vehicle transporting equipment for mining companies is blocked by the power line, causing traffic jams (Source: Author).



Fig. 21. Unauthorized dumping of household waste in a residential area of Lubumbashi city (top) and a protest movement by elementary school pupils against the negative impacts of climate change (bottom). Source: <https://ponabana.com/au-coeur-de-la-ville-de-lubumbashi/> accessed on 03.01.2024.

multifaceted issues, including land governance, pollution, electricity management and access, transport, deforestation, and sanitation. An effective approach to address these socio-ecological challenges implies collaborative efforts from local, national, and international stakeholders. The future trajectory of Lubumbashi hinges on adopting a holistic and proactive approach to confront its challenges. Embracing sustainable practices, community engagement, and leveraging strategic partnerships will empower the city to overcome obstacles and carve a path toward a resilient, vibrant, and sustainable urban future. In this regard, key themes such as sustainable development, ecological resilience, and social equity emerge as pivotal cornerstones shaping Lubumbashi's future landscape.

Author statement cities

The paper titled "Lubumbashi (DR Congo): Navigating the Socio-Ecological Complexities of a Vital Mining Hub" explores the intricate interplay between socio-economic factors and ecological dynamics in Lubumbashi, a significant mining center in the Democratic Republic of Congo. Through detailed analysis, the paper elucidates the challenges arising from rapid urbanization, mining-driven economic growth, and environmental sustainability. It highlights the city's unique position within both national and international contexts, emphasizing its contribution to broader discussions on urbanization, resource extraction, and sustainable development in sub-Saharan Africa. The paper

proposes theoretical frameworks such as "resource urbanism" to deepen our understanding of the complex interactions shaping urban landscapes in resource-dependent regions. Ultimately, it underscores the importance of comprehensively addressing the socio-ecological complexities of mining hubs like Lubumbashi to promote sustainable urban development and environmental stewardship.

CRediT authorship contribution statement

Yannick Useni Sikuzani: Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **François Malaisse:** Writing – review & editing, Supervision, Project administration, Data curation, Conceptualization. **Donatien Dibwe Dia Mwembu:** Writing – review & editing, Visualization, Supervision, Methodology, Investigation, Conceptualization. **Jan Bogaert:** Writing – review & editing, Visualization, Supervision, Project administration, Methodology, Data curation, Conceptualization.

Declaration of competing interest

The author declares that there are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data in the paper

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