Rapid Urbanization and Environment Management in Nkafu Municipality, Eastern DR Congo

Alain Tshimbalanga[1,2,3*], Patient M. Zamukulu[1,4], Liévin Chirhalwirwa[5], Katcho Karume[1,6]

[1]Université Evangélique en Afrique (UEA), Bukavu, DR Congo
[2]Institut National des Batiments et Travaux Publics (INBTP), Kinshasa, DR Congo
[3]Office des Voiries et Drainage (OVD), Kinshasa, DR Congo
[4]Institut Supérieur d'Etudes Agronomiques et Vétérinaires (ISEAV), Walungu, DR Congo
[5]Institut Supérieur d'Architecture et Urbanisme (ISAU), Kinshasa, DR Congo
[6]Centre de Recherche en Géothermie, Bukavu, DR Congo
Email: *alaintshimbalanga@gmail.com

Abstract

Rapid and uncontrolled urbanization as well as urban land management are major constraints to land planning in the Democratic Republic of Congo. A household data collection and analysis was carried out in 283 random households in the Nkafu municipality, eastern DR Congo, to assess the local community's perception of rapid urbanization and its impact on land policy and management of the built landscape. Data of socio-demographics characteristics, rapid urbanization, and environment management data were collected and analyzed using XLStat version 2019. In addition, the study area location map, land use and cover change maps were generated using ArcMap 10.8. Results indicate that landowners are dominant and, build simple houses with unsustainable building materials (i.e. wooden plank) obtained locally. In addition, land management is not appreciated by local communities, due to anarchic construction due to lack of financial resources generating thus an increasing amount of urban waste, which is poorly managed. The study suggests, urban roads renew, building in conformity with urban planning and building regulations, potable water supply and health services availability to improve the study area. Geographic Information Systems (GIS) use, would provide spatial information on land planning in the study area.

Keywords

1. Introduction

Urbanization is a socio-economic process that plays a key role in environmental development. This process is based on the urban growth of residential areas, which has an impact on global land policy (Doygun, 2020; Kabiso et al., 2022). According to Benti et al. (2022), Cruz-Bello et al. (2023), ~10% of the global population was living in urban areas in the 1900s, but rapid urban growth, estimated ~50%, has been reported since the early 2000s, causing major land changes in the management of the city's environment with the land conversion of housing areas.

In fact, local perception of the spatio-temporal urban environment is one of the land policies playing a key role in urban development, especially in developing countries characterized by rapid population growth (Collier et al., 2015; Koranteng et al., 2023). In addition, uncontrolled urban growth is one of the major land planning constraints in most of Africa's major cities, such as Bukavu in eastern DR Congo, where rural migration is accelerating poor land policy associated with high occurrence of environmental hazards (Ntamusimwa et al., 2022).

Urbanization and peri-urbanization, linked directly to the urban environment, influence land conversion in built-up areas where rural and urban activities are combined, and where the urbanization of slums modifies land tenure status of residential areas in areas of high population growth (Cruz-Bello et al., 2023). According to Hoffmann et al. (2019), poverty and poor land tenure security accelerate these phenomena and make urban planning more difficult.

In Democratic Republic of Congo (DR Congo), rapid and uncontrolled urbanization in the surrounding cities is one of the results of armed conflict, especially in the eastern part of the country, where population migration has generated slums in major cities such as Bukavu (Lupiki et al., 2020). Furthermore, uncontrolled building in slums has serious social, economic and political impact on communities, where land conflicts and waste management are the main challenges on urban land management (Hoffmann et al., 2019). However, local knowledge of the perceived consequences of rapid urbanization on land and environmental management contributes significantly to the decision-making process during land-use planning for urban expansion (Mevoa et al., 2015; Tohozin & Guedegbe, 2015; Edongo & Tchuikoua, 2021; Udessa et al., 2023). This study was therefore, assesses local community perceptions of rapid urbanization, and identifies consequences of this urbanization on land management and urban environment management.

2. Methodology

2.1. Study Area

This study was carried out in Nkafu district, located in Kadutu municipality (in the city of Bukavu, South Kivu, eastern DR Congo). Bukavu has a very hilly terrain with slopes around 75%. In fact, the lowest point is at 1417 m above sea lev-

el, and the highest is at 2172 m with a difference of 755 m above sea level (**Figure 1**). Bukavu covers ~63 km², with the majority (43 km²) covered by upland and 20 km² by Lake Kivu water (Bilubi, 2014; Chako et al., 2022). According to Ntamu-simwa et al. (2022), Bukavu covers 43 km² and is divided into 3 districts: Kadutu (6.68 km²), Ibanda (13.38 km²) and Bagira (23.26 km²), with Kadutu being the main commercial center and Ibanda the administrative district of South Kivu province.

2.2. Climate and Land Cover

Bukavu has a humid tropical climate, with temperature variations influenced by its elevation and sub-equatorial position. Vegetation in Bukavu is dominated by tree species (e.g. eucalyptus, cypress, etc.), agroforestry and fruit tree species (e.g. mango, guava, lemon, orange, avocado, etc.) and a number of wild grass species (e.g. *Tithonia diversifolia*, *Lantana camara*, *Galinsango parviflora*, and *Commelina diffusa*, etc.).

Bukavu's soil is generally basaltic. It's not completely clayey, as it's much more compact. However, it is also less permeable and highly susceptible to drought. Bukavu's hilly terrain and climate combine to create one of the most sensitive cities to environmental hazards such as soil erosion (Eisenberg & Muvundja, 2020; Chako et al., 2022), and landslides (Bigirimwami, 2009; Maki Mateso & Dewitte, 2014; Balegamire et al., 2017; Kulimushi et al., 2017; Mugaruka et al., 2017;
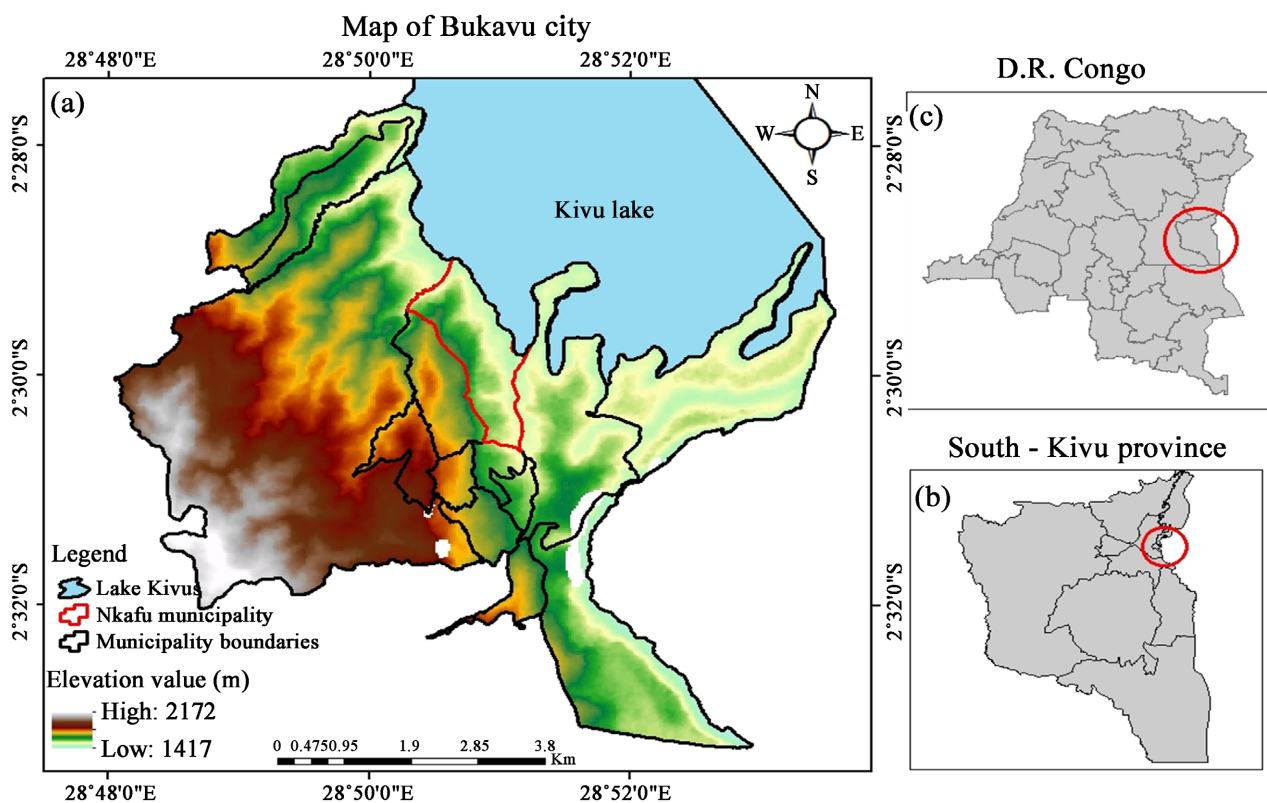

Figure 1. Map of the study area (a) The location of Nkafu municipality in Bukavu city, (b) The location of Bukavu city in the South Kivu province, and (c) The location of South-Kivu province in DR Congo.

Ntamusimwa et al., 2022) which are increasingly occurring in this town faced with rapid population growth.

Figure 2 shows the spatio-temporal change in land use in the Bukavu town from 2000 to 2021. In fact, urbanization is changing over time in many parts of the town, which is characterized by hilly terrain. The land use change from 2000 to 2021 is presented in the Table 1.

2.3. Sampling, Data Collection and Analysis

Data collection based on a household survey using a questionnaire combined with an interview with the local authorities of Kadutu municipality. Household

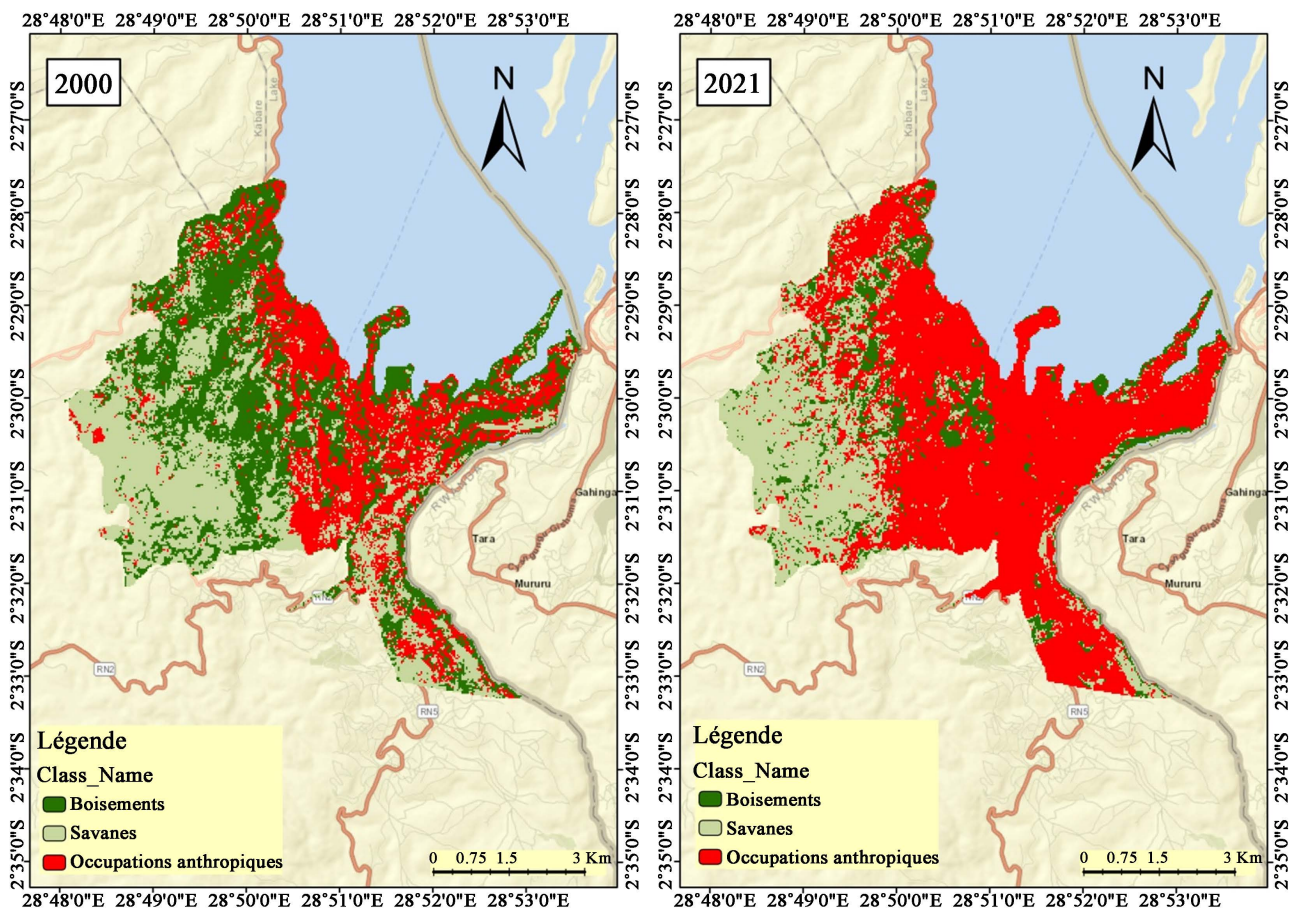**Figure 2.** Spatio-temporal land use in the Bukavu town from 2000 to 2021

Table 1. Land use and cover change o of Bukavu from 2000 to 2021.

Classes	2000	2021
Forest	16.14 km^2	4.87 km^2
Savannah	15.57 km^2	11.94 km^2
Human occupations	11.64 km^2	26.541 km^2
Overall accuracy	(2921/3206) 91.11%	(3251/3411) 95.30%
Kappa coefficient	78.56%	85.42%

characteristics (socio-demographic and economic) were collected from members aged over 18. In addition, information on land tenure security and conformity with urban planning regulations were collected from household heads in the Nkafu district. To achieve this, 283 respondents were selected. Survey data were input using Microsoft Excel, and descriptive analyses were performed using the Statistical Software XLStat version 2019 package.

3. Results

3.1. Socio-Demographic Characteristics of Households in the Study Area

Household characteristics in the study area are presented in Table 2.

Results in Table 1 show that most household heads in the study area were men (96.2%) aged over 60, while those aged from 30 to 40 represented the lowest category. Most respondents were married (91.5%), while others were single (2.7%) or in other marital status (5.8%). The majority had no formal education (54.6%), while those with secondary, post-secondary and primary education represented 3.8%, 3.8%, 8.5%, and 29.4% respectively. Most (65.5%) respondents had lived in the study area between 6 and 10 years, and had trade as their main household income source.

3.2. Land and Building Administration in the Study Area

Results of Land and building administration in the study area are presented in Table 3.

Results in Table 2 shows that most respondents (73.7%) were landowners who lived in simple houses (60.8%) built with unsustainable bulding materials or wood (55.6%) with 3 to 5 rooms (72.4%). Most landowners in the study area obtained their plots by buying them (53.2%), but were separated from the road by more than 5 plots (63.8%).

3.3. Land Policy and Urban Environment Management in the Study Area

Results of Land policy and urban environment management are presented in Table 4.

Results in Table 2 shows that most (65%) respondents did not appreciate the current land administration by the authorities and/or neighbors, and in the case of land conflicts, more than half (86.3%) reached negotiated agreement. In fact, the majority (72%) of respondents had indicated that access to housing plots was one of the reasons for a good urban planning policy, while 32% of respondents had indicated that access to housing plots and uncontrolled construction (29.4%) were the main reasons for a poor land administration policy for building. Soil erosion (4.8%), insalubrity (5.8%), landslides (8.5%), fire frequency (9.6%) and land conflicts (9.9%) were considered to be consequences of the poor urbanization policy. To adapt to the conditions of urbanization, 48.5% and 30.4% of respondents

respectively suggested the delineation of plot boundaries and respect for building standards to be the main corrective strategies.

3.4. Urban Environment and Householder Waste Management

Results of urban environment and householder waste management are presented in Table 5.

Table 2. Socio-demographic characteristics of households.

Variables	Frequency (%)
Gender (%)	
Women	3.8
Man	96.2
Age (%)	
30 - 40 years	5.5
41 - 50 years	6.1
51 - 60 years	9.9
>60 years	78.5
Marital Statut (%)	
Single	2.7
Married	91.5
Other	5.8
Education level (%)	
Secondary	3.8
Post-secondary	8.5
Primairy	33.2
Illiterate	54.6
Stay (*Residence*) *duration* (%)	
11 - 15 years	3.1
16 - 20 years	2.4
1 - 5 years	26.3
6 - 10 years	65.2
>20 years	3.1
Income source (%)	
Agriculture/Livestock	13.7
Other	6.1
Trade	65.2
Teaching	8.9
Public servant	6.1

Table 3. Land and building administration in the study area.

Variables	Frequency (%)
Land tenure system (%)	
Other	26.3
Landowner	73.7
Type of house (%)	
Split-level house	39.2
Single-family house (Detached)	60.8
Type of bulding materials (%)	
Sustainable bulding materials	44.4
Unsustainable bulding	55.6
Number of rooms in the house (%)	
<3 rooms	4.4
3 - 5 rooms	72.4
>5 rooms	23.2
Land acquisition mode (%)	
Buy	53.2
Other	26.3
Legacy	20.5
Number of plots near road (%)	
0 plot	10.2
1 - 3 plots	22.9
3 - 5 plots	3.1
>5 plots	63.8

Table 4. Land policy and urban environment management.

Variables	Frequency (%)
Land administration appreciation (%)	
Good	34.5
Poor	65.5
Land conflict management (%)	
Friendly arrangements	86.3
Local authority	7.8
Other	5.8
Drivers of good planning policy (%)	
Good access to plots	72

Continued

Good land administration	20.5
Reduction of uncontrolled construction	4.1
Respect of environmental regulations	3.4
Consequencess of poor urbanization policy (%)	
Soil erosion	4.8
Insalubrity	5.8
Landslide	8.5
Fire	9.6
Land conflicts	9.9
anarchy (poor land planning)	29.4
Difficult acces to plots	32.1
Corrective strategies (%)	
Strengthening land governance	10.2
Bollard installation	48.5
Interdiction of small plot buying	4.8
building standards respect	30.4
Protecting the land	6.1

Table 5. Urban environment and householder waste management.

Variables	Frequency (%)
Existence of a household waste management policy (%)	
No	40.6
Yes	59.4
Household waste management system (%)	
Incineration	1.7
Household garbage	53.9
Public garbage	44.4
Respect of environmental norms (%)	
No	79.5
Yes	20.5
Constraints to construction (%)	
Limited access to materials	28.3
Limited proximity to roads	10.2
Low income	48.5
Water resources	3.8
Hilly terrain	9.2

Continued

Recommandation	
Drinking water supply	5.5
Bollard installation system	8.2
Strengthening sanitation services	30.7
Creation of green spaces	5.5
Maintenance of urban roads	50.2

Results in Table 2 shows that most respondents (59.4%) indicated that there is a good waste management policy in the area, to protect the urban environment. More than half of respondents (53.9%) use household waste collection systems, while only 1% incinerates their waste. In fact, the majority (79.5%) indicated that environmental regulations are not respected in the study area, and for 48.5% of households, this is mainly due to a lack of financial resources. Road rehabilitation (50.2%) and public waste management (30.7%) are the main recommendations for good urban environmental governance.

4. Discussion

4.1. Rapid Urbanization and Its Impact on Land Policy

The results show that respondents do not appreciate the land policy of the area where they are located, and this is due to the many consequences that local people experience on a day-to-day level. According to Town et al. (2018), Rapid, uncontrolled urbanization has major impacts on the urban environment, particularly in the case of uncontrolled construction, which is one of the main characteristics of shanty towns around major cities. Uncontrolled urban growth is also characterized by environmental pollution and poor access to basic services and infrastructures. In addition, findings of Doygun (2020) show that local perceptions of urbanization are based on poor land management associated with poor environmental management caused by poor sanitation services, which have an impact on public health in low-income areas such as our study area.

Ntamusimwa et al. (2022) indicated that rapid, uncontrolled urbanization in Bukavu's districts is one of the consequences of the city's limited expansion, which is also having a negative impact on restructuring by increasing its susceptibility to natural and anthropogenic hazards such as landslides (Bigirimwami, 2009; Bunduki et al., 2015; UEA-PNUD, 2018), soil erosion (UEA-PNUD, 2018; Chako et al., 2022), flooding (Mawemba, 2016; UEA-PNUD, 2018), wildfire (Banza et al., 2022). Natural and anthropogenic hazards occurring at the same time in the study area are directly linked to the poor land policy in the study area, where the hilly terrain has a negative impact on land planning. Results of Yi et al. (2016) show that urbanization in highland regions requires hillside protection measures, which in the context of poor land-use planning can lead to landslides and material and human damage.

Urban waste management is one of respondents' recommendations for good urban environmental management. Results of Kassoum (2013) show, for example, that uncontrolled construction in developing countries is at the origin of inadequate urban waste management. However, local community knowledge of waste management is one of the main strategies for participative management of the urban environment. According to Benti et al. (2022), all these consequences are mainly due to poor land resource governance for successful and effective land planning. Rapid urbanization and land policy in general have been the driving factors of major environmental and social changes in land policies worldwide (Richards et al., 2020). However, a number of previous studies indicate that integrated land-use planning with Geographic Information Systems (GIS) is one of the major tools of effective land-use policy, with highly promising results in reducing the social and environmental consequences of land-use planning in many parts of the world (Farhan & Al-shawamreh, 2019).

4.2. Environmental Management and Its Consequences

Poor sewage systems are one of the main consequences of the inappropriate land-use policy in the study area, which is characterized by the rapid growth of built-up areas. Results of Mulalisi (2016) in the Panzi district of Bukavu (DR Congo) show that rapid, uncontrolled urbanization is one of the main causes of the poor urban and environmental policies affecting land use and waste management. In Nkafu, for example, rapid, and uncontrolled urbanization is also associated with socio-economic factors, characterized by small businesses that are the livelihoods of most of the area's population.

Local perception and knowledge of urbanization vary from one respondent to another, but the impact of peri-urbanization and rapid urbanization is poorly known in most municipalities where land-use planning policies are not respected (Hatab et al., 2022). Natural hazards, land conflicts, land access difficulty, etc. are the main consequences perceived by the people in the study area. Results of Jurkovič (2014) agree with our findings, revealing that the public planning of land areas causes serious problems for environmental management, by limiting comfort in the residential areas of rapid urbanized cities. According to Peltonen & Sairinen (2010) and Magsi et al. (2017), increasing conflict in developing countries is caused by the lack of social justice and can be seen as a result of factors associated with the availability of resources (e.g. farmland, houses and other physical resources), especially in peri-urban areas.

Our results show that local communities are not involved in land planning as part of the effective management of the urban environment. This can be attributed to the government's policy of public land administration. On the other hand, the results of (van Empel, 2008) demonstrate that the effective participation of local communities in land administration is one of the most effective strategies contributing significantly to participatory land planning and development. Furthermore, the results of Butta (2020) show that social inequalities have

an impact on the urbanization rate (popular and physical) in most poor-country cities, where the land administration sector's resources are insufficient to develop the land tenure system.

5. Conclusion

The aim of the study was to assess local communities' knowledge of rapid urbanization, land policy and management of the urban environment in the Nkafu municipality of Bukavu. Results show that limited financial resources and low participation of local authorities in land governance are the main causes of rapid urbanization, with major consequences such as uncontrolled construction, urban governance, land conflicts and exposure to natural and anthropogenic hazards (e.g. landslides, erosion, fire, etc.). Integrating these results by all stakeholders, together with a Geographic Information System (GIS) based on urban planning techniques would help resolve the land-use planning problems and limit the exposure of buildings to natural hazards in built-up areas in the hilly study area. The spatio-temporal continuation of this research will provide important information on the environmental management of DRC's cities.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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