Policy Research Working Paper 9857

Profiling Living Conditions of the DRC Urban Population

Access to Housing and Services in Kinshasa Province

Yele Maweki Batana
Alexandra Jarotschkin
Akakpo Konou
Takaaki Masaki
Shohei Nakamura
Mervy Ever Viboudoulou Vilpoux

WORLD BANK GROUP
Poverty and Equity Global Practice
November 2021

Policy Research Working Paper 9857

Abstract

This paper examines living conditions—mainly access to infrastructure and basic services—in Kinshasa, by focusing on how they vary within the city and how they are related to household characteristics. First, drawing on a household survey conducted in the capital province in 2018, the paper shows that many Kinshasa residents live with substandard housing and inadequate levels of access to infrastructure and basic services. Second, the level and quality of access to basic services are highly correlated with residents' consumption and education levels, as well as their neighborhood characteristics. Third, despite the presence of negative externalities from the high population density, poor households benefit from living in dense neighborhoods by gaining a minimum level of access. The paper argues that it is imperative to increase the supply of affordable housing to lessen the inequality of access to services in Kinshasa.

This paper is a product of the Poverty and Equity Global Practice. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://www.worldbank.org/prwp. The authors may be contacted at ybatana@worldbank.org or snakamura2@worldbank.org.

Profiling Living Conditions of the DRC Urban Population: Access to Housing and Services in Kinshasa Province

Yele Maweki Batana, World Bank

Alexandra Jarotschkin, World Bank

Akakpo Konou, World Bank

Takaaki Masaki, World Bank

Shohei Nakamura, World Bank[1]

Mervy Ever Viboudoulou Vilpoux, World Bank

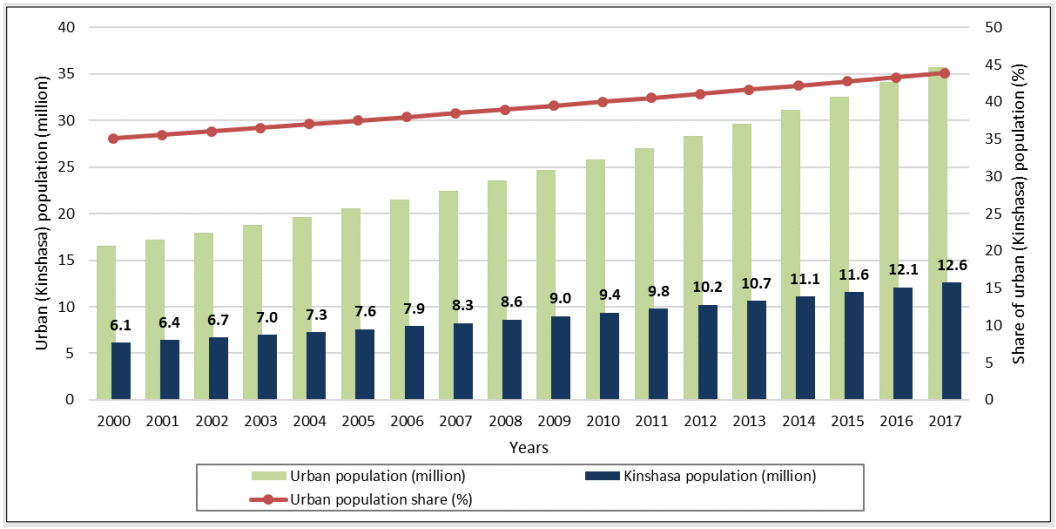
Keywords: Urban poverty; multidimensional poverty; spatial inequality, informal settlements
JEL Codes: C18, D31, I14, I24, I31, I32

[1] Corresponding Author: snakamura2@worldbank.org. We would like to thank Andrew Dabalen, Ruth Hill, Kirsten Hommann and Clarence Tsimpo for useful comments. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations or those of the Executive Directors of the World Bank or the governments they represent.

1. Introduction

The scale and pace of urbanization in the Democratic Republic of Congo (DRC)—and Kinshasa, in particular—over the last two decades has been phenomenal. Due to the lack of recent census data, the total population in Kinshasa is unknown, with varying population estimates existing. According to the World Development Indicators (WDI), the DRC's urban population doubled from 16.5 million in 2000 to 35.7 million in 2017, adding on average 1.1 million people to the urban area annually (Figure 1).[2] During the same period, the urbanization rate (that is, the urban population share) has gone up from 35 percent to 44 percent. Amid this rapid urbanization, Kinshasa has also been growing extensively in terms of size. The population of urban Kinshasa doubled from 6.1 million in 2000 to 12.6 million in 2017. Kinshasa is not only the largest city but also the economic hub of the country (World Bank 2018a), and it is expected to become the largest megacity in Africa by 2030.[3]

Figure 1: Urban population trends in DRC, 2000–2017



Source: WDI.

Because of this rapid urbanization of the population—coupled by a modest pace of poverty reduction (World Bank 2018d)—poverty is gradually shifting to urban areas. Moreover, based on the latest estimates of the poverty headcount in the country, more than half of this urban population is poor. In addition, according to the WDI, the proportion of the urban population living in slums in the country was about 75 percent in 2014. Unlike most countries in Africa, the DRC has high urban poverty rates relatively close to those in rural areas, at 62.5 percent and 64.9 percent respectively in 2012. With a poverty incidence of nearly 53 percent (2012), Kinshasa hosts a large number of poor, which is estimated at approximatively 7 million people in 2017 or about 12

[2] Population is based on WDI. See Section 2 for details.

[3] While Kinshasa remains the largest city in the country, its share of the country's urban population has slightly declined from 37.1 percent in 2000 to 35.4 percent in 2017.

percent of the entire poor population in the country.[4] As reported in Batana et al. (2021), the poverty incidence in Kinshasa is likely to have risen since 2012.

Kinshasa has not been able to reach its full potential due to its disconnection from the global economy and unplanned urbanization. Cities may have several advantages by allowing people to be closer to jobs and generating economic opportunities and enhancing productivity due to agglomeration of economies. Public goods such as infrastructure and basic services can be provided more efficiently and equitably when populations are large and densely packed (World Bank 2018b). However, Kinshasa remains largely a local city—as opposed to a global city that is open to regional and global trade, markets, and investments—and it produces fewer internationally tradable goods and services (60 percent) than other world cities (Lall, Henderson, and Venables 2017).

Another feature characterizing the city is a proliferation of precarious areas, abandoned parts of urban Kinshasa that suffer from rough terrain, poor services, and various environmental/disaster risks. As described in Section 2, this paper defines neighborhoods are identified as precarious if they have characteristics that are not desirable for habitation. The expansion of precarious areas in Kinshasa is a rather recent phenomenon, instigated by the unprecedented population growth that the city has experienced over the past half century (Nzuzi 2017). Precarious areas concentrate particularly in newly built residential areas in suburban/peri-urban areas that lie mainly outside the 5 km radius around the city core. These precarious areas are home to roughly 60 percent of the Kinshasa population.[5]

This paper aims to present new data on the spatial and demographic patterns of the city and the spatial and socio-economic variation in access to services. Key questions addressed in this note include: *what is the standard of living conditions in urban Kinshasa? How do access to infrastructure and basic services vary depending on households' socio-economic characteristics and residential locations?* In examining these questions, this paper briefly reviews the patterns of urban growth and proliferation of precarious neighborhoods in Kinshasa (Section 2). This paper then shows various aspects of living conditions of Kinshasa residents by their socio-economic characteristics and residential locations (Section 3). The paper also examines in Section 4 the degree to which spatial or demographic characteristics drives access to services, thereby shedding light on whether area-focused interventions or individual-interventions are needed to improve service outcomes. It identifies the areas of the city where investments are particularly needed. Finally, the analysis estimates the cost to poor households of getting housing with service provision and located near the economic core of the city.

Key findings are summarized as follows. First, worse living conditions are endured by poor and/or less educated households in precarious and/or peri-urban neighborhoods. Second, inequality in access to water is driven by locational factors, while sanitation access depends on household characteristics, such as the education levels of household heads. Third, while there is a concern about negative externalities from Kinshasa's extremely high population and built-up density, poor households benefit from density to some extent, as indicated by a higher chance of their gaining access to basic services in dense neighborhoods. Finally, high housing costs in neighborhoods

[4] The numbers of the poor in 2017 are simulated based on the projected population from the National Institute of Statistics (*Institut National de la Statistique*, INS).
[5] Based on population estimates from WorldPop (2013).

closer to the city core restrict access to economic opportunities and services among low-income households.

2. Data and background

2.1 Data

The analysis of this paper relies primarily on a recently collected household survey in Kinshasa. Conducted by the INS of the DRC under the World Bank's statistical operation in the country, it is an integrated survey, consisting of two surveys, targeting individuals and households. The first part of the survey includes sociodemographic characteristics, education, health, living condition, employment, urban agriculture and non-agricultural household entrepreneurship. The second component is the household consumption survey.

The Kinshasa Household Survey was collected in two 18-day phases between mid-October and the end of November 2018 on a sample of 2,592 households. Given the outdated last population census—which was collected in 1984—the sampling method for the Kinshasa Household Survey was based on high-resolution satellite imagery. A two-stage stratified sampling design with equal allocation of first-degree EAs was used for the survey. Kinshasa had been divided into two clusters: urban and rural. The 23 communes/districts of the city were considered as urban and some areas of Maluku, as part of the survey, were considered rural.

Two criteria were used to stratify the city (a) the building density of EAs and (b) typology of Kinshasa areas. The stratification of EAs according to the density criterion was carried out as follows: 1) Low density; fewer than 10 buildings per hectare, 2) Medium density; from 10 to 20 buildings per hectare, and 3) High density; more than 20 buildings per hectare. Precarious neighborhoods are those not suitable for habitation. In the survey, precarious areas are defined based on their characteristics of dwellings and geographic and environmental features.

- **Precarious areas.** This is a neighborhood whose dwellings are built by the occupants on land acquired in undeveloped areas, on farmland and market gardens, or on uneven ground (exposure to erosion and flooding). Buildings are anarchic and the use of recycled materials (cardboard, plastics, and sheet metal) is common. Most often, they are located in parts of the city abandoned by the more affluent categories: on steep slopes or near industrial areas, which makes them all the more dangerous and where misery is concentrated. Collective facilities (water, electricity, sanitation, and transport) are reduced and availability is low.
- **Non-precarious areas.** These are neighborhoods where homes are self-constructed, constructed by stages, or constructed with the intervention of a contractor. They are also neighborhoods built entirely by the state for social housing in accordance with urban standards (drainage system, access to water and electricity, tracing roads, and so on) and habitat.

Each enumeration area (EA) is then classified as either precarious or non-precarious by the knowledge of local experts based on the definition above (Figure 2).

The sample was drawn from the following seven strata: (a) low-density non-precarious zone, (b) medium-density non-precarious zone, (c) high-density non-precarious zone, (d) low-density

precarious zone, (e) medium-density precarious zone, (f) high-density precarious zone, and (g) rural area.

While the Kinshasa Survey is prepared with an innovative approach, the use of the survey requires caution against its data quality and comparability. It is extremely challenging to design a sampling survey to collect information about households and individuals that represents Kinshasa, due to the lack of a recent population census. The sampling of the Kinshasa Survey, which is the primary data for this study, was prepared by drawing on satellite imagery. In addition, unlike the 1-2-3 household survey of 2012, the stratification of the 2018 survey explicitly captures precarious areas. Despite such an innovative sampling approach, the Kinshasa Survey has concerns about the data quality because of a problem in the data collection process (see Batana et al. 2021 for detailed descriptions). Considering all these factors, this study does not report any absolute number of population based on the survey and does not make a direct comparison between the Kinshasa Survey and the 1-2-3 household survey.

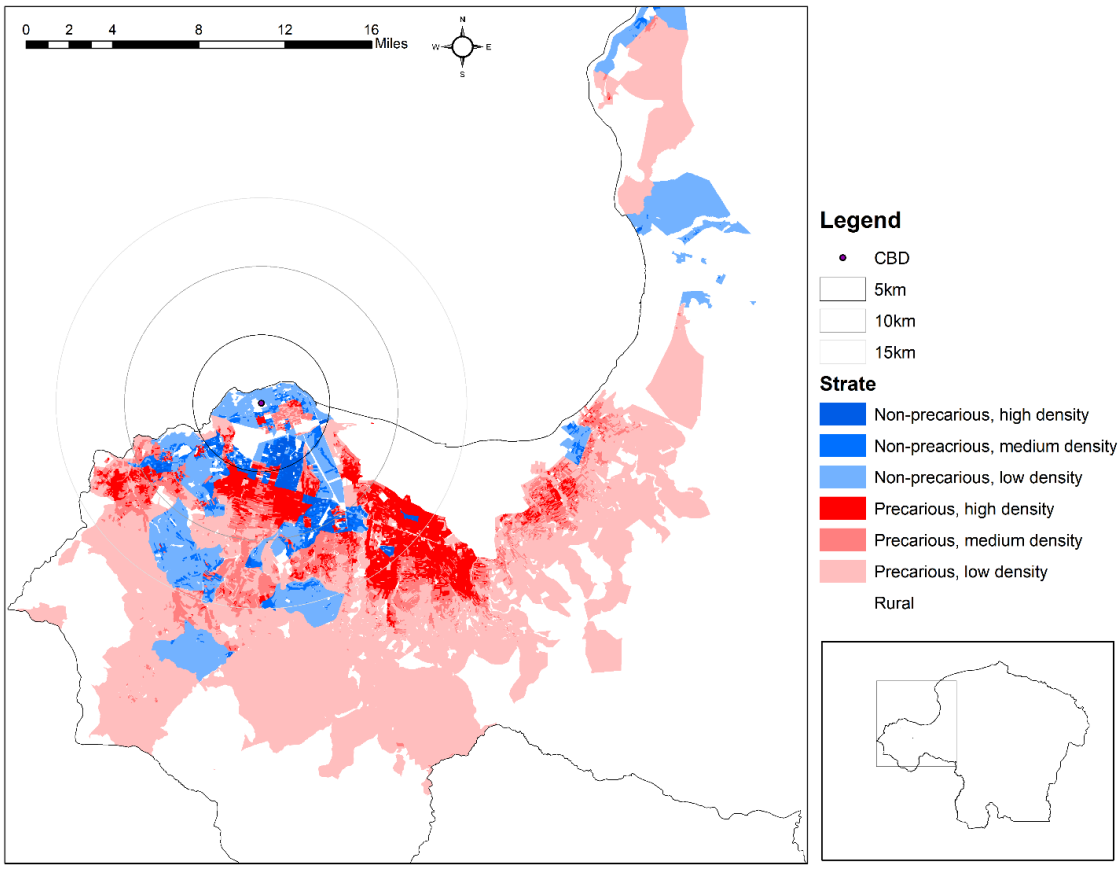
This note also draws on other existing survey data, such as the 1-2-3 household survey of 2012, Water, Sanitation, and Hygiene (WASH) survey, and Demographic and Health Survey (DHS) 2013–2014, as well as satellite imageries and other spatial datasets, to capture trends in the levels and qualities of services and also identify spatial determinants of service access.

Throughout the paper, we follow the definitions of water and sanitation services as provided by World Health Organization (WHO)/United Nations Children's Fund (UNICEF) Joint Monitoring Programme (JMP) for Water Supply, Sanitation, and Hygiene. To distinguish quality of water and sanitation access, they are classified into the following categories.

In the case of water access, it is classified into (a) improved water; drinking water that includes piped water and protected wells/springs, (b) piped water; water sources coming from public/private taps at home or in neighborhoods and (c) basic water; drinking water from an improved source that is available within 30 minutes for a round trip. These categories are not mutually exclusive. For example, some households have access to improved and basic water (improved water in proximity) while others have access to improved water but not basic water (improved water not in proximity).

Regarding sanitation access, the two categories are a) Limited sanitation; access to improved facilities that are shared with other households, and b) Basic sanitation; the use of improved facilities that are not shared with other households.

Figure 2: Proliferation of precarious neighborhoods

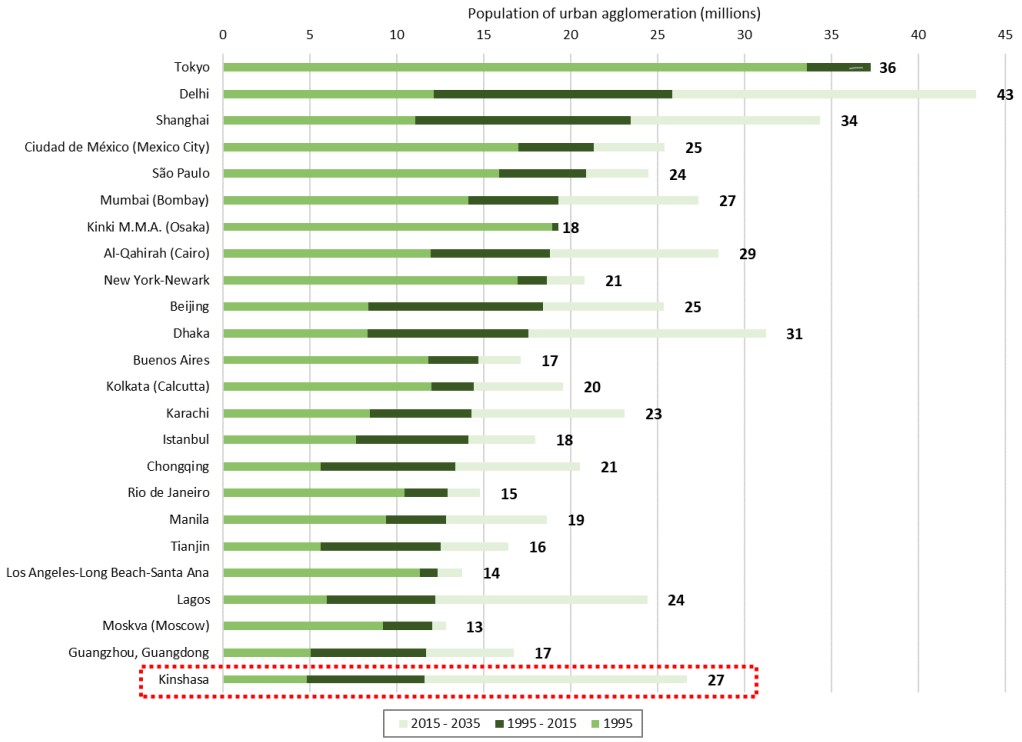


Source: Kinshasa Survey 2018.

2.2 Urban Growth in Kinshasa

Kinshasa's already enormous population will double in the next 20 years, according to the projection by the United Nations. Due to the lack of a recent census in the DRC, the last being in 1984, all population figures for Kinshasa—either Kinshasa Province or Kinshasa City—are projection based. According to the United Nations World Urbanization Prospects, which the WDI adopts, the population size of the Kinshasa urban agglomeration is about 12 million as of 2015, ranked 24th in the world (Figure 3). By 2035, Kinshasa will be the sixth largest urban agglomeration with 27 million population after Delhi, Tokyo, Shanghai, Dhaka, and Cairo. This anticipated addition of 15 million people to Kinshasa over the next two decades urges the government to act proactively.

Figure 3: Population growth of major urban agglomerations in the world

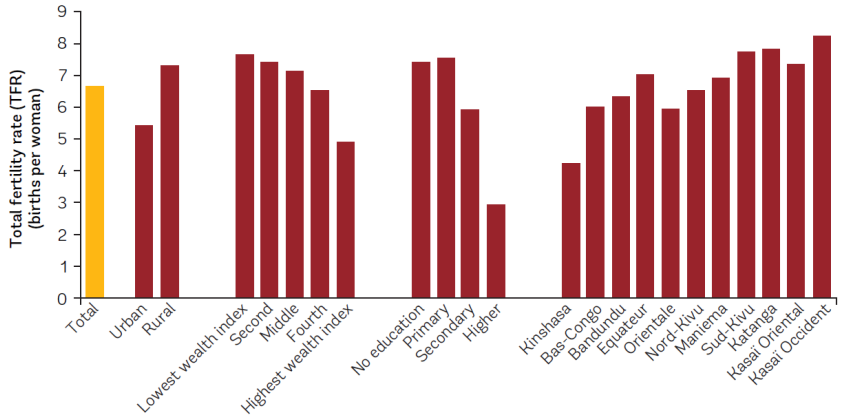


Source: United Nations World Urbanization Prospects, 2018 Revision.
Note: Cities are ordered by their populations as of 2015.

A mix of high fertility rate and internal migration within the DRC has contributed to rapid urban growth in Kinshasa over the past half century. While Kinshasa's population growth during 1965–1984 was attributed largely to a relatively high fertility rate in Kinshasa, a recent decline in the fertility rate suggests that migration has also increasingly contributed to Kinshasa's continued urban growth. Indeed, although the DRC has one of the highest fertility rates in the world—with a country-level total fertility rate (TFR) of 6.6—Kinshasa is a notable exception and has a TFR of 4.2, which is considerably lower than the TFR in urban (5.4) and rural (7.3) areas of the DRC (see Figure 4).[6]

[6] See Anglewicz, Corker, and Kayembe (2017) and World Bank (2019a).

Figure 4: TFR in 2013–2014, national and disaggregated



Source: World Bank 2019, 9.

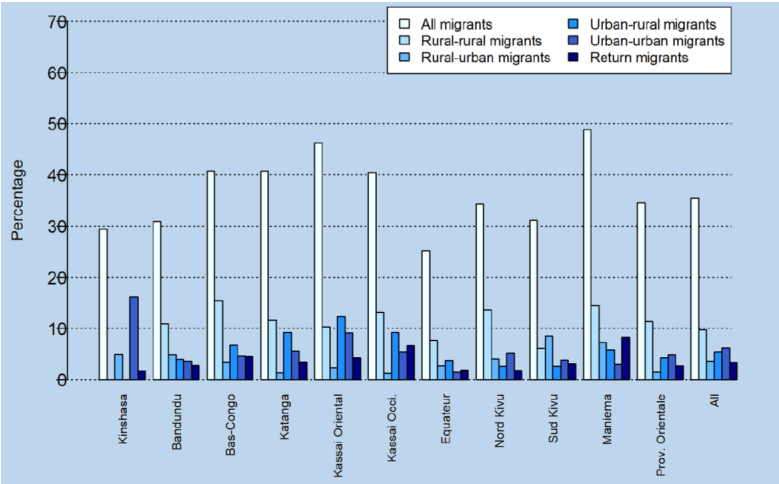
An interplay of push (for example, conflict and natural disasters) and pull factors (for example, job/education opportunities) has driven internal migration into Kinshasa and its population growth. Historically, security concerns had constituted the primary motive of internal migration into Kinshasa. In the 1960s, Kinshasa experienced immigration of people seeking refuge due to political and other security concerns. These immigration waves continued all the way up into the 1990s. Generally, the origin of migrants cannot be pinpointed to any single area or region but rather encompasses migrants from the overall interior of the country. Yet other waves of immigration in the 1990s followed due to clashes between different ethnicities, that is, Katanga versus Kasai Province inhabitants.[7] To avoid these demographic pressures at the time, Kinshasa City started resettling people into their places of origin using pecuniary incentives, among others.

More recently, however, better education or employment opportunities appear to have overtaken security concerns as key drivers for migration to Kinshasa. According to the 1-2-3 survey of 2012, about 30 percent of individuals in the working age between 15 and 64 years in urban Kinshasa migrated from other parts of the country, and urban-to-urban migration accounts for the largest share of migration in Kinshasa (Figure 5).[8] A large majority of these migrants in Kinshasa relocated for family reasons (41 percent), education purposes (23 percent), and employment opportunities (10 percent) while security concerns (for example, displacement by war) accounted for a small fraction of those migrants (2 percent). A study also suggests that migrants tend to have a higher fertility rate compared to nonmigrants and have contributed to the fast population growth in Kinshasa (Anglewicz, Corker, and Kayembe 2017).

[7] For example, in 1998, the Ministry of Social Affairs/United Nations High Commission for Refugees (UNHCR) states that as many as 40,000 people were displaced and had entered Kinshasa. Given that these are the officially registered inflows, the actual numbers are likely to be much higher.

[8] Unfortunately, the 2018 Kinshasa Survey does not contain information necessary to analyze internal migration patterns.

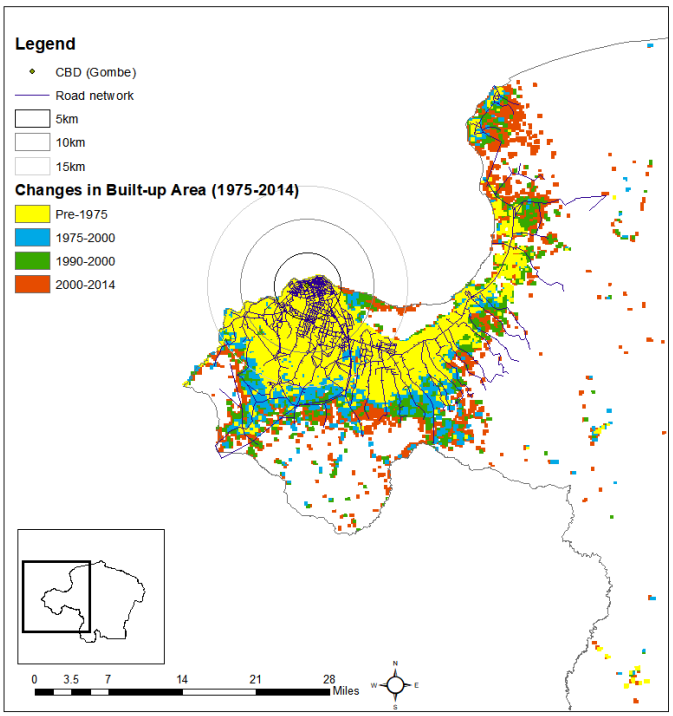
Figure 5: Migrants by migration stream and province, ages 15–64



Source: Adoho and Gansey 2018, 12, based on the 2012 1-2-3 survey.

Unplanned growth has made the city's land use fragmented and sprawling haphazardly. Kinshasa Province stretches over 10,000 km^2—which amounts to a size similar to Lebanon—while the urban part of Kinshasa is geographically concentrated in the northwestern part of the province. The city has been rapidly sprawling. Most of the city's built-up areas were concentrated within 10 km from the central business district (CBD) or city core (Gombe) in the pre-1975 era (Figure 6). Because of the geographical expansion of the city since then, the built-up areas have reached beyond 20 km from the city core.

Figure 6. Spatial Expansion of Built-Up Areas

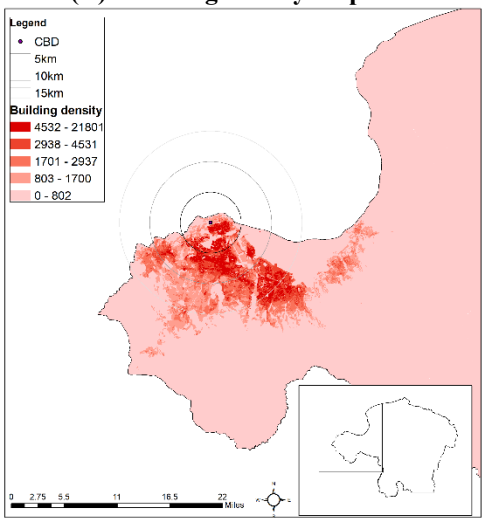


Source: Data on built-up areas from Global Human Settlement Layer (https://ghsl.jrc.ec.europa.eu/datasets.php).

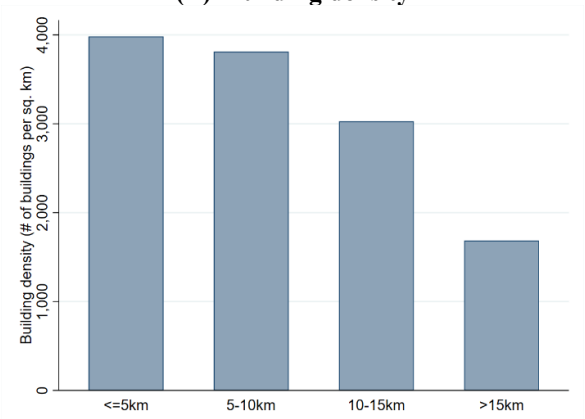
With the latest urban plan approved in 1967, another consequence of unplanned growth is the proliferation of neighborhoods with low livability and walkability, suffering from poor services and various environmental and disaster risks. As illustrated in Panels A and B of Figure 7, building density is higher particularly in and around the central business district (CBD) (e.g., Gombe) while areas farther from CBD are more sparsely populated with a lower density of buildings. The nature of neighborhoods also changes according to distance from the city core. More specifically, precarious neighborhoods have largely developed outside the city core and its immediate vicinity (Panel C). According to one estimate, around 60 percent of Kinshasa residents live in such precarious neighborhoods. Not surprisingly, people living in precarious neighborhoods tend to be less educated and poorer—about 64 percent of Kinshasa's poor live in precarious areas.

Figure 7: Density and precarious areas by distance from city core

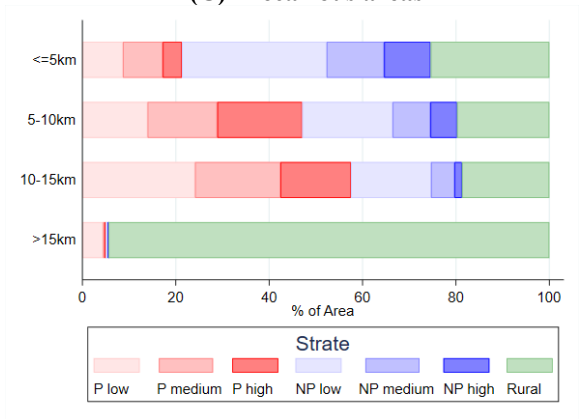
(A) Building density map



(B) Building density



(C) Precarious areas



Source: Building density was computed based on building footprint data provided by the World Bank's Geospatial Operations Support Team

Note: Seven different strata as defined in the Kinshasa Survey include (a) low-density precarious areas (P low), (b) medium-density precarious areas (P medium), (c) high-density precarious areas (P high), (d) low-density non-precarious areas (NP low), (e) medium-density non-precarious areas (NP medium), (f) high-density non-precarious areas (NP high), and (g) rural areas.

Precarious areas in Kinshasa are patched in different parts of the city. Unlike other major African cities (for example, Kibera in Nairobi) where precarious areas (or informal settlements) are geographically concentrated, Kinshasa has multiple pockets of precarious areas spread across its city boundary. In many parts of the city, precarious areas are located right next to non-precarious areas. As discussed more in detail throughout this report, poorer households tend to reside in precarious areas that suffer from a perennial shortage of basic services, and expanding service access to these precarious areas remains a key challenge. Both the level and quality of key basic public services in Kinshasa, such as water supply and sanitation, can easily deteriorate due to the city's inability to cope with the rapid increase of urban population adding pressure on its critical infrastructure and public service systems. Therefore, there is an immediate and increasing need for investing in the delivery of public services and core infrastructure to improve the living standards of Kinshasa residents.

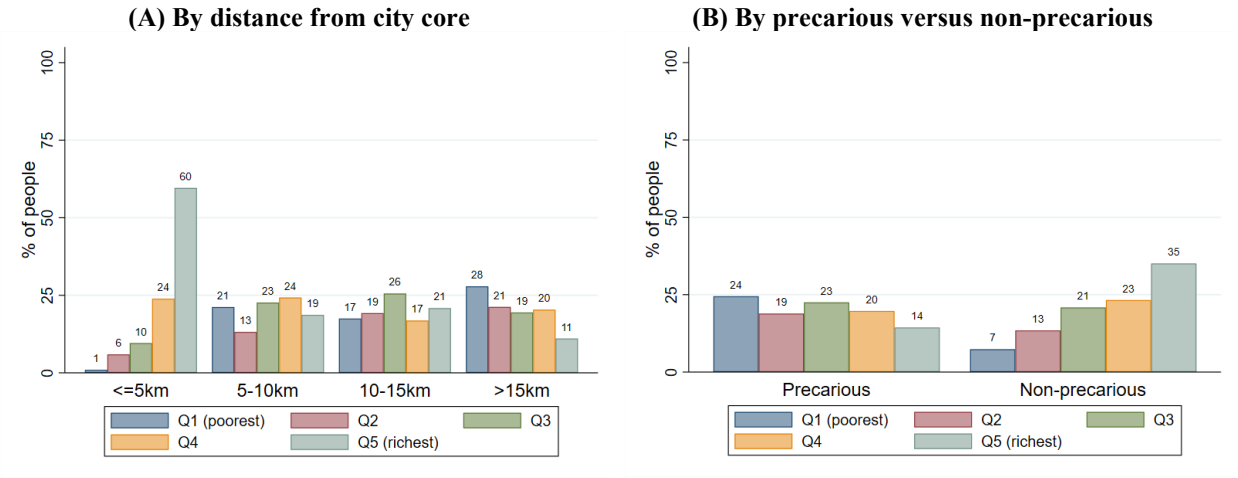
2.3 Socio-economic characteristics by residential locations

Urban centers and non-precarious neighborhoods are home to wealthier households. Figure 8 shows that the distribution of households across the five different quintiles of per adult-equivalent consumption expenditures varies significantly along these spatial dimensions.[9] More specifically, richer households live closer to the city core while poorer ones are largely excluded from the city core or its surrounding areas (Panel A). Similarly, non-precarious areas tend to host a higher proportion of richer households compared to precarious areas (Panel B). As discussed further in the following sections, these rich neighborhoods come with higher housing prices/rents and are largely inaccessible to poorer households who have no choice but to live in more affordable and yet precarious areas that are disconnected from core urban areas and suffer from poorer living conditions.

The wealthier status of those residents in the preferable neighborhoods allows them to purchase better access to key public services, which residents in the non-preferable neighborhoods may not be able to afford. While households living in the city core or non-precarious neighborhoods enjoy better access to services, their spending on these services is accordingly much larger than those households living in the peri-urban or precarious neighborhoods. For instance, the amount that residents in non-precarious neighborhoods spend on bills for electricity and stocking water (for own consumption) are 40 percent and 54 percent higher, respectively, than residents in precarious neighborhoods.

[9] The consumption expenditures are based on the 2018 Kinshasa Survey with adjusted sampling weights. See Batana et al. (2021) for details.

Figure 8: Consumption levels by geographic characteristics

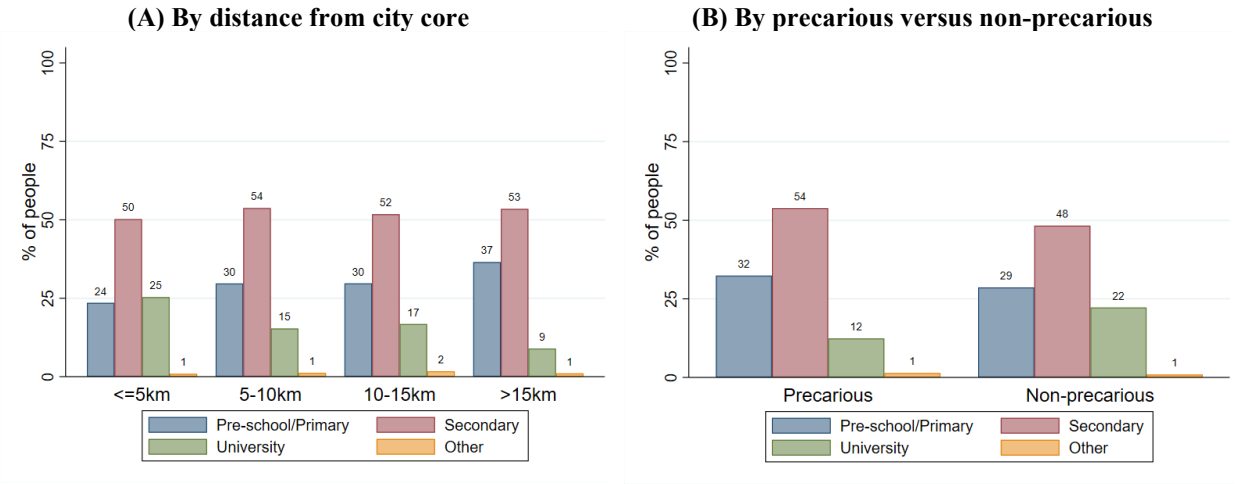


Source: Kinshasa Survey 2018.

Residents of neighborhoods that are located farther from the city core and precarious areas tend to have low levels of literacy/education. Whereas 90 percent (or 94 percent) of individuals in the city core or within the 5 km radius of the central business district of Gombe are literate (or attended school), the corresponding rate for those individuals who reside 15 km or farther away from the city core is 78 percent (or 88 percent). It is also clear that those individuals who reside in the city core are more highly educated than those outside the city core (Figure 9, Panel A). Of individuals who attended school, about 25 percent within the city core had university degrees, while this rate drops to less than 10 percent in areas outside the 15 km radius of the city core.

In terms of demographics of residents, some notable difference is also observed between precarious and non-precarious areas. For instance, those in precarious neighborhoods tend to have lower levels of education attainment than those in non-precarious neighborhoods (Figure 9, panel B). The former group is also more likely to be illiterate or have no schooling compared to the latter. Just as the level of education declines farther away from the city core or in precarious neighborhoods, household structures also differ significantly across areas within Kinshasa. For instance, the number of dependents tends to increase in peri-urban areas in comparison to the city core and in precarious areas compared to non-precarious areas. This pattern reflects the fact that poor households rely on having more children as a coping strategy against risks.

Figure 9. Education levels by geographic characteristics



Source: Kinshasa Survey 2018.

3. How do living conditions spatially vary in Kinshasa?

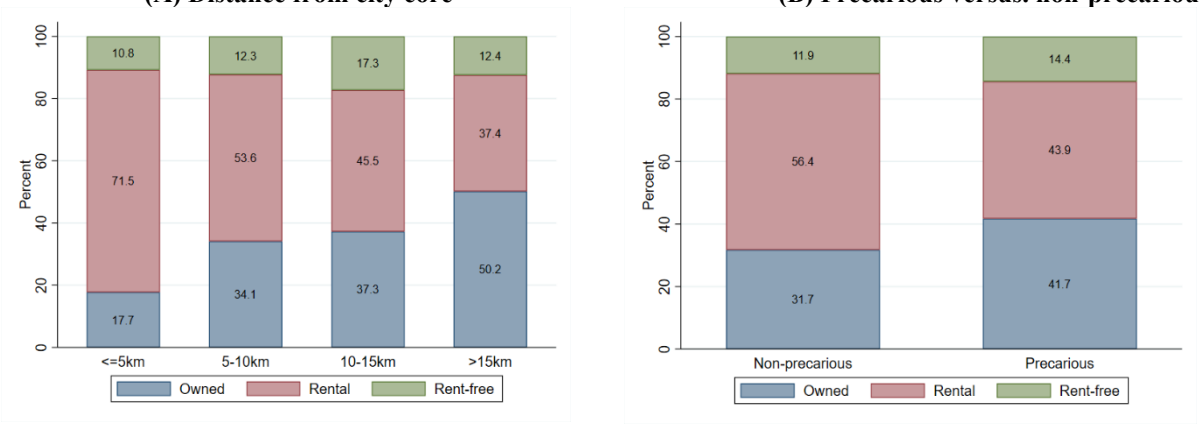
3.1 Housing

In urban Kinshasa, nearly half of the households are tenants. About 44 percent of the households are rent-paying tenants, while 42 percent are owners who do not pay rents (irrespective of the legal occupancy status). Another 14 percent of the households are accommodated based on a rent-free arrangement.

As with other cities with functioning housing markets, residential areas surrounding the city core have a larger share of rental units, whereas owner-occupied units tend to be located in the suburbs. In preferable areas near the city core, the owners of housing properties have a strong incentive to rent their properties out. Well-educated and/or young people, who prioritize good access to skilled jobs and urban amenities over space, prefer to live in such units. More than half of the housing units within 10 km from the city core are such rental units (Figure 10, panel A). Rental units are also more common in non-precarious neighborhoods than precarious areas (Figure 10, panel B).

Figure 10: Ownership of housing by geographic characteristics

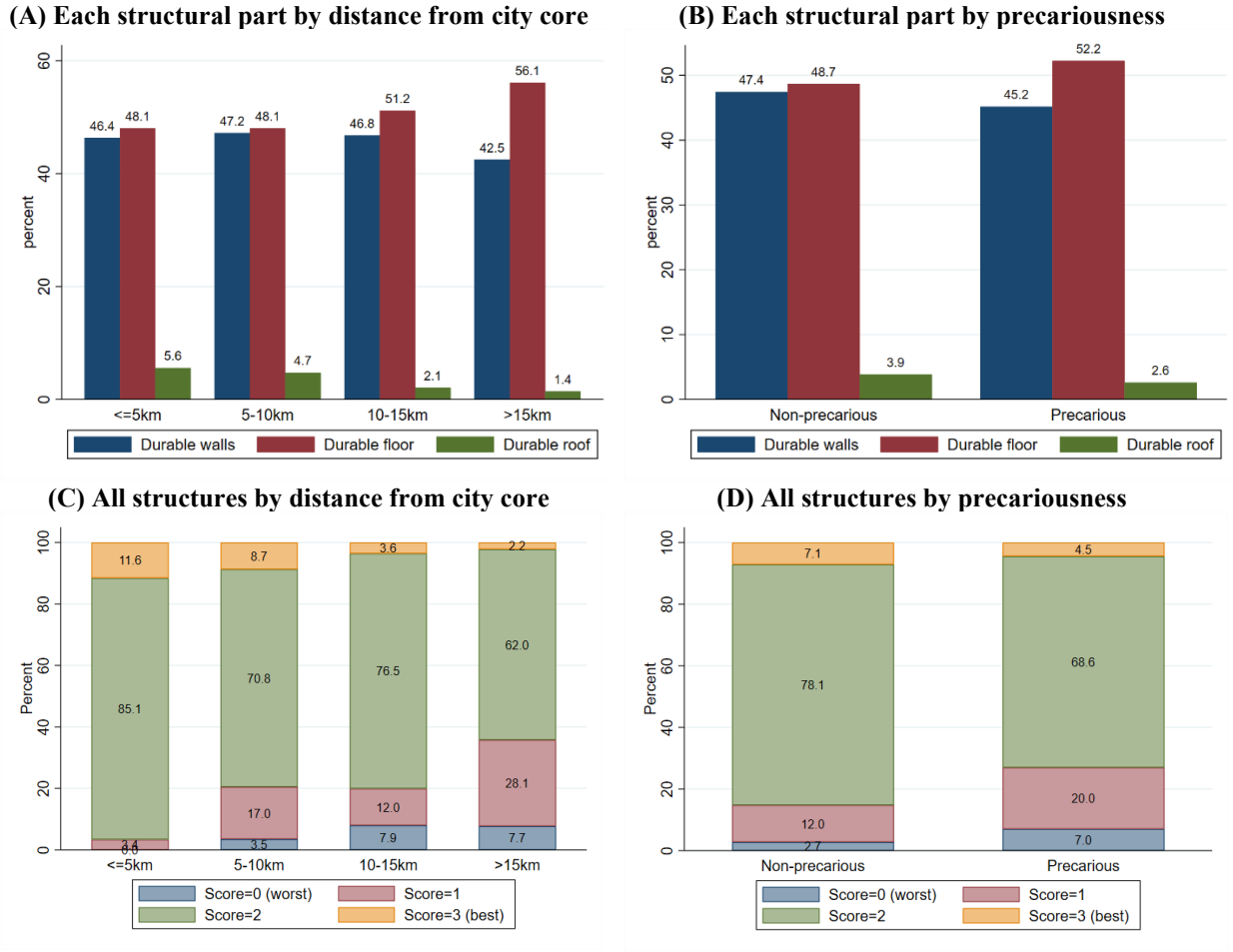
(A) Distance from city core **(B) Precarious versus. non-precarious**



Source: Authors' calculations based on the Kinshasa Survey.

Substandard housing is concentrated in neighborhoods that are located farther from the city core and/or are precarious. Panels A and B in Figure 11 show that the proportion of housing structured with durable materials for walls, rood, and floor separately. As the quality of dwelling is predicated on all of those three structures, it is worthwhile looking at how many of those three structures are made of durable materials. With this respect, dwelling quality is worse in parts of Kinshasa that are farther from the city core (Panel C). For example, most housing units within 5 km from the city core have at least two parts of the dwelling structure made of durable materials. Outside those areas, one-third or more of the housing units have only one part of the dwelling structure made of durable materials. In addition, precarious neighborhoods accommodate a larger share of sub-standard housing, which this note defines as those with none of (or only one of) walls, roof, or floor made of durable materials (Panel D).

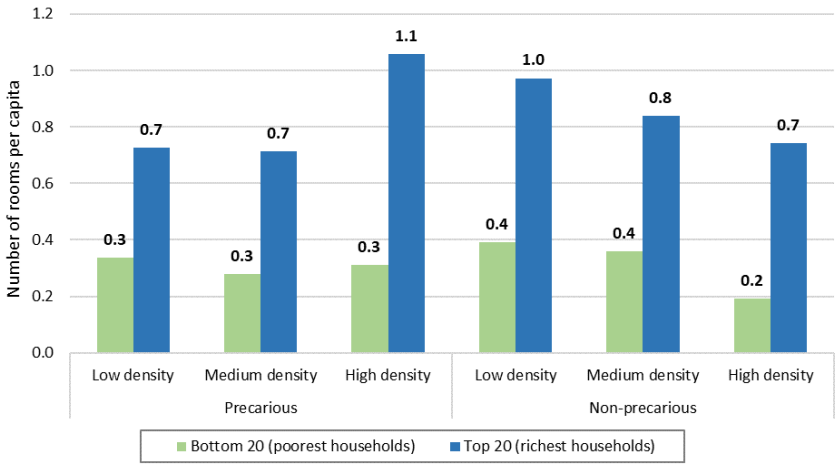
Figure 11: Housing material qualities by distance from the central business district (CBD) and precarious/non-precarious areas



Source: Authors' calculations based on the Kinshasa Survey.
Note: In Panels C and D, dwelling material qualities are measured on a scale of 0 through 3. The score registers a value of 1, 2, or 3 if durable materials are used for one, two, or all of wall (for example, concrete and burnt bricks), floor (for example, wood, floor tile, board, and cement), and roof (for example, concrete, slate, cement, and tile) while 0 means none of these are made out of such quality materials.

Regardless of neighborhood precariousness, low-income households endure overcrowding within their houses. In urban Kinshasa, each individual on average consumes half a room, as indicated by the average number of rooms per capita being 0.54. While richer people tend to live in relatively spacious houses (in terms of the number of rooms), people in the bottom 20 percentile of consumption expenditures consume limited space, either in precarious or non-precarious neighborhoods (Figure 12). Once the size of rooms—which is not available in the 2018 Kinshasa Survey—is considered, the overcrowding conditions faced by the poor and/or those who live in precarious neighborhoods would be even more stark.

Figure 12: Number of rooms per capita by neighborhood characteristics



Source: Authors' calculations based on the Kinshasa Survey.

3.2 Access to public services

Access to basic services in urban Kinshasa is worse than in other major Sub-Saharan African cities. Most households in major African cities—or more precisely, the largest city in each Sub-Saharan African country—have access to improved water (Table 1). However, access to piped water is still limited as only about 60 percent of the households. Kinshasa has a higher share of the households with access to piped water (68 percent), yet its share is still lower than, for example, Nairobi (81 percent) or Addis Ababa (91 percent). Moreover, compared to other major African cities (such as Lagos), a significantly lower proportion of households have access to limited or basic sanitation and electricity in Kinshasa.

Table 1: Comparison of access to services between Kinshasa and other cities in Sub-Saharan Africa

	Access to basic services (% households)			
	Improved water	Piped water	Limited and basic sanitation	Electricity
Kinshasa (2018)	91	68	46	59
Lagos (2013)	97	20	86	99
Nairobi (2016)	99	81	73	91
Dar es Salaam (2016)	98	49	94	74
Accra (2017)	99	15	96	94
Addis Ababa (2016)	91	91	56	99
Largest city in SSA (2012)	96	59	63	84

Source: Population and population density from Demographia 2019. Numbers for access to services are based on the Kinshasa Household Survey 2018 (Kinshasa); the DHS 2013 (Lagos); the Kenya Integrated Household Budget Survey (KIHBS) 2015/16 (Nairobi); the DHS 2016 (Dar es Salaam); the Ghana Living Standard Survey (GLSS) 7 2016/17 (Accra); the Household Consumption and Expenditure Survey (HCES) 2015/16 (Addis Ababa). Largest cities in Sub-Saharan Africa from Nakamura, Paliwal, and Yoshida (n.d.) as cited in Hommann and Lall (2019).
Note: 'Largest city in SSA' indicates the average of the largest city in each Sub-Saharan African country.

Access to public services by socio-economic characteristics

The level and quality of public services are closely associated with households' socio-economic characteristics. Figure 13 describes how the level and quality of access to key services, such as water (panel A); sanitation (panel B); and solid waste management (SWM), electricity, and the Internet (panel C); vary depending on demographic and income variables. For instance, as the dependency ratio and educational levels of household heads are strongly correlated with their income levels, it is not surprising to see the stark contrast in the level and quality of access to services between the poor and non-poor households. The gap is particularly wide between those with university degrees and others (even those who completed secondary education). No significant gap is observed along the gender of household heads.

Access to public services by geographic characteristics

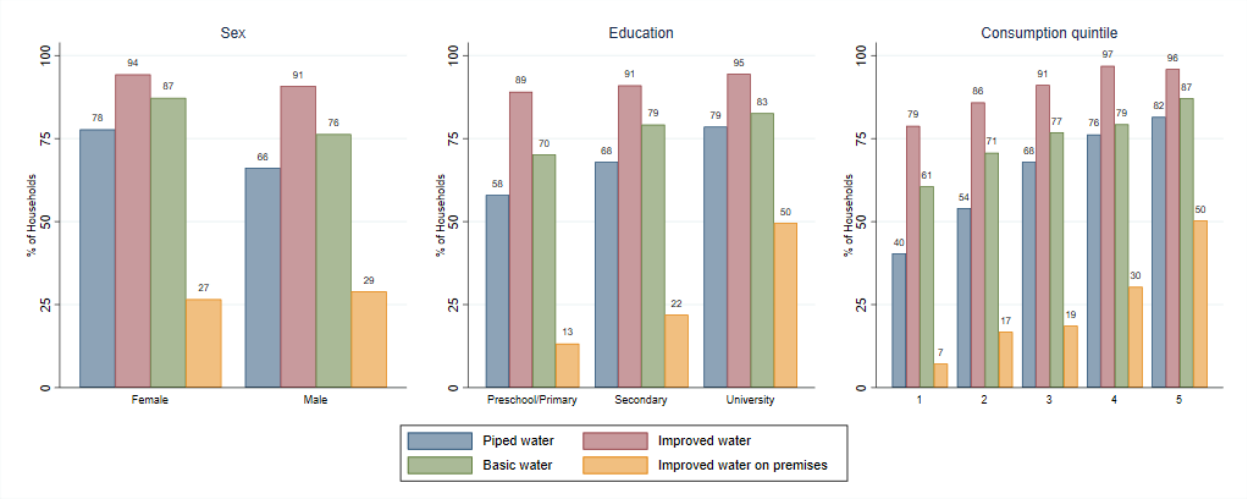
Alongside households' socio-economic characteristics, their residential locations are clearly associated with their levels of access to infrastructure and basic services. It is useful to distinguish the types of infrastructure and services based on the extent to which their installation is predicated on the networks of the trunk infrastructure. The access to piped water is an example of such infrastructure, as individual access to piped water relies on the networks of main water pipelines. The development of such main pipelines and the other local lines connected to them could cost less in a dense city. Infrastructure and basic services that are less network reliant include pit latrines. Septic tanks are more ideal in urban neighborhoods from a public health perspective, though fecal sludge management tends to be challenging in highly dense precarious neighborhoods. Therefore, density and precariousness may be associated with the development of infrastructure and services differently, depending on the types of infrastructure and services.

Within urban Kinshasa lie significant spatial disparities in terms of access to basic services. To illustrate this point, Figure 14, panel A shows spatial variation in access to electricity as captured by the intensity of nighttime light in 2018. It is immediately clear that much of electrification is concentrated in the city core and its immediate surroundings whereas areas farther than 15 km from the city core see very limited nighttime luminosity, which also indicates the low level of electrification. The pattern of electrification also seems to correspond with the road infrastructure network within the city. It is plausible that measures of nighttime light not only indicate access to electricity but also a higher concentration of people or economic activities along the road network.

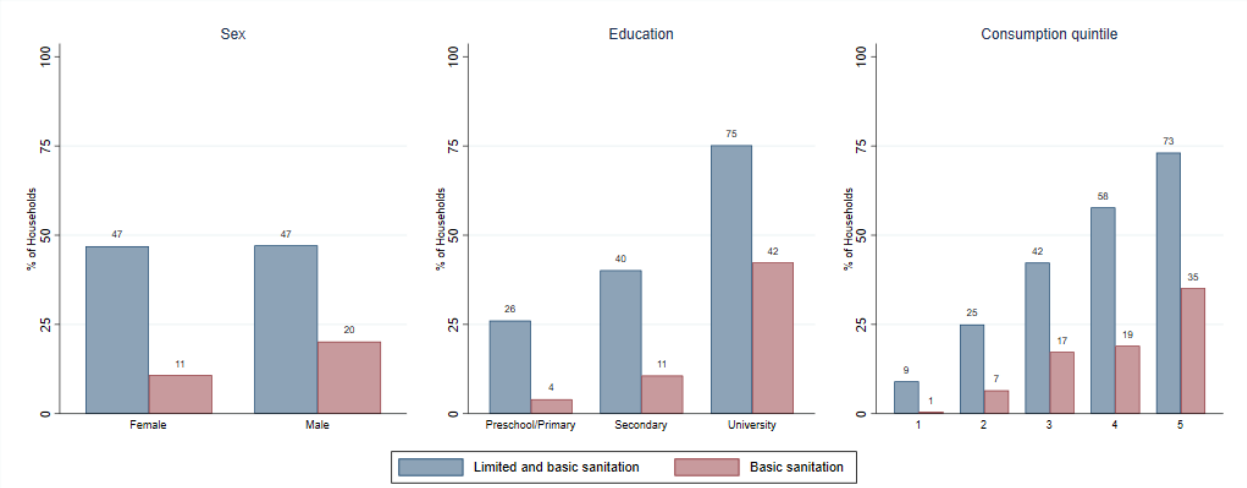
Access to schools and hospitals are very much constrained particularly in the peri-urban neighborhoods outside the 15 km radius of the city core. Not only does the road network become sparse outside the city core and its vicinities, but public transportation is also largely unavailable for a large swath of areas beyond those core urban areas (Figure 14, panel B). This potentially limits access to essential amenities such as schools and health facilities, which are unsurprisingly also concentrated in the city core and its immediate surroundings (Panels C and D in Figure 14). Because the welfare level of households is strongly and positively correlated with proximity to the city core, it is important to expand road accessibility in the peri-urban areas to ensure that poor households can also benefit from a tighter network of public infrastructure that agglomeration economies can offer.

Figure 13: The level of services by sociodemographic characteristics

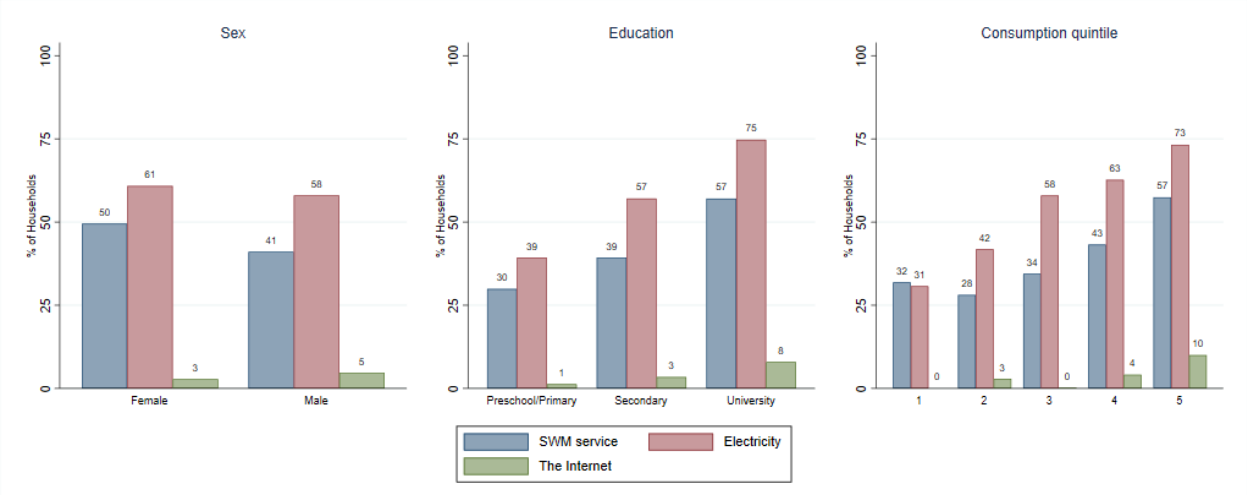
(A) Water supply



(B) Sanitation

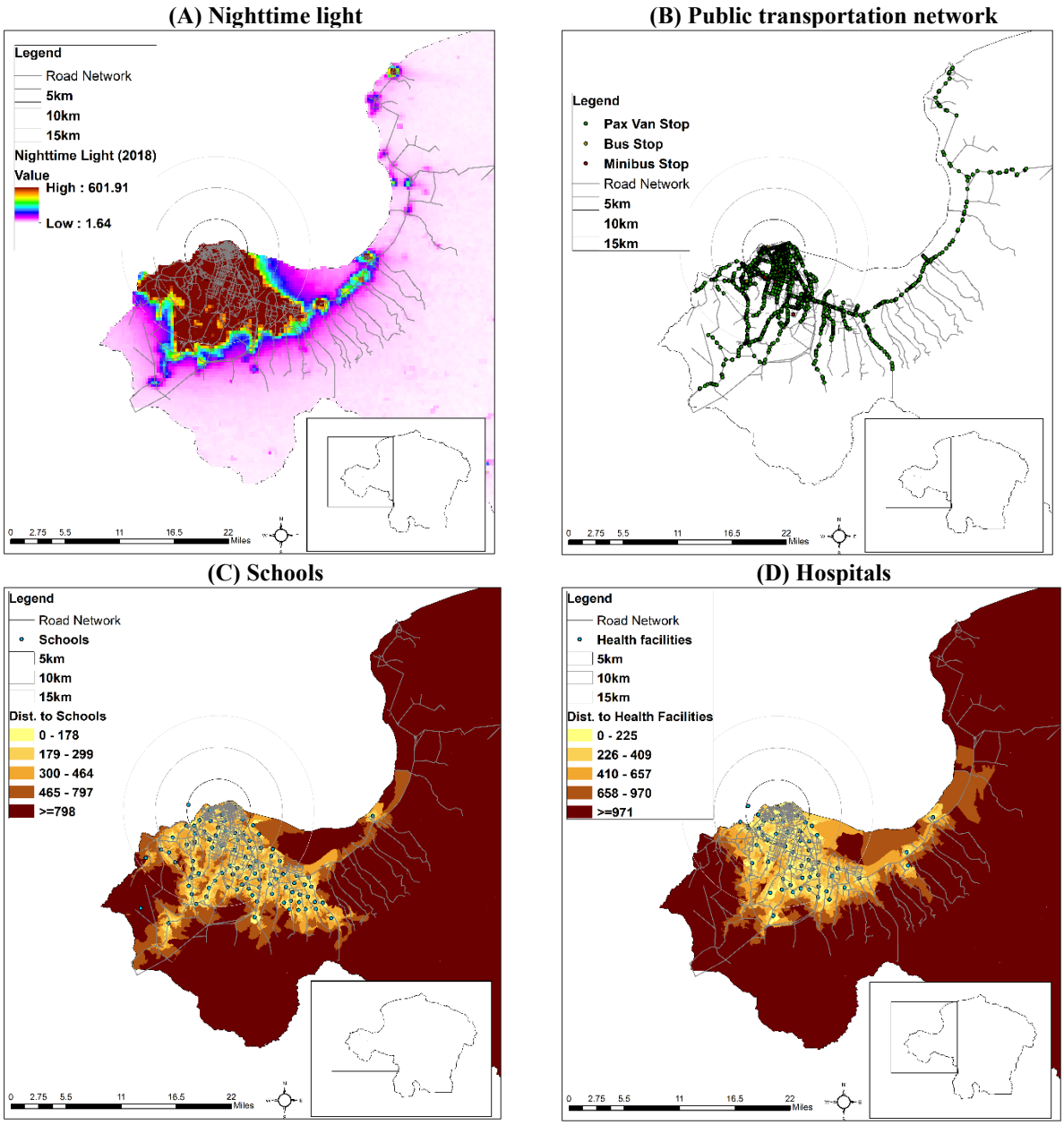


(C) Other services



Source: Authors' calculations based on the Kinshasa Survey.

Figure 14: Nighttime light, road access, and public transportation in Kinshasa



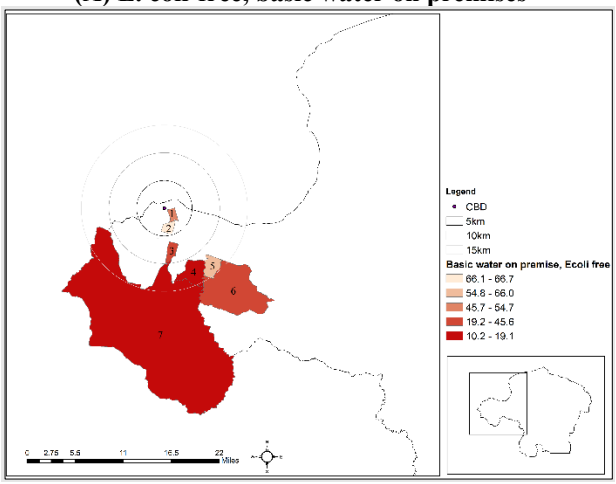
Source: Nighttime light data from Visible Infrared Imaging Radiometer Suite (VIIRS), road network and public transportation data from Japan International Cooperation Agency (JICA) Kinshasa transportation survey, and geographical locations of school and health facilities from OpenStreetMap.
Note: Panel A shows the sum of monthly nighttime luminosity data as recorded in 2018 (except for June where data is missing) and panel B presents the locations of stops for bus, minibus, and pax van. Panels C and D show the locations of education and health facilities as reported in OpenStreetMap and travel distance (in meters) to the closest facility.

The quality and level of water supply is particularly poor in the peri-urban areas outside the core urban areas, including Mont Ngafula and Kisenso. According to data from the WASH survey, for instance, access to water supply varies extensively across different communes within Kinshasa. For instance, the share of households with access to free basic water supply free of Escherichia

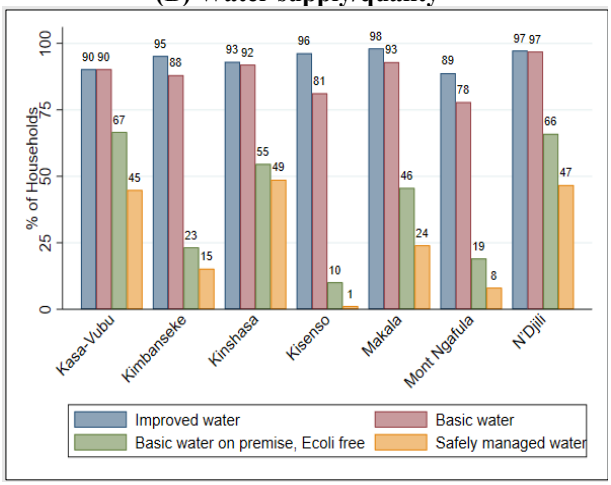
coli (E. coli) on premises is much higher in Kinshasa commune (55 percent), Kasa-Vubu commune (67 percent), and N'Djili commune (66 percent) compared to other lagging communes such as Kisenso commune (10 percent) and Mont Ngafula commune (19 percent) (see Figure 15). Only 1 percent and 8 percent of the households in these two lagging communes have access to safely managed water.[10]

Figure 15: Access to water supply, by commune

(A) E. coli-free, basic water on premises



(B) Water supply/quality



Source: WASH Survey.

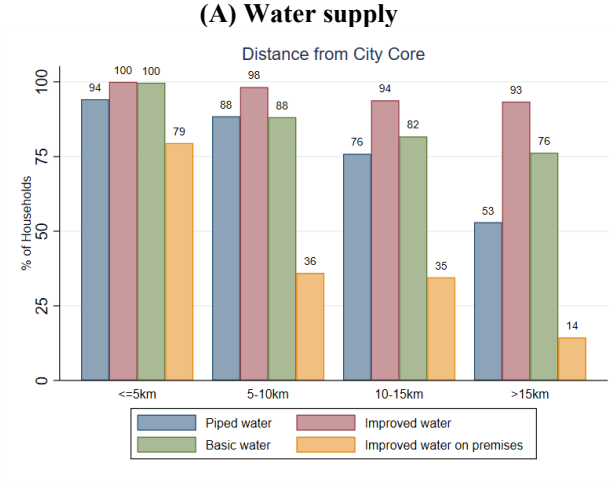
Note: Panel A shows only surveyed communes in the WASH survey. Percentage of households with access to basic water on premises, E. coli-free. The WASH survey covered seven different communes: 1 = Kinshasa, 2 = Kasa-Vubu, 3 = Makala, 4 = Kisenso, 5 = N'Djili, 6 = Kimbanseke, and 7 = Mont Ngafula.

Lower level—and the potential deterioration—of access to services in the peri-urban areas signals the failure of service delivery amid the rapid urban growth. The share of households with access to improved water tends to be lower in outer parts of urban Kinshasa (Figure 16, panel A). In addition, people tend to rely on lower quality of water access in neighborhoods farther from the city core. For example, only 14 percent of urban Kinshasa residents beyond 15 km from the city core have access to improved water on premises while this rate increases to 79 percent within the 5 km radius of the city core. A similar pattern is observed for sanitation and other public services (Panels B and C in Figure 16). As more population is added to peri-urban areas, the level of access to key services can be deteriorating.

[10] Safely managed water is defined as drinking water from an improved water source that is located on premises and available when needed and free from fecal and priority chemical contamination.

Figure 16: The level and quality of public services by distance from the city core

(A) Water supply



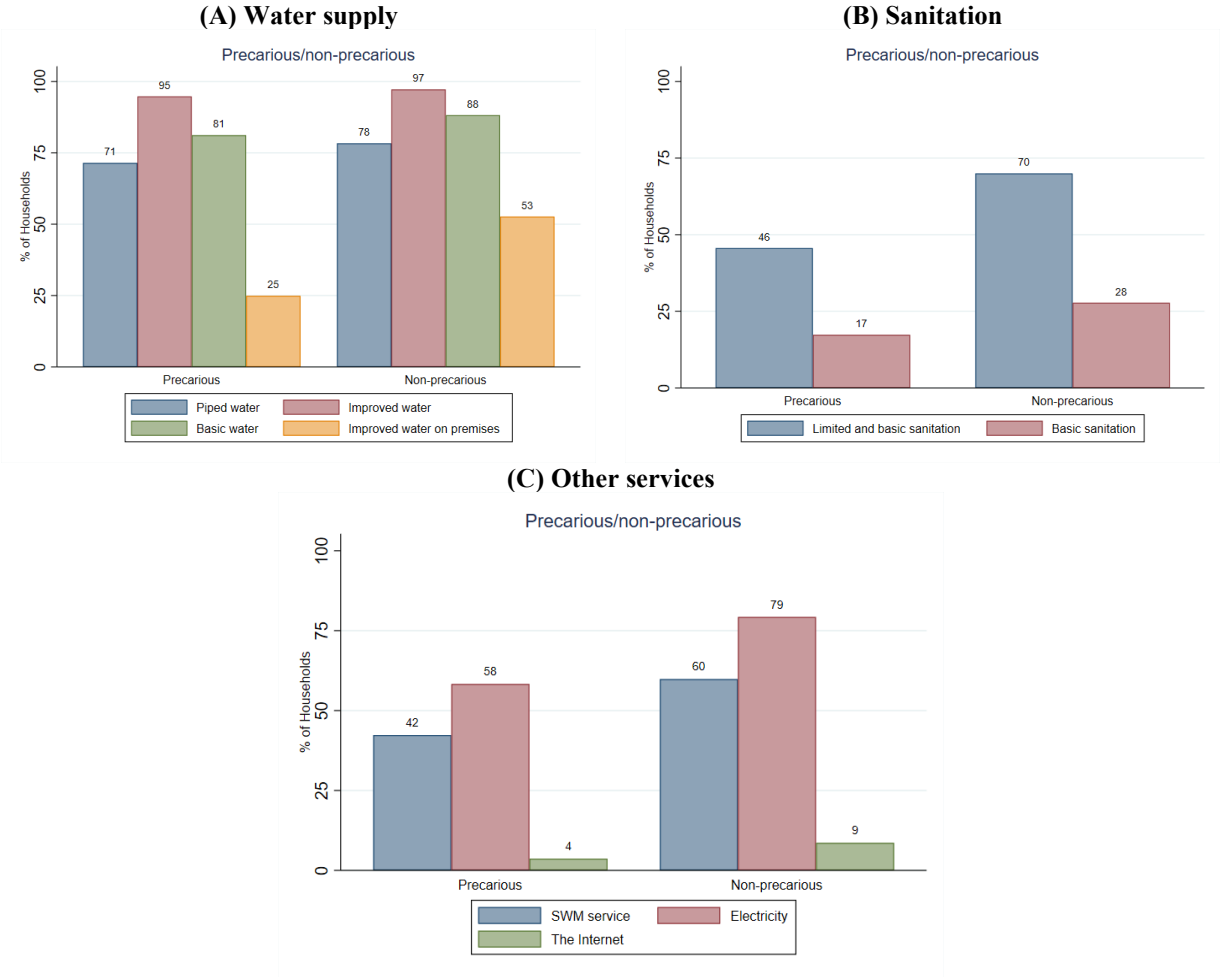
(B) Sanitation

(C) Other services

Source: Authors' calculations based on the Kinshasa Survey.

Although access to services is overall worse in precarious areas than non-precarious areas, there is a wide variation within precarious areas as well. In terms of water access, almost all households have access to some types of improved water even in precarious areas (Figure 17, panel A). That said, a relatively high proportion of them still rely on lower quality of water access, compared to those in non-precarious areas. The gap between precarious and non-precarious areas is much wider with respect to sanitation access and other public services. For instance, only half of the households in precarious areas have access to limited/basic sanitation, which is significantly lower than the corresponding rate in non-precarious areas of 70 percent (Figure 17, panel B).

Figure 17: The level of services by precarious versus non-precarious

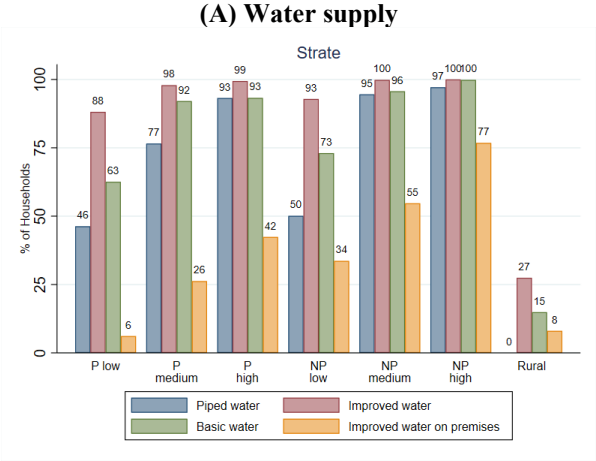


Source: Authors' calculations based on the Kinshasa Survey.

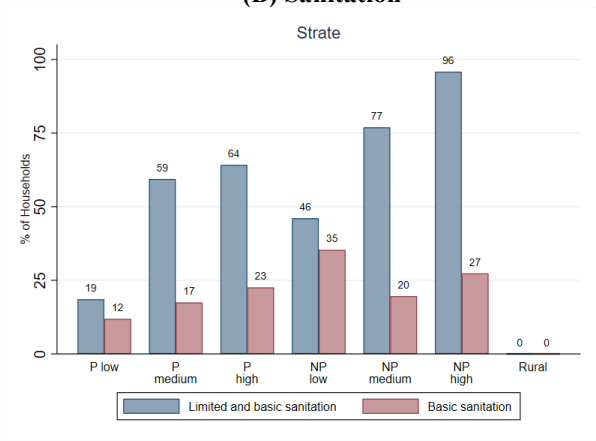
Population and building density correlates positively with the level and quality of services even within precarious areas. Households within precarious areas on average have better access to water and sanitation if those neighborhoods are characterized by a higher density of buildings, which also indicates a high concentration of people. Figure 18 shows the level of public services across seven different strata that were demarcated based on precarious/non-precarious areas and levels of building density. As clearly depicted in the figure, access to services improves from low-density to high-density areas and this pattern applies to both precarious and non-precarious areas. High-density areas are often accompanied by a tighter network of public goods such as schools, hospitals, roads, piped water, and sanitation facilities, among others, and people in those neighborhoods, regardless of precariousness or non-precariousness, appear to reap such agglomeration benefits.

Figure 18: The level of services by precariousness/non-precariousness and population density

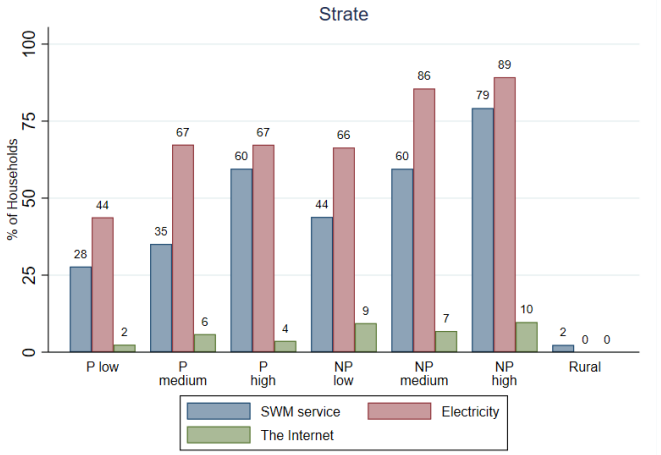
(A) Water supply



(B) Sanitation



(C) Other services



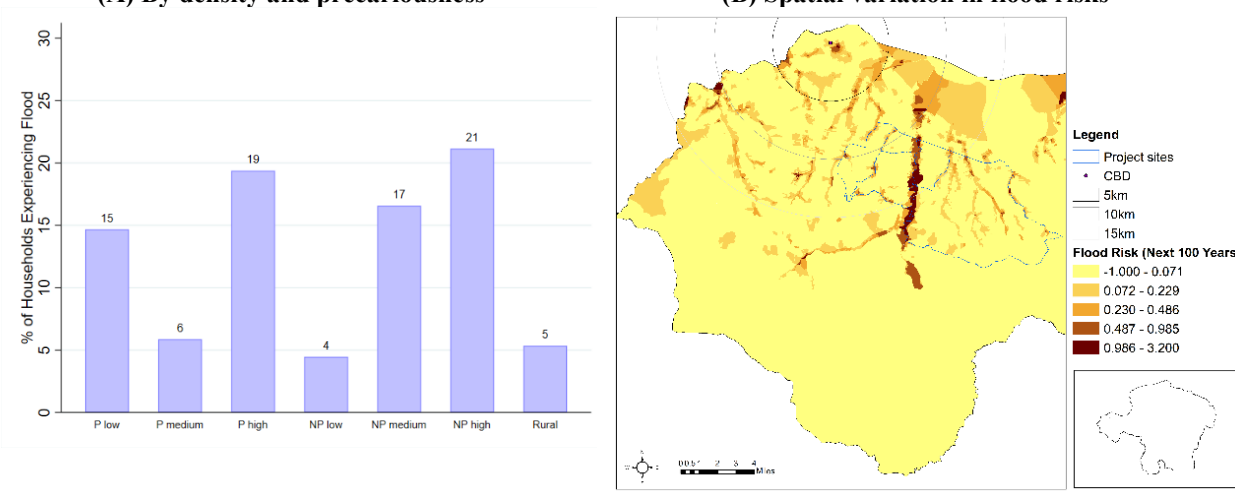
Source: Authors' calculations based on the Kinshasa Survey.
Note: Seven different strata as defined in the Kinshasa Survey are (a) low-density precarious areas (P low), (b) medium-density precarious areas (P medium), (c) high-density precarious areas (P high), (d) low-density non-precarious areas (NP low), (e) medium-density non-precarious areas (NP medium), (f) high-density non-precarious areas (NP high), and (g) rural areas.

3.3 Flooding

Flooding is one of the most frequent natural disasters that hit urban Kinshasa. About 14 percent of the households in the Kinshasa Survey reported being directly exposed to flooding, rendering them the most frequent disaster, followed by erosion (5 percent) and landslides (6 percent). The likelihood of exposure to flooding is particularly high in densely populated areas of Kinshasa (Figure 19, panel A). In the high-density precarious areas, about 19 percent of households reported being exposed to flooding while the corresponding rate is even higher in the high-density, non-precarious neighborhoods (21 percent).

Figure 19: Exposure to flood risks

(A) By density and precariousness **(B) Spatial variation in flood risks**



Source: Panel A shows the share of households that reported experiencing drought shocks in the Kinshasa Survey. Panel B shows the estimated depth of flooding (in meters) for the duration of 100 years according to the SSBN Global Flood Hazard dataset.

4. Key constraints to service delivery in Kinshasa and ways forward

4.1 Driving factors for inequality in access to services

While access to public services improves in more densely populated neighborhoods, the poor particularly benefit from agglomeration to gain access to services. To further analyze determining factors for access to services, a multivariate regression analysis is performed (see Table A.1 in the Annex for the full results).[11] As noted above, densely populated areas with better access to core public services tend to be concentrated in the city core and its surrounding areas and are also populated by wealthier and relatively highly educated households who can afford to live in those areas.[12] However, the multivariate regression analysis suggests that even after controlling for baseline demographic characteristics like consumption levels or education levels as well as other spatial features, households that reside in more densely populated areas are more likely to enjoy access to various services (for example, access to quality water and sanitation). This pattern may be explained partly by Kinshasa residents relocating into areas with better access to public

[11] A linear probability model (or ordinary least squares [OLS] regression) is performed to test the effects of demographic and geographic characteristics on households' probabilities of accessing basic public services—piped water, improved water, basic water, improved water on premises, limited/basic sanitation, basic sanitation, electricity, SWM services, and the Internet. All these service (outcome) variables enter the regression models as binary indicators (0 - no access and 1 - with access) and are modeled as a function of demographic characteristics (for example, age, gender, dependency ratio, and education); geographic characteristics (for example, distance to the CBD, building density or number of buildings per km^2, and high flood risk areas); and the welfare-level characteristics (as measured in the five different quintiles of per adult equivalent consumption expenditures).

[12] We also perform a multivariate regression to test determinants of education levels and find that while distance from CBD is significantly and negatively correlated with the likelihood of having tertiary education, this relationship does not stand robust to controlling for consumption levels (see Table A.2). This implies that relatively highly educated individuals living in or close to the city core also tend to be wealthier than those less educated or living outside the city core.

services—thereby increasing the overall density of those areas—even though this comes at the cost of paying higher prices/rents for housing.

As expected, access to network-dependent infrastructure, such as piped water, is more closely linked to distance from the city core and built-up density. While density is positively correlated with the chance of households' access to improved water and basic water, the linkage with piped water is stronger. This is because access to piped water is predicated on the networks of main water pipelines and the development of the main and local pipelines may be less costly in dense areas. For the same reason, the distance from the city core is also most strongly (negatively) correlated with households' chance of having access to piped water. In case of sanitation access, there is no clear relationship observed between density and access to basic sanitation, reflecting that use of pit latrines are location specific.

The benefits of agglomeration, however, are not uniform across different segments of the population. In particular, living in highly dense neighborhoods improves the odds of having access to quality water services (for example, piped/improved/basic water) particularly for the poorest households (for example, the bottom 20 percentile of consumption) while richer households stand to benefit more in terms of access to some of the other services such as limited/basic sanitation or SWM services.[13] Even if it is preferable to live in dense and/or well-connected neighborhoods, those poor households may not necessarily be able to afford those amenities. One of the potential reasons for this pattern may be that rents for neighborhoods with access to these services tend to be more expensive, which in turn deter poor households from living in those areas.

Households with higher levels of education stand to benefit from greater access to core public services although these education dividends are not uniform across different age groups. Even after accounting for various spatial and demographic characteristics, education attainment is positively correlated with access to high-quality services such as improved water on premises, basic sanitation, SWM services, and electricity. Education dividends are particularly evident for a relatively small fraction of households whose heads had completed university degrees. This finding does not come as a surprise given that those highly educated individuals tend to concentrate in neighborhoods that are proximate to the city core and have greater access to quality public services. That being said, these education dividends do not accrue to all age groups. More specifically, households headed by young working-age individuals (15–24 years) do not seem to enjoy greater access to services even if they have higher levels of education. [14]

4.2 Costs of living in housing and neighborhoods with better access to services

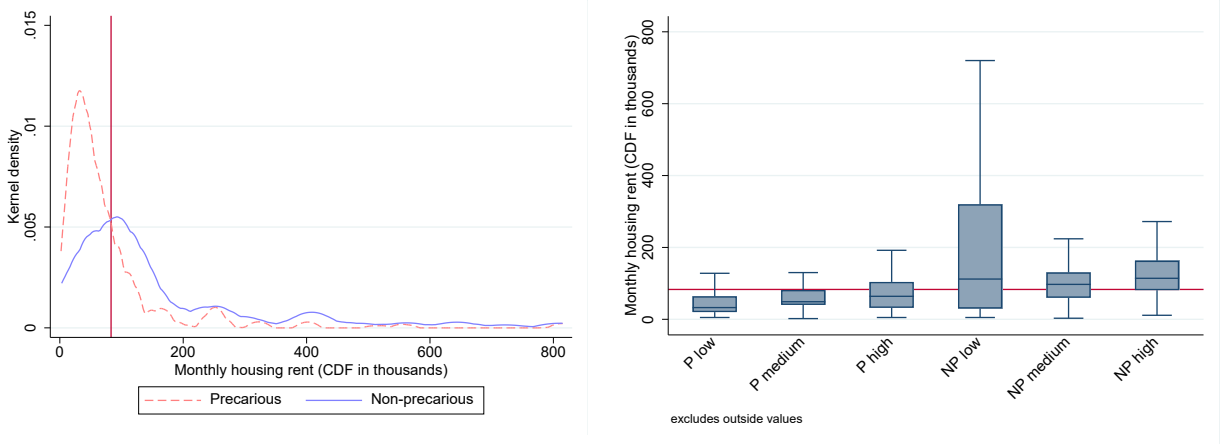
An obvious reason why low-income residents have low level (or quality) of access to services is that they cannot afford such services. However, another equally important reason is that they cannot live in neighborhoods that are well connected to basic services and other amenities. In functioning housing markets, housing values are expected to reflect the level and quality of access to amenities. Housing rents are clearly lower in precarious neighborhoods and/or peri-urban areas (Figure 20). By allocating 20 percent of its monthly budget for housing, a household with its monthly consumption expenditures equivalent to the median value of Kinshasa households can

[13] These are indicated by negative interaction effects between wealth and building density in Table A.1.
[14] These are indicated by negative interaction effects between education levels and youth dummy variable in Table A.1.

mostly afford housing units in precarious neighborhoods. Also, there is a stark contrast in housing rents, depending on the quality and access to services (Figure 21). Given the limited budget that can be allocated for housing, low-income households need to determine their residences by weighing the costs and benefits based on their preferences.

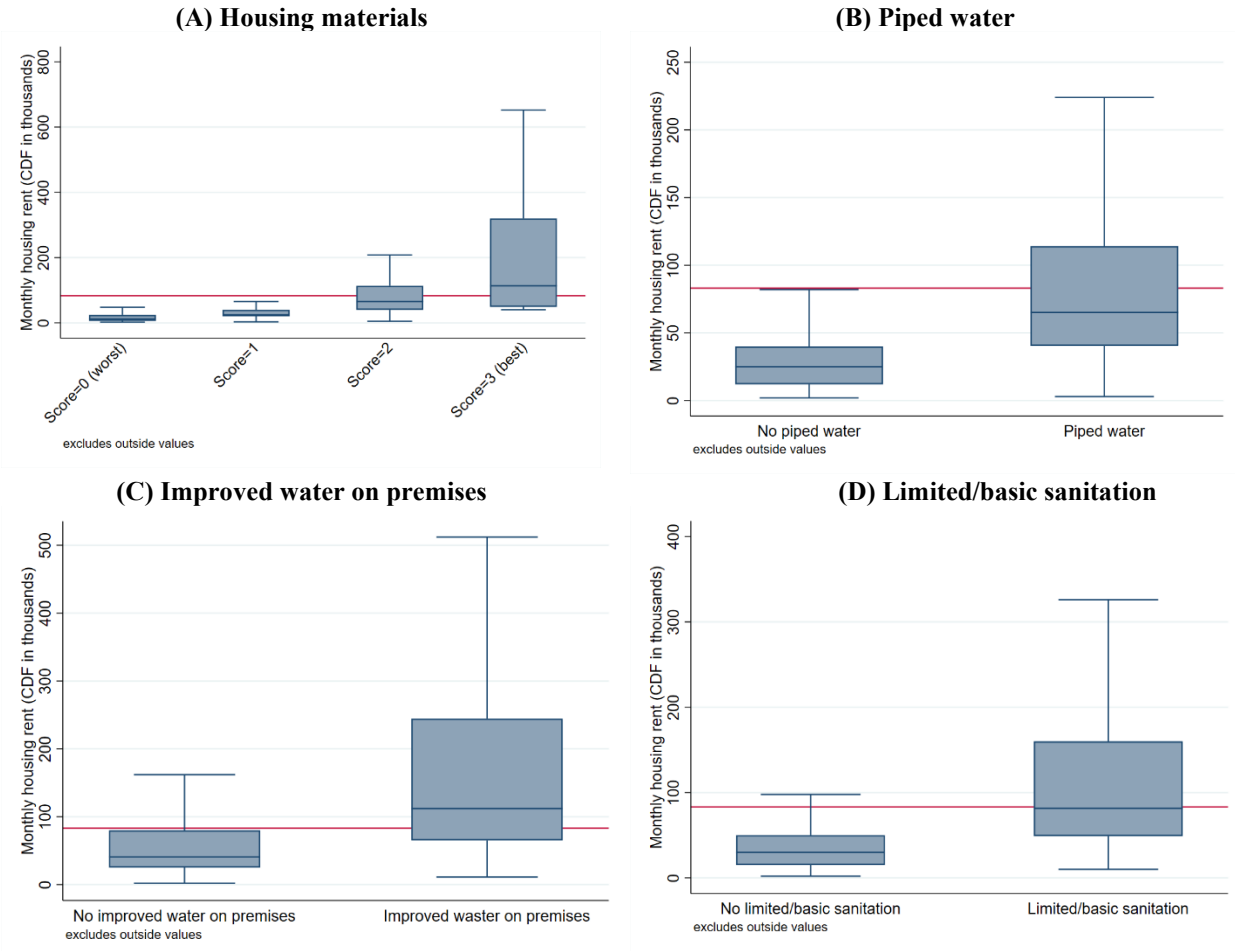
Figure 20: Housing rents by locations

(A) By precariousness **(B) By precariousness and density**



Source: Authors' calculations based on the Kinshasa Survey.
Note: Seven different strata as defined in the Kinshasa Survey are (a) low-density precarious areas (P low), (b) medium-density precarious areas (P medium), (c) high-density precarious areas (P high), (d) low-density non-precarious areas (NP low), (e) medium-density non-precarious areas (NP medium), and (f) high-density non-precarious areas (NP high). Red line indicates the median monthly consumption value (CDF 83,000).

Figure 21: Housing rents by housing materials and access to services



Source: Authors' calculations based on the Kinshasa Survey.
Notes: Red line indicates the median monthly consumption value (CDF 83,000).

Kinshasa's housing market is functioning (at least in the rental market) in a sense, meaning that there is no free lunch in obtaining access to amenities. A hedonic regression analysis is carried out to analyze such trade-off in residential choices (see Table A.3 in the Annex for the full results).[15] The estimated hedonic regression model explains the variation of housing rents, suggesting that housing rents reasonably reflect the quality of dwelling, access to services and other neighborhood/location characteristics. Indeed, rents are higher for housing that is structured with walls, roof, and floor made of better materials and/or equipped with better access to water, sanitation, SWM, and electricity. Thus, as far as rental units are concerned, one has to pay an extra amount of rent to obtain each of those better amenities.

Kinshasa residents need to pay extra to live closer to the city core and are even ready to tolerate low quality of dwelling and service access. As already observed in the earlier section, housing

[15] The hedonic regression model is an OLS model, which is estimated for the sample of rental units. The dependent variable is the natural logarithm of the monthly housing rents. The independent variables include the quality of dwelling structure; access to service, such as water, sanitation, electricity, SWM; and several locational factors, including distance from the CBD, precariousness of the neighborhood, and flood risk.

rents tend to be higher in locations closer to the city core. More specifically, housing rents become on average 11 percent lower every 1 km away from the city core. This negative correlation between the distance from the city core and housing rents remains statistically significant even after controlling for the quality of dwelling characteristics and access to services (4 percent lower rents with every 1 km away from the CBD). This suggests that given the characteristics of dwelling and access to services, it still costs extra to live closer to the city core, where economic opportunities and urban amenities are concentrated.

Moreover, it is less expensive to live in neighborhoods that are precarious and/or are prone to flooding (even after controlling for dwelling and service quality), therefore attracting low-income households. As already seen, housing rents are clearly lower in precarious areas. This is partly because those housing units tend to be structured with low-quality materials and lack access to services. Even after discounting such low-quality aspects, housing rents are on average 20 percent lower in precarious areas, compared to non-precarious areas. There may be some other negative characteristics (that is, disamenities) in precarious neighborhoods. Nevertheless, such disamenities lower the rents in precarious areas and thereby attract low-income households. Similar discount in rents is found in neighborhoods that are prone to flooding (11 percent lower rents).

5. Conclusion

Drawing on recently collected household survey data, this paper examines living conditions in Kinshasa, by focusing on its spatial variations. The key findings are summarized as follows. First, worse living conditions are endured by poor and/or less educated households in precarious and/or peri-urban neighborhoods. Second, inequality in access to water is driven by locational factors, while sanitation access depends on household characteristics, such as the education levels of household heads. Third, while there is a concern about negative externalities from Kinshasa's extremely high population and built-up density, poor households benefit from density to some extent, as indicated by a higher chance of their gaining access to basic services in dense neighborhoods. Finally, high housing costs in neighborhoods closer to the city core restrict access to economic opportunities and services among low-income households.

It is imperative to increase the supply of affordable housing to lessen the inequality of access to services in Kinshasa. Without providing affordable housing in the core urban areas of Kinshasa, the poor will continue to be excluded from the service benefits of city agglomeration —a tighter network of public services that more densely populated areas offer, such as public taps, public toilets, or SWM services that are less frequently seen in more sparsely populated peri-urban areas. At the same time, it is imperative that targeted investments are made in key peri-urban areas to reduce such spatial inequalities and improve access to basic public services for the poor households that seem to concentrate in those peri-urban or rural neighborhoods.

The proliferation of precarious neighborhoods in the extremely dense and populous city makes its residents potentially vulnerable to the COVID-19 pandemic. While density brings various benefits, it creates serious problems if not managed well. The risk of the spread of COVID-19 is very high in neighborhoods characterized by high population density, overcrowded housing, inadequate access to water, sanitation, and SWM services, and frequent exposure to flooding. As shown in this note, many precarious neighborhoods in Kinshasa have such characteristics. Spatially targeted preventive interventions that reduce such risk are critically important.

Annex A: Regression tables

Table A.1: Regression analysis on the determinants of access to services

	Piped water	Improved water	Basic water	Improved water on premises
Age	0.002	−0.000	−0.000	0.003
	(0.002)	(0.001)	(0.001)	(0.002)*
Female	−0.025	0.023	−0.050	0.019
	(0.039)	(0.018)	(0.031)	(0.040)
1 dependent per working-age person	−0.047	−0.054	−0.046	0.055
	(0.041)	(0.034)	(0.043)	(0.053)
1−2 dependents per working-age person	−0.110	−0.025	−0.053	0.043
	(0.068)	(0.024)	(0.039)	(0.061)
> 2 dependents per working-age person	−0.115	−0.075	−0.158	0.053
	(0.085)	(0.075)	(0.093)*	(0.065)
Secondary	0.078	−0.028	0.076	0.057
	(0.054)	(0.033)	(0.093)	(0.033)*
University	0.051	−0.063	0.024	0.198
	(0.061)	(0.036)*	(0.074)	(0.050)***
Distance from CBD	−0.078	−0.009	−0.028	−0.019
	(0.013)***	(0.008)	(0.014)**	(0.015)
Distance from CBD (squared)	0.003	0.001	0.001	0.001
	(0.000)***	(0.000)*	(0.000)***	(0.000)*
Young working age 15−24	0.564	−0.015	0.229	0.146
	(0.170)***	(0.104)	(0.106)**	(0.068)**
Young working age 15−24	−0.586	−0.021	−0.213	−0.133
×Secondary	(0.173)***	(0.113)	(0.122)*	(0.130)
Young working age 15−24	−0.396	0.036	−0.329	−0.437
×University	(0.205)*	(0.118)	(0.200)	(0.164)***
Consumption quintile (20–40 percentile)	0.486	0.482	0.569	−0.194
	(0.229)**	(0.212)**	(0.251)**	(0.172)
Consumption quintile (40–60 percentile)	0.394	0.278	0.589	−0.158
	(0.261)	(0.217)	(0.293)**	(0.151)
Consumption quintile (60–80 percentile)	1.030	0.826	1.069	0.002
	(0.310)***	(0.222)***	(0.381)***	(0.307)
Consumption quintile (80–100 percentile)	1.575	0.877	0.790	0.092
(The richest)	(0.377)***	(0.341)**	(0.527)	(0.458)
Building density (log transformed)	0.343	0.160	0.278	0.096
	(0.038)***	(0.046)***	(0.058)***	(0.031)***
Building density (log transformed)	−0.057	−0.063	−0.074	0.035
×Consumption quintile (20–40 percentile)	(0.030)*	(0.026)**	(0.032)**	(0.027)
Building density (log transformed)	−0.038	−0.035	−0.077	0.027
×Consumption quintile (40–60 percentile)	(0.032)	(0.027)	(0.037)**	(0.023)
Building density (log transformed)	−0.116	−0.101	−0.140	0.019
×Consumption quintile (60–80 percentile)	(0.039)***	(0.027)***	(0.048)***	(0.042)
Building density (log transformed)	−0.184	−0.110	−0.095	0.027
×Consumption quintile (80–100 percentile)	(0.050)***	(0.040)***	(0.065)	(0.056)
Precarious	−0.071	0.040	0.060	0.187
	(0.082)	(0.027)	(0.063)	(0.067)***
Flood risk - high	0.026	0.010	0.113	−0.032
	(0.075)	(0.026)	(0.046)**	(0.048)
Adjusted R-squared	0.39	0.18	0.22	0.23
Observation	1,511	1,511	1,512	1,525

Note: Standard errors in parentheses and clustered by primary sampling units. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.1 (continued): Regression analysis on the determinants of access to services

	Limited/basic sanitation	Basic sanitation	SWM	Electricity	Internet
Age	0.004	0.006	0.001	−0.002	0.001
	(0.002)**	(0.001)***	(0.002)	(0.002)	(0.001)
Female	−0.014	0.017	−0.080	−0.007	0.021
	(0.042)	(0.032)	(0.069)	(0.054)	(0.018)
1 dependent per working-age person	0.024	0.072	0.007	−0.046	−0.002
	(0.060)	(0.052)	(0.061)	(0.060)	(0.035)
1−2 dependents per working-age person	−0.010	0.083	−0.035	0.003	−0.006
	(0.069)	(0.039)**	(0.064)	(0.049)	(0.031)
> 2 dependents per working-age person	−0.012	0.047	0.100	0.013	−0.000
	(0.065)	(0.057)	(0.111)	(0.065)	(0.033)
Secondary	0.079	0.080	0.056	0.119	0.005
	(0.056)	(0.036)**	(0.049)	(0.069)*	(0.019)
University	0.268	0.321	0.154	0.198	0.020
	(0.074)***	(0.067)***	(0.078)**	(0.089)**	(0.017)
Distance from CBD	−0.048	0.009	−0.050	−0.079	−0.007
	(0.011)***	(0.010)	(0.020)**	(0.016)***	(0.004)**
Distance from CBD (squared)	0.002	−0.000	0.001	0.002	0.000
	(0.000)***	(0.000)	(0.001)***	(0.001)***	(0.000)*
Young working age 15−24	0.117	0.217	−0.130	−0.249	0.001
	(0.118)	(0.100)**	(0.194)	(0.238)	(0.045)
Young working age 15−24	0.091	−0.210	0.152	−0.037	−0.023
×Secondary	(0.161)	(0.105)**	(0.265)	(0.271)	(0.041)
Young working age 15−24	−0.610	−0.353	−0.064	−0.231	−0.094
×University	(0.201)***	(0.189)*	(0.302)	(0.284)	(0.052)*
Consumption quintile (20–40 percentile)	−0.601	−0.141	−0.869	0.234	−0.015
	(0.235)**	(0.121)	(0.330)***	(0.279)	(0.052)
Consumption quintile (40–60 percentile)	−0.457	0.069	−0.815	0.155	−0.024
	(0.255)*	(0.169)	(0.399)**	(0.338)	(0.032)
Consumption quintile (60–80 percentile)	−0.208	0.422	−1.136	0.414	−0.119
	(0.228)	(0.227)*	(0.337)***	(0.399)	(0.108)
Consumption quintile (80–100 percentile)	0.111	0.864	−0.277	0.862	0.151
[The richest]	(0.475)	(0.399)**	(0.605)	(0.558)	(0.261)
Building density (log transformed)	0.125	−0.015	0.031	0.094	0.007
	(0.034)***	(0.018)	(0.052)	(0.062)	(0.009)
Building density (log transformed)	0.100	0.025	0.106	−0.026	0.005
×Consumption quintile (20−40 percentile)	(0.034)***	(0.016)	(0.043)**	(0.039)	(0.007)
Building density (log transformed)	0.095	0.012	0.098	−0.006	0.002
×Consumption quintile (40−60 percentile)	(0.036)***	(0.022)	(0.049)**	(0.042)	(0.004)
Building density (log transformed)	0.077	−0.032	0.148	−0.040	0.019
×Consumption quintile (60−80 percentile)	(0.030)**	(0.028)	(0.040)***	(0.043)	(0.015)
Building density (log transformed)	0.047	−0.076	0.048	−0.094	−0.009
×Consumption quintile (80−100 percentile)	(0.056)	(0.048)	(0.074)	(0.060)	(0.032)
Precarious	0.072	0.018	0.028	−0.016	0.020
	(0.064)	(0.056)	(0.088)	(0.071)	(0.022)
Flood risk - high	−0.081	0.013	−0.001	0.053	0.017
	(0.072)	(0.102)	(0.094)	(0.090)	(0.034)
Adjusted R-squared	0.38	0.23	0.16	0.26	0.05
Observation	1,509	1,509	1,450	1,526	1,526

Note: Standard errors in parentheses and clustered by primary sampling units. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.2 : Regression analysis on the determinants of education levels

Dependent variable	Preschool/ primary	Secondary	Tertiary	Preschool /primary	Secondary	Tertiary
Distance	0.004	0.006	-0.010	0.002	0.003	-0.005
from CBD	(0.005)	(0.006)	(0.005)**	(0.004)	(0.005)	(0.004)
Building density	-0.010	0.017	-0.007	-0.018	0.034	-0.017
(log transformed)	(0.023)	(0.027)	(0.024)	(0.022)	(0.024)	(0.019)
Precarious	-0.019	-0.098	0.118	-0.005	-0.022	0.027
	(0.037)	(0.049)**	(0.062)*	(0.038)	(0.044)	(0.054)
Flood risk - high	0.068	-0.080	0.012	0.010	-0.040	0.030
	(0.059)	(0.076)	(0.048)	(0.074)	(0.075)	(0.057)
Age				0.003	-0.008	0.005
				(0.001)***	(0.002)***	(0.002)***
Female				-0.171	-0.013	0.184
				(0.033)***	(0.039)	(0.035)***
1 dependent per				-0.011	0.142	-0.131
working-age person				(0.024)	(0.063)**	(0.067)*
1−2 dependents per				0.009	0.160	-0.169
working-age person				(0.040)	(0.076)**	(0.080)**
> 2 dependents per				0.084	0.141	-0.225
working-age person				(0.082)	(0.108)	(0.076)***
Consumption quintile				-0.023	-0.114	0.136
(20–40 percentile)				(0.056)	(0.071)	(0.044)***
Consumption quintile				-0.072	-0.071	0.144
(40–60 percentile)				(0.063)	(0.070)	(0.054)***
Consumption quintile				-0.077	-0.138	0.214
(60–80 percentile)				(0.076)	(0.064)**	(0.052)***
Consumption quintile				-0.100	-0.327	0.427
(80–100 percentile)				(0.057)*	(0.068)***	(0.059)***
(Richest)						
Adjusted R-squared	0.01	0.01	0.03	0.10	0.12	0.20
Observation	1,792	1,792	1,792	1,526	1,526	1,526

Note: Standard errors in parentheses and clustered by primary sampling units. Each of these regressions conducts a linear probability model testing the effects of each covariate on the likelihood that household heads have preschool/primary (the first and fourth columns), secondary (the second and fifth columns), and tertiary education (the third and sixth columns). $^{*}p < 0.1$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A.3 : Hedonic regression results

	(1)	(2)	(3)	(4)
Score=0 (worst) [reference]				
Score=1	0.505***	0.472***	0.479***	0.476***
	(0.115)	(0.095)	(0.093)	(0.095)
Score=2	0.939***	0.695***	0.715***	0.701***
	(0.118)	(0.098)	(0.097)	(0.098)
Score=3 (best)	1.201***	0.804***	0.824***	0.807***
	(0.143)	(0.120)	(0.118)	(0.119)
Tap inside dwelling [reference]				
Tap outside dwelling		−0.021	−0.003	−0.019
		(0.068)	(0.067)	(0.068)
Public tap		−0.404***	−0.339***	−0.402***
		(0.120)	(0.118)	(0.120)
Shared tap		−0.255***	−0.214***	−0.253***
		(0.073)	(0.072)	(0.073)
Other improved water		−0.471***	−0.461***	−0.476***
		(0.080)	(0.079)	(0.080)
Unimproved water		−0.604***	−0.548***	−0.612***
		(0.124)	(0.122)	(0.124)
Flush toilet inside dwelling [reference]				
Flush toilet outside dwelling		−0.360***	−0.376***	−0.364***
		(0.078)	(0.077)	(0.078)
Pit latrine		−0.496***	−0.493***	−0.494***
		(0.066)	(0.065)	(0.066)
Unimproved sanitation		−0.880***	−0.867***	−0.875***
		(0.079)	(0.078)	(0.079)
SWM service		0.169***	0.161***	0.156***
		(0.038)	(0.038)	(0.039)
Electricity		0.226***	0.206***	0.228***
		(0.046)	(0.046)	(0.046)
Distance from CBD	−0.122***	−0.043***	−0.024***	−0.046***
	(0.008)	(0.008)	(0.008)	(0.008)
Distance from CBD (squared)	0.002***	0.000**	−0.000	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)
Precarious			−0.225***	
			(0.038)	
Flood risk - high				−0.123**
				(0.059)
Adjusted R-squared	0.693	0.798	0.804	0.798
Observation	1,082	1,018	1,018	1,018

Note: Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Additional controls include the number of rooms.

References

Adoho, Franck, and Romeo Gansey. 2018. "Migration and Welfare in the Democratic Republic of Congo." Washington, DC: World Bank.

Anglewicz, P., J. Corker, and P. Kayembe. 2017. "The Fertility of Internal Migrants to Kinshasa." *Genus* 73 (4): 1–18.

Barros, R., and F. Ferreira. 2009. "Measuring Inequality of Opportunities in Latin America and the Caribbean." Washington DC: World Bank.

Batana, Y. M., T. Masaki, S. Nakamura, and M. E. V. Vilpoux. 2021. "Estimating Poverty in Kinshasa by Dealing with Sampling and Comparability Issues." World Bank Policy Research Working Paper.

Eastwood, R., and M. Lipton. 1999. "The Impact of Changes in Human Fertility on Poverty." *The Journal of Development Studies* 36 (1): 1–30.

Herzer, D., H. Strulik, and S. Vollmer. 2012. "The Long-run Determinants of Fertility: One Century of Demographic Change 1900–1999." *Journal of Economic Growth* 17: 357–385.

Hommann, Kirsten, and Somik V. Lall. 2019. "Which Way to Livable and Productive Cities?: A Road Map for Sub-Saharan Africa." Washington, DC: World Bank.

Lall, Somik Vinay, J. Vernon Henderson, and J. Anthony Venables. 2017. *Africa's Cities: Opening Doors to the World*. Washington, DC: World Bank.

Nakamura, Shohei, Bhavya Paliwal, and Nobuo Yoshida. n.d. *Recent Trends of Poverty and Urbanization in Sub-Saharan Africa*. Unpublished Manuscript.

Nzuzi, Francis Lelo. 2017. *Les bidonvilles de Kinshasa*. L' Harmattan RDCongo.

World Bank. 2018a. "Democratic Republic of Congo Urbanization Review: Productive and Inclusive Cities for an Emerging Congo." *Directions in Development—Environment and Sustainable Development*. Washington, DC: World Bank. https://openknowledge.worldbank.org/handle/10986/28931 License: CC BY 3.0 IGO.

———. 2018b. "The Challenge of Urbanization in West Africa." AFCW3 Economic Update, Spring 2018.

———. 2018c. *Republic of Guinea: Overcoming Growth Stagnation to Reduce Poverty*. Systematic Country Diagnostic, Report No 123649-GN, March.

———. 2018d. Congo, Democratic Republic of - Systematic Country Diagnostic (English). Washington, DC: World Bank. http://documents.worldbank.org/curated/en/171101529346675751/Congo-Democratic-Republic-of-Systematic-country-diagnostic

———. 2019a. "Demographic Dividend in DRC: Catalyzing Economic Growth through Demographic Opportunities." Washington, DC: World Bank.

———. 2019b. *Democratic Republic of the Congo DRC – Poverty Assessment*. Washington, DC: World Bank.

WorldPop (www.worldpop.org - School of Geography and Environmental Science, University of Southampton). 2013. Democratic Republic of the Congo 100m Population. Alpha version 2010 and 2015 estimates of numbers of people per grid square, with national totals adjusted to match UN population division estimates (http://esa.un.org/wpp/) and remaining unadjusted. DOI: 10.5258/SOTON/WP00072.