Impact of Kigali City master plan implementation on living conditions of urban dwellers: case of Nyarugenge District in Rwanda

M J Nyiransabimana\textsuperscript{1}, I Rwabudandi\textsuperscript{3}, W T de Vries\textsuperscript{4}, J P Bizimana\textsuperscript{2} and G G Benineza\textsuperscript{1}

\textsuperscript{1}Department of Civil, Environmental and Geomatics Engineering, University of Rwanda, P.O. Box 3900, Kigali Rwanda
\textsuperscript{2}Department of Geography and Urban Planning and Centre for Geographic Information Systems and Remote Sensing, University of Rwanda, P.O. Box 3900, Kigali Rwanda
\textsuperscript{3}Department of Geomatics Engineering, Institut Teknologi Sepuluh Nopember (ITS), Kampus ITS Surabaya 60111, Indonesia
\textsuperscript{4}Department of Civil, Geo and Environmental Engineering, Technische Universität München (TUM), Chair of Land Management, Arcisstraße 21, 80333 München, Germany

Abstract. The increasing population and inadequate planning resulted in informal settlements and poor social infrastructures in Kigali City. As response, the Kigali City authority adopted the Kigali City Master Plan (KCMP) to guide the urban development. However, no evaluations of the KCMP implementation has been carried out. This study assessed therefore the level of KCMP implementation and its impact on living conditions of urban dwellers in Nyarugenge District. We evaluated the KCMP implementation using Geographical Information System (GIS) overlay analysis, based on indicators of degree of conformity: accordance, unfulfillment and deviation. We assessed the impact of KCMP implementation using a paired sample t-test analysis to compare the availability/accessibility of urban quality of life indicators before and after the adoption of the KCMP. The results indicated that the level of KCMP implementation is low due to zoning categories and construction standards that are not affordable for low-income citizens. Nevertheless, this implementation has partly improved dwellers’ living conditions through the provision of some elements of urban quality of life. The KCMP should be revised thereby considering the affordability of its implementation by different stakeholders including low-income populations. Further researches should assess negative impacts of KCMP implementation on living conditions of urban dwellers.

1. Introduction
Rural-urban migration has been causing a rapid population growth in Kigali City, resulting in the emergence of informal settlements and poor social infrastructures [1]. To handle this problem, the planning authority of Kigali City adopted a legal framework which guides and regulates urban planning and development in Kigali City. This legal framework includes among others the detailed Master Plans for Nyarugenge, Gasabo and Kicukiro Districts. These detailed Master Plans were later integrated into a single Kigali City Master Plan that was approved in 2013 for the entire City of Kigali [2]. The Kigali City Master Plan has several objectives and some of them are related to the improvement of living
conditions of urban dwellers. These objectives are among others the following: to ensure adequate allocation of land uses; to provide modern and comprehensive housing solutions for all groups of people; to develop efficient transportation infrastructures and public facilities; to create and conserve attractive recreational features; and to create local employment opportunities [3]. To date, however, there are no comprehensive evaluations of the Kigali City Master Plan implementation and its impact on living conditions of urban dwellers, especially considering that, the plan preparation alone does not necessarily ensure the proper implementation of what had been proposed [4].

To be able to ensure compliance to the Master Plan, a comprehensive implementation evaluation method is required. For this reason, this study aimed to bridge that gap by evaluating the implementation of the Kigali City Master Plan and assessing its impact on living conditions of urban dwellers in Nyarugenge District. Such impact is conceptualized as a change which can be attributed to living conditions of urban dwellers, through the availability and accessibility of elements of urban quality of life in dwellers’ neighbourhoods. In this paper therefore, we first present the analytical framework concerning plan implementation evaluation and a conceptual framework that guides the assessment of the impact of Master Plan implementation on dwellers’ living conditions. After this, we describe the data collected and research methods used. We then present and discuss our results. Finally, we conclude and give suggestion for further researches.

2. Analytical and conceptual framework
According to Alexander and Faludi [5], there are two plan implementation evaluation approaches: performance and conformance. The performance approach is often applied when plans are considered as visions, and it focuses on the role of plans in decision-making [6]. The conformance approach however, considers plans as blueprints, with their provisions eventually reflected in actual spatial development [7]. Therefore, the conformance approach assumes that plans are successfully implemented if their outcomes on ground correspond to plan provisions [5]. Mabaso, Shekede, Chirisa, Zanamwe, Gwitira, and Bandauko [8], used GIS overlay analysis to evaluate the degree of conformance of physical developments in the City of Mutare in Zimbabwe. Tian and Shen [9], also evaluated the implementation of the Guangzhou Urban Master Plan in China using GIS overlay analysis, based on three categories of implementation indicators: accordance, unfulfillment and deviation. Moreover, Johar, Sabri and Yunos [10], evaluated the implementation of the physical development strategy in Iskandar Malaysia using the three indices: accordance, unfulfillment and deviation. Referring to the above studies, this study evaluated the implementation of the Kigali City Master Plan in Nyarugenge District by applying a conformance approach and using GIS overlay analysis tools. This study also assessed the impact of such implementation on living conditions of urban dwellers. Hereafter, we present the conceptual framework for such impact assessment.

To assess the impact of the Kigali City Master Plan implementation, we proposed a framework which guides the assessment. The framework has the following five dimensions: Adequate allocation of land use; affordable housing; efficient transportation infrastructures and public facilities; recreational areas and employment opportunities. These dimensions are the previously mentioned objectives of the Kigali City Master Plan which are related the improvement of living conditions of urban dwellers. The following figure is an illustration of this framework.
The figure 1 above shows that in this study, the assessment of the impact of Master Plan implementation on living conditions of urban dwellers, was based on indicators of urban quality of life. The selected indicators are those related to the previously mentioned objectives of the Kigali City Master Plan. We assessed the level to which dwellers acknowledge the current level of availability/accessibility of these indicators in the study area and how dwellers are satisfied with such level of availability/accessibility of those indicators. Knowing that the quality of life correlates with the general living condition [11], we identified the impact of the Kigali City Master Plan implementation on the living conditions of urban dwellers based on the selected indicators of urban quality of life, as well as the peoples’ level of satisfaction. The next section presents a description of the data and methods we used in this study.

3. Research methods
This section presents a description of the methods that were used from the rational understanding of the study area to the data collection and data analysis.

3.1. The study area and justification
Kigali City, a Capital City of Rwanda, is divided into three Districts namely Gasabo, Kicukiro and Nyarugenge. Nyarugenge District, with an area of 134.2km² is the smallest of the three Districts and lies to the west of the City at 10km from the Kigali international Airport. Nyarugenge District is divided
into 10 sectors. This study was carried out in three of these sectors. Those three sectors are Nyarugenge, Muhima and Kigali. The study area was selected based on where Master Plan implementation activities have started earlier than in other areas in order to detect the impact of Master Plan implementation, through the comparison of the before and after the adoption of the Master Plan. The figure below shows the location of the study area.

Figure 2. Location of the study area.

The figure 2 above shows where Nyarugenge District is located in Rwanda and where the three selected sectors are located in Nyarugenge District.

3.2. Research approach

Research approach is a procedure that consists of the steps from broad assumptions to detailed methods of data collection, analysis, and interpretation [12]. According to Creswell [13], there are three main research approaches: quantitative, qualitative and mixed methods research approaches. The quantitative approach is used when the researcher needs to respond to research questions requiring numerical data [14]. The qualitative approach is used when the research questions need textural data, while the mixed methods approach is used for research questions that want both numerical and textural data [ibid]. The combination of both the qualitative and quantitative approaches provides a more complete understanding of a research problem than either approach alone [13]. In this study therefore, we used a mixed methods approach. We collected primary data through field observation, interviews and household survey. Some secondary data was collected through literature review, while others are geospatial datasets that were collected from Kigali City office. These geospatial datasets include the 2013 existing land use data (2013 ELU), the 2013 Kigali City Master Plan (2013 MP) and the 2019
existing land use data (2019 ELU). To evaluate the level of conformance of Master Plan with the existing situation on ground, the three geodata sets were overlaid using ArcGIS 10.6.

The conformance evaluation was based on the three indicators of the degree of conformity: accordance, unfulfillment and deviation. According to Tian and Shen [9], these indicators of the degree of conformity are explained as follow: the accordance means that the actual land use conforms to plan provision; the unfulfillment means that in a piece of land, no change has been made while it was planned to change the use that comply with the Master Plan; in this case of unfulfillment, the Master Plan is not yet implemented but it might or might not be implemented in the future; the deviation is when the actual land use on a piece of land is different from the planned land use and also different from the use of before the adoption of the Master Plan. Each of the three mentioned indicators of the degree of conformity was evaluated for the following major land use types: residential, commercial, infrastructures, public facilities, industrial, natural area, agriculture, and open spaces. We then determined the overall level of conformance for all these land uses. In fact, a high level of accordance indicates a high level of conformance of the Master Plan to the current situation, thereby indicating a high level of Master Plan implementation. However, a high level of either unfulfillment or deviation indicates the low level of conformance of the Master Plan to the current situation thereby indicating a low level of Master Plan implementation.

To assess the impact of Master Plan implementation on living conditions of urban dwellers, we used the primary data that was collected through household survey. To determine the number of respondents, we used a multilevel mixed method sampling technique. Normally, when Mixed Methods are used to investigate phenomena, the research yields greater information than it could be achieved through single method [15]. In addition, Multilevel Mixed Method is used in hierarchical organized social institutions, in which one level is nested with another [16]. For this reason, we used this technique because the required data was from hierarchical institutions (from the Kigali City to local levels), and the data was both qualitative and quantitative in nature. We used a purposive sampling, one of the sampling methods, to select cells in each of the three sectors. The selected cells are Rwampara, Agatare, Ubumwe, Nyabugogo, Kigali and Rwesero cells. They were selected based on where the implementation of the Master Plan has started earlier than other cells. The total number of households in these cells was 6393, counting 1526 for Rwampara, 1306 for Agatare, 36 for Ubumwe, 822 for Nyabugogo, 1941 for Kigali and 762 for Rwesero cells. By using the sampling formula from Gwaleba [17], we got a sample size of 362 households, corresponding to 82 households in Rwampara, 75 households in Agatare, 2 households in Ubumwe, 47 households in Nyabugogo, 112 households in Kigali and 44 households in Rwesero cells. In addition, by using a purposive sampling, four interviewees were selected based on the positions they held in urban planning and implementation, for the purpose of getting a detailed information about master plan implementation and challenges encountered during such implementation. The first interviewee is urban planner who overseeing urban planning and master plan implementation at Kigali City level. The other three interviewees are local leaders who oversee master plan implementation at sector level.

After collecting primary data, those from household survey were analysed using the paired sample t-test analysis in statistical package for the social sciences (SPSS). In fact, the paired sample t-test analysis is used to compare two means of two observations [18]. For instance, the before-and-after observations on the same subjects [19,20]. As this study compared the before and after the adoption of the Master Plan, the use of paired sample t-test analysis was the most appropriate analytical tool for this assessment. We compared the current level of availability/accessibility of the indicators of urban quality of life and their level of availability/accessibility before the adoption of the Master Plan (before 2013). A statistically significant difference between the two levels of availability/accessibility indicates an improvement of the elements of urban quality of life. Normally, urban quality of life is the human satisfaction with different urban attributes such as transportation, recreational opportunities, land use patterns, ease access of services and public amenities [21]. The term “quality of life” overlaps with several terms, including "well-being," "social indicators," and "way of life" among others [Andrews as
cited in 21]. There exist various indicators of urban quality of life, but in this study, we used the indicators that are related to the objectives of the Kigali City Master Plan that have a direct impact on the living condition of urban dwellers. These indicators are mentioned in Table 1 below.

| Dimension/Master Plan objectives | Indicators                                                                 | Assessment strategy                                                                 | Source of indicator |
|---------------------------------|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------|---------------------|
| Adequate allocation of land uses | Safe land use patterns                                                    | Use of Likert scale responses to assess dwellers’ level of satisfaction with the proposed zoning category | [22]                |
| Provision of efficient transportation | Availability of pedestrian infrastructures, streets and traffic lights | Use of Yes/No responses to assess the number of people who confirm that these indicators are available in their neighbourhoods | [23]                |
|                                  | Availability of bus stops                                                 | Use of quantitative responses to assess the time taken to reach the nearest bus stop |                     |
| Infrastructure and public facilities | Access to waste management facilities                                    | Use of Yes/No responses to assess the number of people who confirm that sewage systems are available in their neighbourhoods | [24]                |
|                                  | Access to educational services                                            | Use of quantitative responses to assess the time taken to reach the nearest nursery schools and primary schools | [24–26]            |
| Provision of modern housing solution for all groups of people | Affordable housing accessibility |
|-------------------------------------------------------------|---------------------------------|
| Health facilities accessibility.                            | Use of quantitative responses to assess the time taken to reach the nearest health facility |
| Accessibility of power of electricity                       | Use of Yes/No responses to assess the number of people having the power of electricity in their shelters |
| Access to clean water                                       | Use of quantitative responses to assess the time taken to reach the nearest water tap |
| Provision of modern housing solution for all groups of people| Use of Likert scale responses to assess dwellers’ level of satisfaction with their monthly income to pay the rental cost (for tenants) |
| Creation and conservation of attractive recreational features| Use of Yes/No responses to assess the number of people who confirm that recreational features are easily available and accessible in or nearby their neighbourhoods. |
| Creation of local employment opportunities                 | Use of Likert scale responses to assess dwellers’ level of satisfaction with their occupational status |

The Table 1 above presents the selected indicators of urban quality of life. The level of availability/accessibility of these indicators was assessed based on three different assessment strategies depending on the measurement possible for each indicator. For indicators such as bus stops, educational services, health facilities and clean water, their levels of availability/accessibility were assessed based on the minimum time taken by dwellers to reach these indicators. For safe land use patterns, affordable
housing and employment opportunities, their levels of availability were assessed using Likert scale responses to determine dwellers’ level of satisfaction with the zoning category, monthly income to pay the rental cost (for tenant) and dwellers’ occupational status respectively. For pedestrian infrastructures, streets, traffic lights, waste management facilities and recreational features, their levels of availability were assessed using Yes/No responses to determine the number of people who confirm that these indicators are available in dwellers’ neighbourhoods.

4. Results and discussion
This section firstly presents the level of conformance of the Master Plan to the current existing situation on the ground. Secondarily, the section describes the impact of Master Plan implementation on living conditions of urban dwellers. Then, the section presents the challenges encountered during the implementation of the Kigali City Master Plan.

4.1. The level of conformance of the Master Plan to the current existing situation
For each of the eight analysed land uses, their levels of conformance are summarized in Table 2 below and further discussed deeply in the next paragraphs.

| Land use      | Accordance (%) | Unfulfillment (%) | Deviation (%) | Total planned (%) |
|---------------|----------------|-------------------|---------------|------------------|
| Residential   | 43.0           | 54.8              | 2.1           | 100.0            |
| Commercial    | 41.6           | 50.0              | 8.5           | 100.0            |
| Infrastructure| 48.6           | 41.3              | 10.1          | 100.0            |
| Public facilities | 67.7     | 26.0              | 6.3           | 100.0            |
| Industrial    | 0.0            | 71.0              | 29.0          | 100.0            |
| Open Space    | 1.3            | 88.4              | 10.3          | 100.0            |
| Agriculture   | 77.0           | 8.7               | 14.3          | 100.0            |
| Natural area  | 61.1           | 33.6              | 5.3           | 100.0            |
| Overall       | 42.5           | 46.7              | 10.7          | 100.0            |

The Table 2 above shows the three indicators of the degree of conformity of the Master Plan for the eight analysed land uses. The table also shows the overall level of conformance of the Master Plan in the area planned for all the eight analysed land uses types.

For residential land use, the overlay analysis showed that there is a low level of accordance, a medium level of unfulfillment and a very low level of deviation. The level of accordance, unfulfillment and deviation correspond to 43.0%, 54.8% and 2.1% (Table 2) of the total area planned for residential use respectively. The accordance is mostly seen in Nyarugenge Sector where it corresponds to 63.7% of the total area of accordance for residential use. The unfulfillment is very high in Kigali sector where it corresponds to 94.3% of the total area of unfulfillment for residential use. These results show that the level of Master Plan implementation is low in areas planned for residential use as the level of accordance for residential use is low in the study area. In addition, the analysis revealed that there is a low level of conformance between the current existing commercial use and the areas planned for commercials. Instead, there is a moderate level of unfulfillment and a very low level of deviation in the areas planned for commercial use. The accordance level for commercial is only 41.6% and it is highly found in Nyarugenge sector. The unfulfillment is 50.0% of the total area planned for commercial and is very high in Kigali sector. The level of deviation is 8.5% of the total area planned for commercial and it is mostly
found in Muhima sector. Therefore, having a low level of accordance in the areas planned for commercial use, it indicates that the level of Master Plan implementation is low for proposed commercial use in the study area.

Moreover, the analysis revealed that the levels of accordance, unfulfillment and deviation for infrastructures correspond to 48.6%, 41.3% and 10.1% (Table 2) of the total area planned for infrastructures respectively. This shows that the accordance level is low, with a low level of unfulfillment and a very low level of deviation in the area planned for infrastructures and this indicates that the Master Plan implementation is low where infrastructures are proposed to be located in the study area. Furthermore, the analysis identified that most of the existing public facilities conform to the Master Plan. The accordance, unfulfillment and deviation correspond to 67.7%, 26.0% and 6.3% (Table 2) of the total area planned for public facilities respectively. The area of accordance for public facilities is mostly high in Nyarugenge sector, while the area of unfulfillment for public facilities is low and it is mostly located in Kigali sector. Thus, having a high level of accordance in area planned for public facilities, it indicates that the level of Master Plan implementation is high for public facilities in the study area. However, this study identified that there is no area of accordance of the Master Plan in the area planned for industrial use in the study area. Instead, there is a high level of unfulfillment and a low level of deviation corresponding to 71.0% and 29.0% (Table 2) of the total area planned for industrial use respectively. As the level of accordance for industrial use is null, it indicates the lack of Master Plan implementation for industrial use in the study area. However, this study revealed that the level of conformance in the area planned for open spaces is very low in the study area whereby the area of accordance, unfulfillment and deviation correspond to 1.3%, 88.4% and 10.3% (Table 2) of the total area planned for open spaces respectively. Having a very low level of accordance with a high level of unfulfillment, it shows that the implementation of the Master Plan for open spaces is very low in the study area. This is because most of the wetlands that were planned to be developed as open spaces are not yet developed as planned. Regarding the area planned for agricultural use, the level of accordance, unfulfillment and deviation correspond to 77.0%, 8.7% and 14.3% (Table 2) of the total area planned for agricultural use respectively. This shows that in the study area, almost everywhere proposed for agriculture is currently used as proposed. Hence, this indicates a high level of Master Plan implementation for agricultural use in the study area. In addition, this study showed that the level of accordance, unfulfillment and deviation for natural area correspond to 61.1%, 33.6% and 5.3% (Table 2) of the total area planned for natural area respectively. Since, the level of accordance for natural area is more than a half of the total area planned for natural area, it indicates that the Master Plan implementation is high for natural area in the study area.

When considering all eight analysed land uses, the overall level of accordance is low, and it corresponds to 42.5% (Table 2) of the total area planned for the eight land uses. The accordance is mostly found in Nyarugenge Sector. The overall level of unfulfillment is slightly equal to the overall accordance and it corresponds to 46.7% (Table 2) of the total area planned for the eight land uses. The unfulfillment is mostly found in Kigali sector. The overall level of deviation is very low, and it corresponds to 10.7% (Table 2) of the total area planned for the eight land uses. The deviation is very low since the Kigali City authority enforces zoning regulations and people are restricted to undertake new activities which are contradictory with zoning regulations. The figure 3 below shows the overall conformance of the Master Plan to the exiting situation.
Figure 3. Level of conformance of the Master Plan to the exiting situation.

The next subsection explains the identified impact of the Kigali City Master Plan implementation on living conditions of urban dwellers.
4.2. The impact of the Kigali City Master Plan implementation

The analysis of the impact of the Kigali City Master Plan implementation on living conditions of urban dwellers has identified the results which are summarized in Table 3 below.

Table 3. Level of availability/accessibility of urban quality of life indicators.

| S/N | Indicator                  | Level of availability/accessibility | MD   | Std  | t    | df  | Sig. (2-tailed) |
|-----|---------------------------|-------------------------------------|------|------|------|-----|-----------------|
|     |                           | Current (2019)                      | Before 2013 |      |      |     |                 |
| 1   | Pedestrian infrastructures | 0.671                              | 0.323         | 0.348| 0.477| 13.9| 361            | 0.000           |
| 2   | Streets                   | 0.834                              | 0.696         | 0.138| 0.353| 7.4 | 361            | 0.000           |
| 3   | Traffic lights            | 0.053                              | 0.047         | 0.006| 0.074| 1.4 | 361            | 0.158           |
| 4   | Bus stops                 | 0.450                              | 0.262         | 0.188| 0.391| 9.1 | 361            | 0.000           |
| 5   | Nursery schools           | 0.735                              | 0.682         | 0.052| 0.235| 4.2 | 361            | 0.000           |
| 6   | Primary school            | 0.865                              | 0.796         | 0.069| 0.265| 5.0 | 361            | 0.000           |
| 7   | Health facilities         | 0.843                              | 0.779         | 0.064| 0.255| 4.7 | 361            | 0.000           |
| 8   | Clean water               | 0.978                              | 0.517         | 0.461| 0.499| 17.6| 361            | 0.000           |
| 9   | Power of electricity      | 0.978                              | 0.586         | 0.392| 0.489| 15.3| 361            | 0.000           |
| 10  | Sewage system             | 0.481                              | 0.362         | 0.119| 0.324| 7.0 | 361            | 0.000           |
| 11  | Affordable housing area   | 0.218                              | 0.456         | -0.238| 0.445| -10.2| 361         | 0.000           |
| 12  | Recreational area         | 0.227                              | 0.218         | 0.008| 0.190| 0.8 | 361            | 0.406           |
| 13  | Employment opportunities  | 0.080                              | 0.069         | 0.011| 0.128| 1.6 | 361            | 0.103           |

MD: Mean difference, Std: Standard deviation, df: Degree of freedom, Sig: Significance

The Table 3 above illustrates the results obtained from the paired samples t-test analysis for each of the selected indicators of urban quality of life. The result for each indicator is discussed hereafter. The number of people who access pedestrian infrastructures, has increased from 32.3% to 67.1% (Table 3) of the total people surveyed. The analysis also identified that dwellers are likely satisfied with the current level of accessibility of pedestrian infrastructures (Table 4). The accessible pedestrian infrastructures help in the reduction of road traffic accidents. Therefore, the implementation of the Kigali City Master Plan plays role in the provision of pedestrian infrastructures in the study area. Table 4 below shows the dwellers’ level of satisfaction with the current level of availability/accessibility of some selected elements of urban quality of life.
Table 4. Level of satisfaction with the current availability/accessibility of elements of urban quality of life.

| S/N | Variables                  | Mean satisfaction | Std. |
|-----|----------------------------|-------------------|------|
| 1   | Pedestrian infrastructure  | Likely satisfied  | 1    |
| 2   | Streets                    | Likely satisfied  | 1    |
| 3   | Traffic lights             | Unlikely satisfied| 1    |
| 4   | Bus stops                  | Likely satisfied  | 2    |
| 5   | Nursery schools            | Likely satisfied  | 1    |
| 6   | Primary schools            | Very satisfied    | 1    |
| 7   | Health facilities          | Likely satisfied  | 1    |
| 8   | Clear water                | Very satisfied    | 1    |
| 9   | Power of electricity       | Very satisfied    | 1    |
| 10  | Sewage system              | Unlikely satisfied| 1    |
| 11  | Affordable housing         | Unlikely satisfied| 1    |
| 12  | Recreational facilities    | Unlikely satisfied| 1    |
| 13  | Employment opportunities   | Unlikely satisfied| 1    |

*Std*: Standard deviation.

This study identified that the number of people who access streets has increased from 69.6% to 83.4% (Table 3) of the total people surveyed. Therefore, 13.80% of the people surveyed access streets constructed in their neighbourhoods after the adoption of the Master Plan. Consequently, dwellers are likely satisfied with the current level of accessibility of streets in their neighbourhoods (Table 4). These streets facilitate transportation and serve as connections to enhance friendship among dwellers between neighbourhoods. Thus, the Master Plan implementation plays a role in the accessibility of streets in the study area. However, this study revealed a shortage of traffic lights in the study area. Among the total people surveyed, only 5.3% (Table 3) agreed that traffic lights are currently available. Therefore, the implementation of the Master Plan did not play a significant role in the availability of the traffic light in the study area. Consequently, dwellers are unlikely satisfied with the current level of availability of traffic lights (Table 4).

In addition, this study identified that 45.0% (Table 3) of the total people surveyed can easily access the bus stops. The level of accessibility of bus stops has increased compared to how it was before the adoption of the Master Plan. In fact, only 26.2% (Table 3) of the total people surveyed could easily access bus stops before the adoption of the Master Plan, while 45.0% (Table 3) of the total people surveyed can now easily access bus stops in their neighbourhood. The average time taken to reach the nearest bus stop was 21 minutes (Table 5) by walk before the adoption of the Master Plan, while the current average time taken to reach the nearest bus stop is 17 minutes (Table 5) by walk. This means that new bus stops were provided in the study area. The study also identified that dwellers are likely satisfied with the current level of availability and accessibility of bus stops (Table 4). However, the study conducted by Niyonsenga [28], revealed that 54% of the total population in Kigali City is provided acceptable access distance to public transport in Kigali City based on the 500meters standard. The Table 5 below presents the average time taken to reach the selected elements of urban quality of life whose availability/accessibility can be measured from the minimum time taken by dwellers to reach these elements.
The average time taken to reach the selected elements of urban quality of life.

| S/N | Variables       | Time taken | Mean difference | Std. | t     | df | Sign  |
|-----|-----------------|------------|-----------------|------|-------|----|-------|
|     |                 | Current    | Before          | (min)|       |    |       |
| 1   | Bus stop        | 18         | 21              | -4   | 7     | 361| 0.000 |
| 2   | Nursery schools | 12         | 14              | -2   | 12    | 361| 0.000 |
| 3   | Primary schools | 12         | 15              | -3   | 6     | 361| 0.000 |
| 4   | Health facility | 15         | 23              | -8   | 9     | 361| 0.000 |
| 5   | Water tap       | 2          | 7               | -5   | 6     | 361| 0.000 |

Regarding the accessibility of nursery schools, the paired sample t-test analysis identified that the number of people who accessed nursery schools before the adoption of the Master Plan was 68.2% (Table 3) of the total people surveyed. Those who access nursery schools currently correspond to 73.5% (Table 3) of the total people surveyed. Consequently, the average time taken to reach the nearest nursery school by walk has reduced from 14 minutes to 12 minutes (Table 5). Therefore, due to the implementation of the Master Plan, educational facilities are being provided in the study area. Contradictory to rural area, the study conducted by the United Nations Children’s Fund [29], in 20 different sites selected based on their rural location and high levels of poverty outside of Kigali City, revealed that on average, households with children who attend nursery schools correspond to 27.4% of the total people that were surveyed.

Moreover, our study showed that the number of people who access primary schools is 86.5% (Table 3) of the total people surveyed. Those who accessed primary schools before the adoption of the Master Plan correspond to 79.6% (Table 3) of the total people surveyed. Consequently, the average time taken by most of citizens to reach the nearest primary school has reduced from 15 to 12 minutes by walk (Table 5). Therefore, most of the people in the study area are very satisfied with the level of accessibility of primary schools (Table 4). Furthermore, the analysis showed that the accessibility of health facilities before the adoption of the Master Plan was 77.9% (Table 3) of the total people surveyed. Currently, those who access health facilities correspond to 84.3% (Table 3) of the total people surveyed. The average time taken to reach the nearest health facilities has reduced from 23 minutes to 15 minutes (Table 5) due to the implementation of the Master Plan. The accessible health facilities help in getting basic medical services easily thus improving the living condition of the dwellers. For this reason, dwellers are likely satisfied with the availability and accessibility of health facilities in the study area (Table 4).

In addition, due to the implementation of the Master Plan, most of the people in the study area are currently able to easily access clean water from the water tap. In fact, people who access water tap in their neighbourhoods has increased from 51.7% to 97.8% (Table 3) of the total people surveyed. Consequently, the average time taken to reach the nearest water tap has reduced from 7 minutes to 2 minutes (Table 5). This helps the dwellers to easily get clean water to be used in different activities. Comparatively, the study conducted by Kartas and Jütersonke [30], revealed that about 87% of the population in Kigali City currently has access to water. The same study [30] revealed that on average, 61% of those who do not have water tap at their home, access water taps within 500 metres. Moreover, the analysis showed that the level of accessibility to the power of electricity has increased. Normally, the number of people who access the power of electricity in their shelters corresponds to 97.8% (Table 3) of the total people surveyed, while, they were 58.6% (Table 3) before the adoption of the Master Plan. Dwellers use electricity in different ways such as lighting rooms, charging electrical devices, cooking and ironing. People are very satisfied with the current availability of the power of electricity (Table 4). Regarding the availability of sewage system, dwellers reported that the well-constructed sewage systems are not sufficient in their neighbourhoods. For this reason, people are unlikely satisfied with the quality of existing sewage systems and their level of availability (Table 4).
Furthermore, the analysis showed that there is a shortage of affordable housing in the study area. In fact, up to 78.2% of the total people surveyed confirmed that affordable housings are not available (Table 2). This is justified by that most of the tenant who were surveyed said that they are unlikely satisfied with their monthly income to pay the rental cost (Table 4). However, 54.4% (Table 3) of the total people surveyed said that houses were affordable before the adoption of the Master Plan. The analysis identified a statistically significant negative difference between the current availability of affordable housing and that of before the adoption of the Master Plan. Therefore, the implementation of the Master Plan did not play a significant role in the provision of affordable housing in the study area. This is contradictory to one of the objectives of the Kigali City Master Plan which is to provide affordable housing solution for all groups of people. Our result on affordability of housing confirms the statement of Mayer and Somerville [31], which states that zoning may affect housing affordability by imposing standards relating to height, density and amenities that make the overall building costs too high or alternatively leading to higher prices of finished houses. In addition, the enforcement of the Master Plan and zoning regulations is regarded as a major factor to the shortages of affordable housing in Kigali [32]. Regarding the availability of recreational areas, the analysis showed that the current level of availability of recreational areas seems to be the same as that of before the adoption of the Master Plan. In fact, only 21.3% (Table 3) of the total people surveyed could access recreational areas before the adoption of the Master Plan, while 23.8% (Table 3) of the total people surveyed are the only people who can access recreation areas currently. Therefore, the implementation of the Master Plan did not significantly improve the level of availability of recreational areas. This is because, the area planned to be developed as recreational area, are not yet developed. For this reason, dwellers are unlikely satisfied (Table 4) with the current level of availability and accessibility of recreational areas. Moreover, this study showed that only 6.9% (Table 3) of the people surveyed were employed before the adoption of the Master Plan. And 8.0% (Table 3) of the total people surveyed are currently employed. This shows that the Master Plan implementation did not significantly impact on the availability of employment opportunities in the study area. Thus, dwellers are unlikely satisfied with the current availability of employment opportunities (Table 4).

In addition, dwellers were asked to rate their levels of satisfaction with the zoning categories planned in their neighbourhoods. The analysis showed that most of the respondents are unlikely satisfied with the zoning categories planned in their neighbourhoods since the zoning categories proposed in the study area require high cost to fulfil them. Therefore, low-income people who are unable to fulfil the requirements are relocated from their properties. This confirms what was stated by Harney [33], that the fundamental problem with zoning regulations has been apparently excluding urban low-income communities by imposing housing standards out of their reach. However, as the implementation of the Kigali City Master Plan has impacted on the availability/accessibility of some elements of urban quality of life, we may conclude that due to the implementation of the Master Plan, dwellers’ living conditions are partly improved. Nevertheless, the lack of enough implementation of the Master Plan causes the deficiency of elements of urban quality of life in some parts of the study area. The following subsection presents challenges that affect the implementation of the Kigali City master.

4.3. The challenges that affect the implementation of the Kigali City Master Plan

During the implementation of the Kigali City Master Plan, different challenges are encountered. In this study, we conducted an interview with the authority in charge of urban planning at Kigali City and he mentioned these challenges: The first challenge is the limited public owned land in which infrastructure and public facilities can be constructed. The second challenge is the budget limited for the Government to acquire private land for public use, to provide public infrastructure, as well as affordable public housing for the lower and medium income groups. The third challenge is the low capacity of the citizens to comply with the Master Plan, where it requires to relocate them from their properties, while many people are not willing to be relocated. The fourth challenge is the issues of the perceptions of the people whereby some citizens think that they are not concerned with the implementation of the Master Plan, and others think that the Master Plan is meant to favour riches and exclude the poor. The fifth challenge is the lack of citizens participation during the planning process. The grassroots community have not
been given time to share their suggestions on how the Master Plan should look so as not to be surprised during the implementation stage [34].

5. Conclusion and recommendation

The paper aimed at evaluating the implementation of the Kigali City Master Plan and assessing its impact on living conditions of urban dwellers in Nyarugenge District. The evaluation of the Master Plan implementation was based on the three indicators of the degree of conformity: accordance, unfulfillment and the deviation. The results have shown that the implementation of the Master Plan is high in areas planned for agricultural, public facilities and natural area. However, Master Plan implementation is low in areas planned for infrastructures, residential and commercial. Nevertheless, the implementation of the Master Plan is very low in the area planned for open spaces, and it is null in the area planned for industries. Therefore, this study has shown that the overall level of Master Plan implementation is low especially in Kigali sector. However, where the Kigali City Master Plan conforms to the existing ground situation, dwellers’ living conditions are partly improved through the availability and accessibility of some elements of urban quality of life. These elements which show an improvement in their level of availability/accessibility are the following: pedestrian infrastructures, streets, bus stops, nursery schools, primary schools, health facilities, clean water and electricity. Those which are not significantly improved are traffic lights, recreational areas and employment opportunities. In addition, the implementation of the Master Plan has negatively impacted on the availability of affordable housing due to zoning regulations which oblige the use of high cost building materials and housing categories which are not affordable by low income people. This is seen as a challenge which hinders the implementation of the Kigali City Master Plan. Additional challenges of the Kigali City Master Plan implementation include among others the limited public-owned land for the government to construct infrastructures and public facilities; budget limited; participatory issues and the issues of the peoples’ perceptions on the role played by Master Plan implementation.

Based on the findings of this study, we recommend the review of the Master Plan and its implementation tools for ensuring its sustainable implementation. We also recommend the provision of elements of urban quality of life where they are deficient for better improvement of dwellers’ living conditions. Lastly, we suggest for further researchers to conduct a deeply evaluation of the negative impact of the Kigali City Master Plan implementation on the living condition of urban dwellers as this study was mostly concerned on the positive impact of the Kigali City Master Plan implementation on dwellers’ living conditions.

6. References

[1] Rwanda Environment Management Authority. 2017. State of Environment and Outlook Report. Kigali, Rwanda
[2] The City of Kigali 2013 Kigali City Master Plan Report. Kigali, Rwanda; 85 p.
[3] The City of Kigali 2010 Detailed Master Plan Report for Nyarugenge District. Kigali, Rwanda; 2010.
[4] Hameed R and Nadeem O 2008 Challenges of Implementing Urban Master Plans: The Lahore Experience. International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering 2 1297–304
[5] Alexander E R and Faludi A 1989 Planning and plan implementation: notes on evaluation criteria Environment and Planning B: Planning and Design 16 127–40
[6] Faludi A 2000 The performance of spatial planning. Planning Practice and Research 15 299–318
[7] Laurian L, Day M, Berke P, Ericksen N, Backhurst M, Crawford J, et al. 2004 Evaluating plan implementation: A conformance-based methodology. Journal of the American Planning Association. 2004 70(4):471–80.
[8] Mabaso A, Shekede M D, Chirisa I, Zanamwe L, Gwitiru I, and Bandauko E 2015 Urban physical development and Master Planning in Zimbabwe: An assessment of conformance in the City
[9] Tian L, Shen T 2011 Evaluation of plan implementation in the transitional China: A case of Guangzhou City Master Plan 28 11–27.

[10] Johar F, Sabri S, and Yunus F Implementation of the physical development strategy in Iskandar. Paper Presented in Track E (Development, Policy, and Control) at the 2nd International Conference on Regional Development, Semarang (Indonesia). 2013.

[11] Rusanen M, Hooli L. Planning Together for Better Quality of Life – Guide for Integrated Management of Urban Rural Interaction. Turku, Finland.: Union of the Baltic Cities Commission on Environment; 2011.

[12] Chetty P. Importance of research approach in a research. Research design strategy. 2016.

[13] Creswell JW. Research design: qualitative, quantitative, and mixed methods approaches. SAGE; 2014.

[14] Williams C. Research Methods. Journal of Business & Economic Research. 2007;5(3):65–72.

[15] Azorin JM, Cameron R. The application of mixed methods in organisational research: A literature review. Electronic Journal of Business Research Methods. 2010;8(2):95–105.

[16] Teddie C, Tashakkori A. Foundations of Mixed Methods Research: Integrating Quantitative and qualitative approaches in the social and behavioral sciences. Los Angeles; 2009.

[17] Gwaleba, M. J. (2016). Improving Tenure Security of Informal Settlements Through Participatory Land Use Planning (PLUP). Technical University of Munich.

[18] Lani J. Paired Sample T-Test. In: Statistics Solutions. 2010.

[19] Shier R. Paired t-tests. In: Statistics. 2004.

[20] McGreedy J. The Paired t-test and Hypothesis Testing. The Johns Hopkins University and John McGreedy; 2006.

[21] Serag HD El, Shalaby A, Elsayed H, Elariane SA. Principles of urban quality of life for a neighborhood. HBRC Journal. 2015;9(1):86–92.

[22] Gilhooly M, Gilhooly K. Quality of Life: Meaning, Measurement, and Models. 2005.

[23] Garau C, Pavan VM. Evaluating Urban Quality: Indicators and Assessment Tools for Smart Sustainable Cities. Sustainability. 2018;10(3), 575.

[24] Shoebibi M, Amraii I, Mafakheri A, Karimi A, Alahdinivandi A. Analysis of Subjective Indicators of Quality of Life in Urban Areas of Iran (Case Study: Sonqor City). 2015;3(3):39–46.

[25] Khaef S, Zebardast E. Assessing Quality of Life Dimensions in Deteriorated Inner Areas: A case from Javadieh Neighborhood in Tehran Metropolis. Social Indicators Research. 2018;127(2):761–75.

[26] Stein P. urbact project results. European Union; 2001.

[27] UNHabitat. Urban Indicators Guidelines Monitoring the Habitat Agenda and the Millennium Development Goal. 2004. 47 p.

[28] Niyonsenga D. Assessing public transport supply for Kigali, Rwanda. University of Twente; 2018.

[29] United Nations Children’s Fund. Early Childhood Development and Family Services Baseline Evaluation in 20 Sites in Rwanda. Kigali, Rwanda; 2014.

[30] Kartas M, Jütersonke O. Urban Resilience in Situations of Chronic Violence Case Study of Kigali, Rwanda. 2012:1–39.

[31] Mayer CJ, Somerville CT. Land use regulation and new construction. Regional and Urban Economics. 2000.

[32] Nkubito F. Impact of zoning-based planning systems on housing affordability for the urban poor: The case of Kigali City, Rwanda. University of Manchester; 2016.

[33] Harney B. The economics of exclusionary zoning and affordable housing. Stetson Law Review. 2009;38(91):489.

[34] Rwanda Housing Authority. City of Kigali seeks public engagement in updating Master Plan. City of Kigali seeks public engagement in updating Master Plan. 2018.