

Impact Analysis of Settlement on Land Management in Rwanda

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Abstract: This study analyzed the impact of settlement on land management with case of Kicukiro district of the City of Kigali, Rwanda from 2000 to 2020. The secondary data on population and households, Gross Domestic Product (GDP) growth were collected from reports of Kicukiro district and National Institute of Statistics of Rwanda (NISR). The data on land cover were collected from the United States Geological Survey (USGS). All data were analyzed by Geographic Information System (GIS) and Statistical Package for Social Sciences (SPSS). The results indicated that from 2000 to 2020, households in Kicukiro district doubled from 240,893 persons by 2000 to 383,608 people by 2020. The Gross Domestic Product (GDP) increased from 273.7US\$ per person per years in 2006 and reached 923 US\$ by 2020. The build-up or residence, government, and infrastructure land increased while cropland, wetlands water bodies, and forestland recorded decreasing numbers, respectively. The study showed that around 100% of urbanization was recorded and 70% of this increase results from unplanned urban settlement. This is not good, and policy makers should ensure that the communities are building with reference to the Kigali City urban master plan without any deviation as planned. Finally, regular consultation for limiting people who disobey the terms and conditions would be another alternative for sustainable land management in the City of Kigali.

Key Words: City of Kigali, Settlement, Land Management, Kicukiro district, Population growth

1.Introduction

Population growth analysis has revealed that however measures are being implemented population growth will continue where from 2020 to 2050 the world expects to have total population increase from 7.8 billion of people to 9.9 billion of people, respectively (Kolb, 2021).

The developing countries are still relying on agriculture for people's living conditions and this has made land disaggregation and has created conflict with settlement where agriculture land changed for settlement. In developed countries land was replaced by service sector for economic development and population growth was displayed as challenge for economic development (Atoh, 2010).

In Africa, Rwanda inclusive, the question of landownership (acquisition) and land rights is at its center stage in every country today. This has been escalated by the increasing urbanization and industrialization and created conflicts in terms of access to land (Kermundu, 2008). Rwandan people will remain increasing and will reach 33.35 million of people by 2099. Today Rwanda has around 13 million people (2021) and this is expected to reach 20,000 thousand by 2042 and later 30 million in next 34 years (2076). Population increase in Rwanda is at 2.58 percent counted 2019 to 2021 means an increase of around 325 thousand people per year (IISD, 2020).

While agricultural activities occupy more than 75% of the households as main income source in Rwanda, Rwanda high population growth continually escalates energy-water-food-land nexus pressures. Out of the available 26,336 km², only about 14,000 km² is arable while the rest of the land is either hills or marshlands, forcing the 13.03 million people to settle on hills/slopes and these are sometimes not well constructed and end up collapsing in form of landslides. The 14,000 km² arable land is adequate for growing food crops but there is another challenge of inadequate settlement areas (WB, 2021).

Currently, the number of populations is increasing over the years, and people need the land for settlement. However, poor managed settlement negatively affects land management and land utilization and later result into environmental degradation and loss of lives (Livi-Bacci, 2019). This remain a problem and in one way or another has raised conflicts between people and government, where people think that government is limiting people to use as they want the land of their ancestors. Population control measures are also new in Rwanda (not lasted more than 20 years), settlement master plans are new emerging and family planning are voluntary measures. This means that, there is a need to investigate in deep the impact of settlement and land management so, that balance between them could be achieved or harmonized in normal way with voluntary contribution of the people (Ntagwirumugara, 2020). Thus, this study intended to establish the impact analysis of settlement on land management in Kicukiro district, city of Kigali, Rwanda.

2. Methods and Materials

2.1 Description of study area

This research was conducted by considering Kicukiro District as the case study. The district is one of the three Districts which constitute the City of Kigali and is situated in the South-East of the City of Kigali. This district (Fig.1) is made up to ten (10) administrative sectors, 41 cells and 333 Administrative villages. The district covers a total area of 166.7 km² with about 319,661 inhabitants. It was established by Organic Law n°29/2005 organizing the administrative entities of the Republic of Rwanda, at the start of the second phase of decentralization in January 2006 (MINALOC, 2018). The 4th Rwanda Population and Housing Census (PHC) has enumerated 318,564 residents in Kicukiro district, which represents 28.4% of the total population of Kigali City (1,132,686 residents) (MINALOC, 2018).

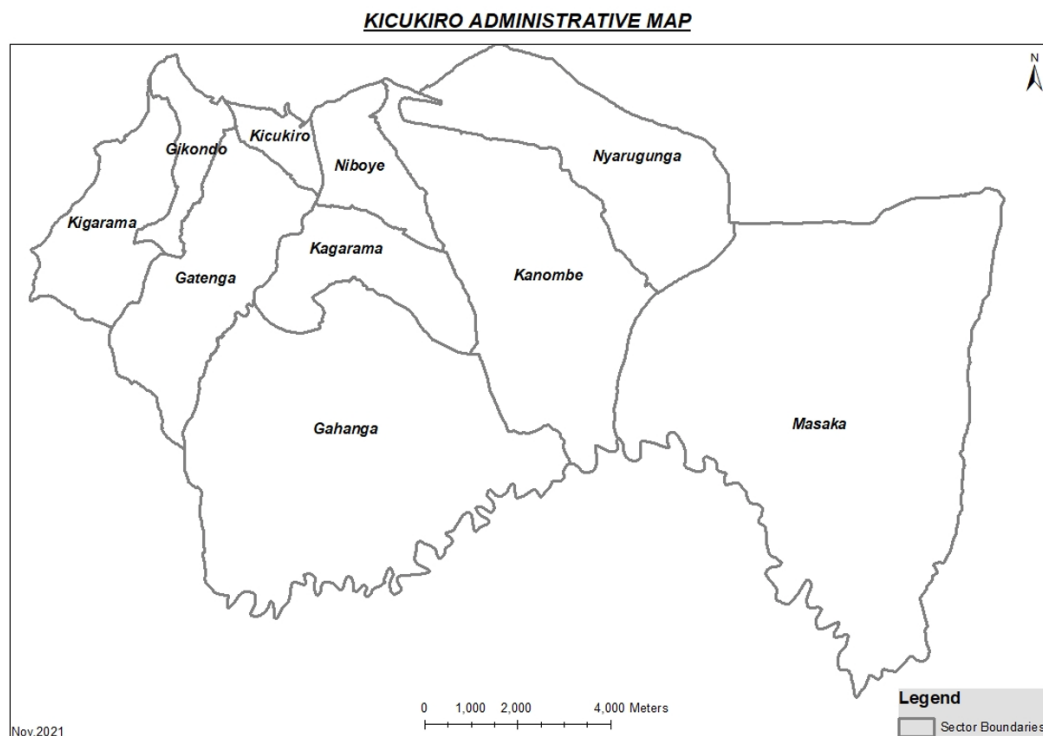


Figure 1: Kicukiro District Administrative Map

The hydrographs of the District are largely constituted by streams and rivers which form a part of the basin of the Akagera River. The main rivers are Akagera and Nyabarongo, which flows through the city of Kigali from Lake Muhazi. The District has four seasons. Two rainy seasons and two dry seasons, alternating in the following manner: Short dry season: December, January and February, long rainy season March, April and May, long dry season June, July, August and

September, short rainy season October and November. These seasons are often irregular due to the changing global climate. Lower or higher limits of each season cannot be determined accurately. The rainy season may drag on into the dry season and vice versa. Average temperature is 22°C for a rainfall varying between 900 and 1150 mm of annual rain (REMA, 2015).

2.2 Data collection and analysis

This study has adopted the use of secondary data source as main source of information on settlement and land management in Rwanda generally and Kicukiro district. The data related to population growth and Gross Domestic Growth (GDP) and urbanization rate in Kicukiro district were collected from the Office of Kicukiro district and Surveys and census reports published of the National Institute of Statistics of Rwanda (NISR). These data were presented into tables and Chart produced by the SPSS (Statistical Package for Social Scientists) version 20.

The data on land use and land cover were collected from the Unites States geological Survey (USGS) and Spatial Analyst Tools of ArcGIS facilitated in their analysis in order to clip on the case study. In order to analyze the impact of settlement on land management the authors applied the Pearson Correlation (r) whose values, as shown in Table 1, range between ± 1 , this may be positive or negative strong or weak based on the test results, and which range it fit from $[-1; +1]$ and it takes also under consideration Sig.(2-Tailed) which test the statistical significance of tested variables. This should be less or equal to 0.05 for being statistically significant.

Table 1: Level of statistical analysis and categories

Coefficient/positive or negative	Label /positive or negative
$r=1$	Perfect linear correlation
$0.9 < r < 1$	Positive strong correlation
$0.7 < r < 0.9$	Positive high correlation
$0.5 < r < 0.7$	Positive moderate correlation
$0 < r < 0.5$	Weak correlation
$r=0$	No Relationship

Source: (Helmstedt et al., 2019)

3. Results and Discussion

3.1 Settlement trend

Th results in Figure 2 show that population increased from 1.4 percent in 2001 and reached 3.8% in 2020. The increase of population has led to the increase of households as shelter for

households. Thus, growth of households was highly increased rather than population growth where by 2000 to 2001, households' growth rate was 1.4% and later by 2019/2020 reaches 3.8%. However, this increase as recently reported, households increase reduced land covered by forests, water bodies (wetland) and other natural beauty (UNDP, Gender Equality for increased productivity and sustainable growth, 2019).

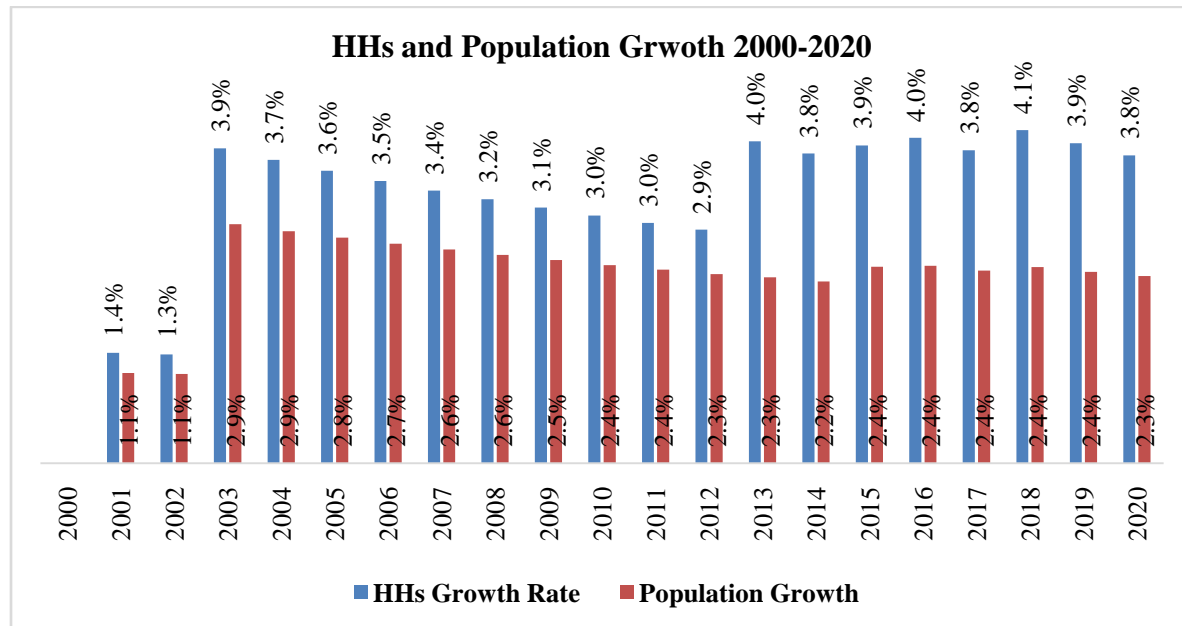


Figure 2: Households and Population Growth of Kicukiro District 2000 to 2020

Source: NISR, (2021).

From the results shown in Figure 3, the number of households in Kicukiro District increased from 54,210 households by 2000 to 105,028 households in 2020. This is clear that, households are increasing at high level in Kicukiro District. This is a challenge for land management in one way but also favorable in other way. Managed settlement is good and favoring easy land management and poor planned settlement is a challenge to land management practices (Christian et al., 2019).

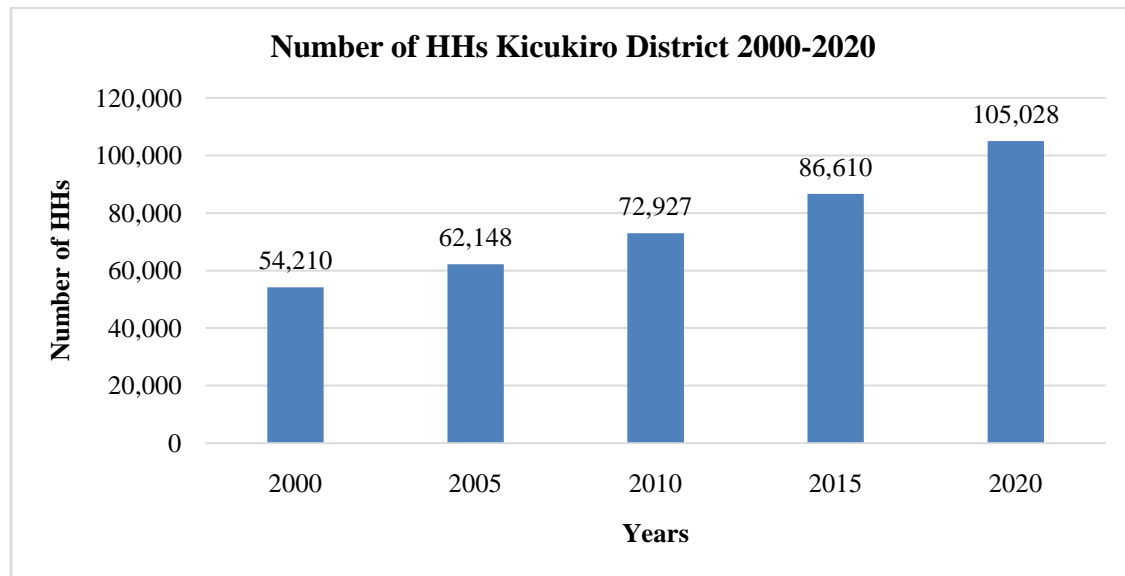


Figure 3: Households’ growth in Kicukiro District by Sector 2000-2020

Source: (NISR, 2021).

Globally, city’s major concern is soil erosion and wetland encroachment. Many efforts are being taken, like terraces over slopes greater than 12% and protection of swamps (UNDP, Gender Equality for increased productivity and sustainable growth, 2019). For Rwanda, the boundary delineated by REMA does not correspond with the on-ground situation where the actual marshland cover is much smaller than the wetland boundary. Hence, it is critical to reclaim the lost wetlands and restore them, as much as possible, to their natural conditions (NISR, 2021).

Nonetheless, as shown in Figure 4, from 2000 to 2020, rapid urbanization took place and transformed almost rural areas of many sectors of Kicukiro district. This likely expresses that most of the wetlands of the district have been encroached or built up for industrial, housing, and agricultural uses.

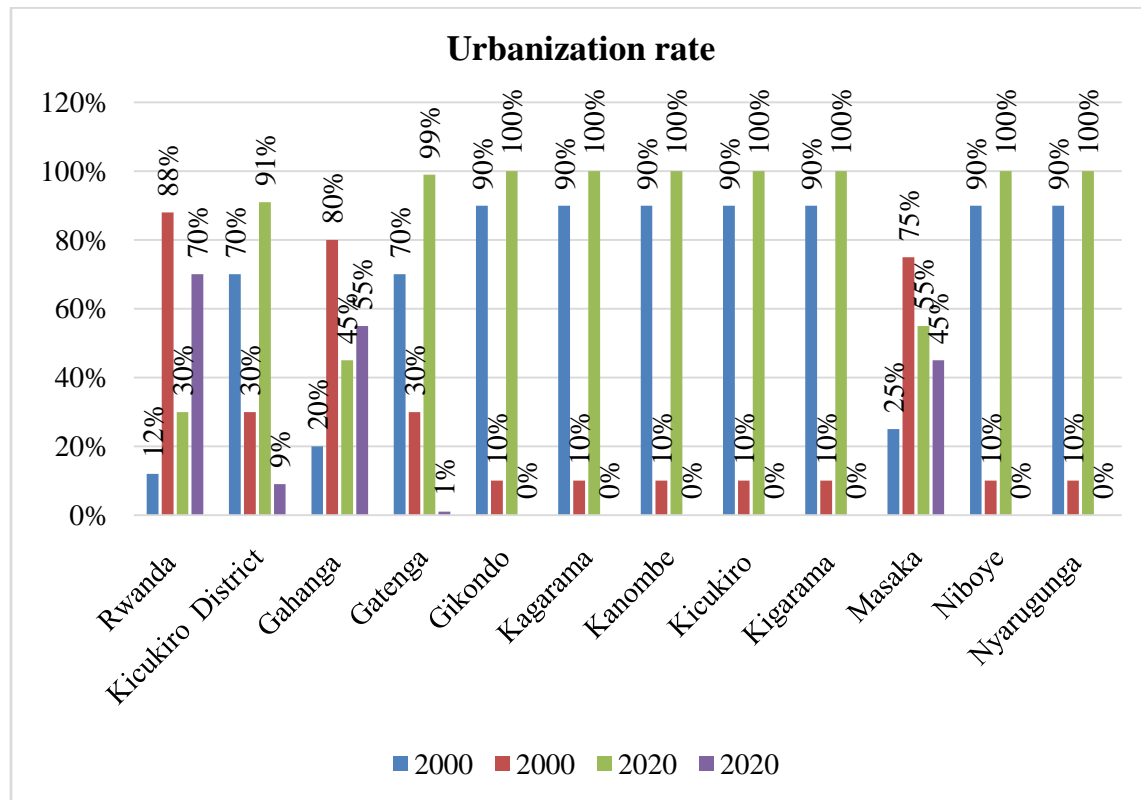


Figure 4: Urbanization rate in Rwanda, Kicukiro District and Sectors 2000-2020

Source: (Kicukiro District, 2018)

The results in Figure 5 indicated that GDP of households or people in Kicukiro sectors was increased from 273.7US\$ per person per years in 2006 and reached 923 US\$ by 2020. As GDP increase people get money for constructing more houses, for industries development and other activities which use land. Population growth and GDP has also increased waste generation from 182.5 kg by 2006 of waste per year and reached 1,277.5kg by 2020. Rwandan population also were increased while land size remains not changing.

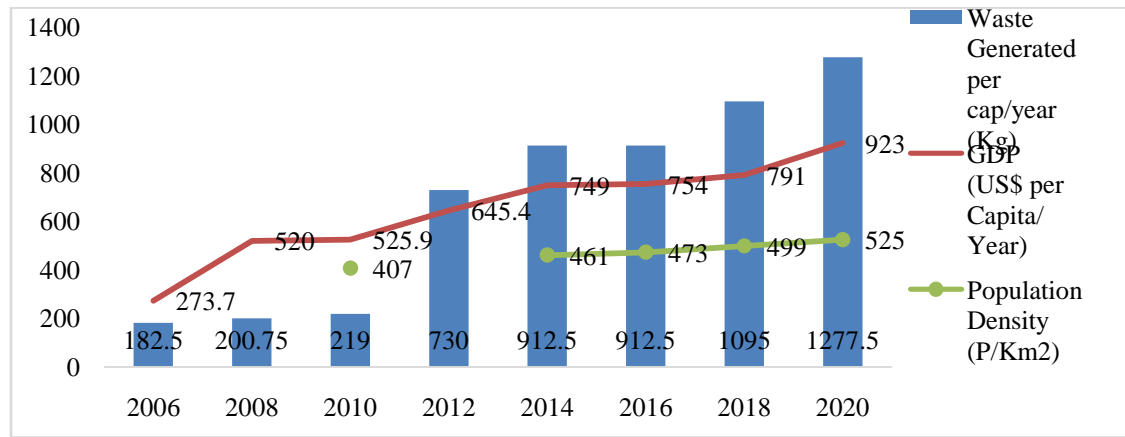


Figure 5: Households waste generation per capita and GDP Growth 2006-2020

Source: (NISR, 2021)

3.2 Land use and land management

The results in Figure 6 shows that in 2010 (a), 2015 (b) and 2020 (b), the district of Kicukiro district recorded a decreasing forestland and cropland due to expanding built up land. This expresses that even though land management was recently introduced in Rwanda, in most space of Kigali City more specifically Kicukiro District settlement was not made with respect of urbanization plan.

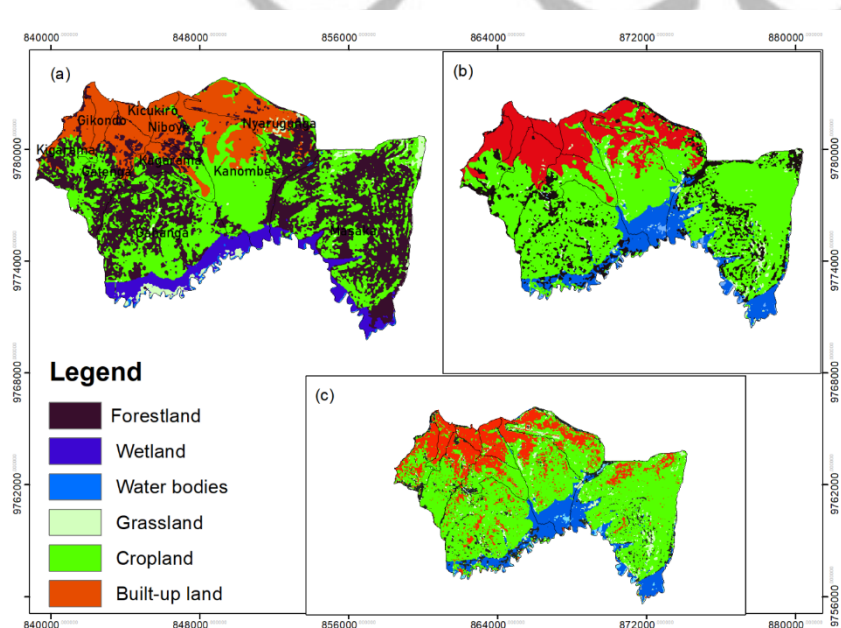


Figure 6: Land cover dynamics in Kicukiro District

4.4 Relationship between settlement and land management

The results in Table 2 show that there is a negative impact of settlement on size of land for agriculture, forest wetland, water land, etc. and land degradation.

$$Y = 14.118 - 1.580x_1 - 0.951x_2 - 3.791x_3 \quad (2)$$

Y represent size of land for agriculture, forest wetland, water land, etc. and land degradation and x_1 to x_3 represent increased urbanization, increase of households, and increase of constructed in unplanned urban settlement. This means that one unit change of x_1 to x_3 lead to reduced land size of agriculture, forest, wetland, water land, and lead to land degradation with the current value plus current value times -1.580; -0.951 and -3.791. Once the values of x_1 to x_3 are null or absolute, the size of land for agriculture, forest wetland, water land, etc. and land degradation is equal to 14.118 units. This means that, increase of urbanization, households and unplanned settlement reduce size of land for agriculture, forest wetland, water land, etc. and land degradation.

Table 2: Impact of settlement on cropland, forest, wetland and water land

Coefficients ^a					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	14.118	2.296		6.149	.000
Urbanization Rate	-1.580	.365	-.809	-4.331	.000
Growth of households	-.951	.462	-.335	-2.059	.005
Rate of HHs in unplanned urban settlement	-3.791	1.833	-.367	-2.069	.024

a. Dependent Variable: Land for agriculture, forest wetland, water land, etc. and land degradation

The results in Table 3 shows a negative impact of settlement on GDP Growth rate.

$$Y = 23.157 + 0.877x_1 + 1.989x_2 - 15.861x_3 \quad (3)$$

Y represent GDP Growth rate and x_1 to x_3 represent increased urbanization, increase of households, and increase of constructed in unplanned urban settlement. This means that one unit change of x_1 to x_3 lead to GDP growth current value plus the same value times 0.877; 1.989 and -15.861. Once the values of x_1 to x_3 are null or absolute, the Total GDP is equal to 23.157 units. This means that, increase of urbanization, and households to GDP Growth. Increase of unplanned settlement is not good to the GDP growth. It ensures reduced GDP. This means that,

as unplanned settlement increases GDP reduced as later government take time to redress and replace poor settlement into planned settlement and modern settlement.

Table 3: Impact of settlement on total or national GDP Growth rate

Model		Coefficients ^a			t	Sig.
		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta		
1	(Constant)	23.157	2.945		7.863	.000
	Urbanization Rate	.877	.468	.321	1.874	.008
	Growth of households	1.989	.592	.501	3.359	.004
	Rate of HHs in unplanned urban settlement	-15.861	2.351	-1.096	-6.746	.000

a. Dependent Variable: GDP Growth rate

4. Conclusion

This study analyzed how settlement impact on land management in Kicukiro district of the City of Kigali. Secondary dates on urbanization, population density, number of households, GDP trend and land cover from 2000 to 2020 were employed. The ArcGIS and SPSS were the major data analysis tools. The results indicated that the number of households and total population of Kicukiro district recording a growing trend similar to the urbanization and GDP. However, in terms of land management, it is noted only urban land (human activities like settlement, industries, infrastructures, offices, facilities etc.) increased while agricultural land, forest and grassland decreased. It is a problem where activities increase while land remains not changing. Therefore, it is concluded that once urbanization reduces the size of land for agriculture, it might lead to reduction of agriculture sector production (in case other factors like technology or modernization of agriculture remain constant). Increase of households also reduce land for cultivation, unplanned urban settlement and then reduce land for agriculture and create problems to the remaining land.

Acknowledgement

The authors express their thanks to all data provided which facilitated the completion of this research.

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APPENDICES

Appendix 1: Interview Guide

1. How do you observe characteristics of settlement in Kicukiro District and associated sectors?

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2. What are the main activities for land use within Kicukiro District?

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3. Explain the linkage or difficulties generated by settlement to land management?

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4. In your words how settlement is linked to the land management in a specific area (Rwanda)?

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Thank You!