Journal of Agriculture & Environmental Sciences

Assessing The Impact of Urban Growth On the Agricultural Activities of the Small-Scale Farmers in Gasabo District, Rwanda

Theoneste Manirarora & Dr. Richard MIND'JE

ISSN: 2616-8465

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture & Environmental Sciences
Volume 10||Issue 2||Page 87-106 ||July||2026|
Email: info@stratfordjournals.org ISSN: 2616-8465

Assessing The Impact of Urban Growth On the Agricultural Activities of the Small-Scale Farmers in Gasabo District, Rwanda

Theoneste Manirarora[1] & Dr. Richard MIND'JE[1] (PhD)

[1]Faculty of Environmental Studies, University of Lay Adventists of Kigali, Kigali, Rwanda

***How to cite this article*: Manirarora T., & MIND'JE R. (2026). Assessing The Impact of Urban Growth On the Agricultural Activities of the Small-Scale Farmers in Gasabo District, Rwanda. *Journal of Agriculture & Environmental Sciences Vol* 10(2) pp. 87-106. https://doi.org/10.53819/81018102t2586**

Abstract

The study assessed the extent to which urban growth affects agricultural activities among small-scale farmers in Gasabo District. Using a descriptive survey design with quantitative, qualitative, and geospatial approaches, the study sampled 394 respondents through stratified random and purposive sampling. Data were collected through questionnaires, key informant interviews, Landsat imagery (Landsat 5TM, 7ETM+, and 8 OLI), Google Earth imagery, and land-use records. Quantitative data were analyzed using Excel and SPSS, while spatial analysis was conducted using ArcGIS Pro. Findings showed that urban land increased from 3,449.07 hectares in 2000 to 4,914.09 hectares in 2024, while agricultural land declined from 28,848 hectares to 14,717 hectares. Correlation analysis revealed a very strong negative relationship between urban growth and agricultural land (r = -0.97). Regression analysis showed that urban growth explains approximately 94% of the variation in agricultural land reduction. The study concluded that rapid urban expansion has significantly reduced farming areas, disrupted traditional agricultural systems, and encouraged livelihood diversification among small-scale farmers.

Keywords: *Agricultural activities, Gasabo District, GIS, Land use change, Rwanda and Urban growth.*

1. Introduction

Urbanization is among the most significant drivers of global landscape, economic, and livelihood transformation in the 21st century. The United Nations Department of Economic and Social Affairs (2018) reported that 55% of the world's population lived in urban areas, with this proportion projected to increase to 68% by 2050. Rapid urban expansion, particularly in developing countries, has resulted in extensive conversion of agricultural land into residential, commercial, and infrastructure developments, threatening agricultural productivity and the livelihoods of small-scale farmers. Globally, approximately 30 million hectares of agricultural land are expected to be lost between 2000 and 2030 due to urban expansion, with developing countries experiencing the greatest impacts (FAO, 2017).

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture & Environmental Sciences
Volume 10||Issue 2||Page 87-106 ||July||2026|
Email: info@stratfordjournals.org ISSN: 2616-8465

Across Asia and Latin America, urban growth has significantly reduced agricultural land, displaced farming communities, and altered traditional farming systems. Similar trends are evident in Sub-Saharan Africa, which has the fastest urban growth rate globally at approximately 3.9% annually (UN-Habitat, 2020). Although agriculture remains central to the region's economy, employing over 60% of the workforce and supporting food security (World Bank, 2021), expanding cities increasingly compete with agricultural activities for land and resources. Countries such as Kenya, Ethiopia, Ghana, and Nigeria have experienced substantial agricultural land conversion, resulting in reduced farm sizes, increased land prices, and changing farming practices among peri-urban farmers.

Rwanda has also undergone rapid urban transformation, with its urban population increasing from approximately 6% in 1990 to 17.3% in 2022 and projected to reach 35% by 2050 (Government of Rwanda, 2020). Kigali, as the country's economic center, has experienced significant expansion, with built-up areas increasing by approximately 250% between 2000 and 2020. This growth has extended into peri-urban areas, including Gasabo District, where agricultural land has increasingly been converted for urban development. Previous studies indicate that urbanization in Kigali has contributed to land fragmentation, reduced farm sizes, changing land tenure systems, and challenges related to water access and agricultural productivity.

Gasabo District, particularly Bumbogo Sector, represents a rapidly transforming peri-urban area where small-scale farmers traditionally depended on crop production and livestock farming. However, increasing demand for residential estates, commercial facilities, and infrastructure has accelerated agricultural land conversion. Despite these changes, limited empirical evidence exists on how urban growth specifically affects small-scale farmers' agricultural activities, livelihoods, and adaptation strategies in Gasabo District.

Small-scale farmers, who often operate on less than one hectare of land, are highly vulnerable to urban-induced land-use changes. The decline in available farmland, rising land prices, environmental pressures, and changing agricultural systems may threaten food security and household incomes. Therefore, this study seeks to assess the impact of urban growth on agricultural activities among small-scale farmers in Gasabo District. The findings aim to provide evidence to support sustainable urban planning, agricultural policies, and strategies that balance urban development with the protection of agricultural livelihoods.

1.2 Objectives of the Research

1.2.1 General objective

The general objective of the study is to assess the extent at which urban growth affects the agricultural activities of the small-scale farmers, in Gasabo District, Rwanda.

1.2.2. Specific objectives

(i) To analyze the extent and patterns of urban growth in Gasabo District over the past two decades (2000-2024).
(ii) To assess the current state of agricultural activities among small-scale farmers in Gasabo District.
(iii) To determine the relationship between urban growth and changes in agricultural activities of small-scale farmers in Gasabo District.

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture & Environmental Sciences
Volume 10||Issue 2||Page 87-106 ||July||2026|
Email: info@stratfordjournals.org ISSN: 2616-8465

2. Research methods

2.1 Description of the study area

The study was conducted in Gasabo District, located in the northeast of Kigali City, Rwanda. As a peri-urban district, Gasabo represents a transition zone where rural agricultural landscapes interact with expanding urban development. The district covers 430 square kilometers and has a total population of 879,505 residents, with a population density of 2,056 inhabitants/km². Of the population, 714,069 (81.2%) live in urban areas, while 165,436 (18.8%) reside in rural areas where livelihoods largely depend on agricultural activities (NISR, 2022).

Gasabo District has experienced rapid urban expansion influenced by the implementation of the Kigali City Master Plan. The district demonstrates increasing conversion of agricultural land into residential areas, commercial developments, infrastructure, and other urban uses. Kigali's spatial expansion has been estimated at approximately 10% annually, accelerating land-use changes and increasing pressure on agricultural spaces (Mugisha, 2014).

Agriculture remains an important livelihood activity in Gasabo District, with small-scale farmers producing cereals, legumes, root crops, vegetables, and livestock on increasingly fragmented plots (Nsengiyumva, 2021). However, urban growth has created challenges, including declining agricultural land availability, soil degradation, limited mechanization, and inadequate irrigation infrastructure. Furthermore, 93.3% of households reported difficulties in covering their living expenses, indicating significant socioeconomic vulnerability (Nsengiyumva, 2021). Therefore, Gasabo District provides an important context for examining how urban expansion affects agricultural activities, farmer livelihoods, and land-use dynamics.

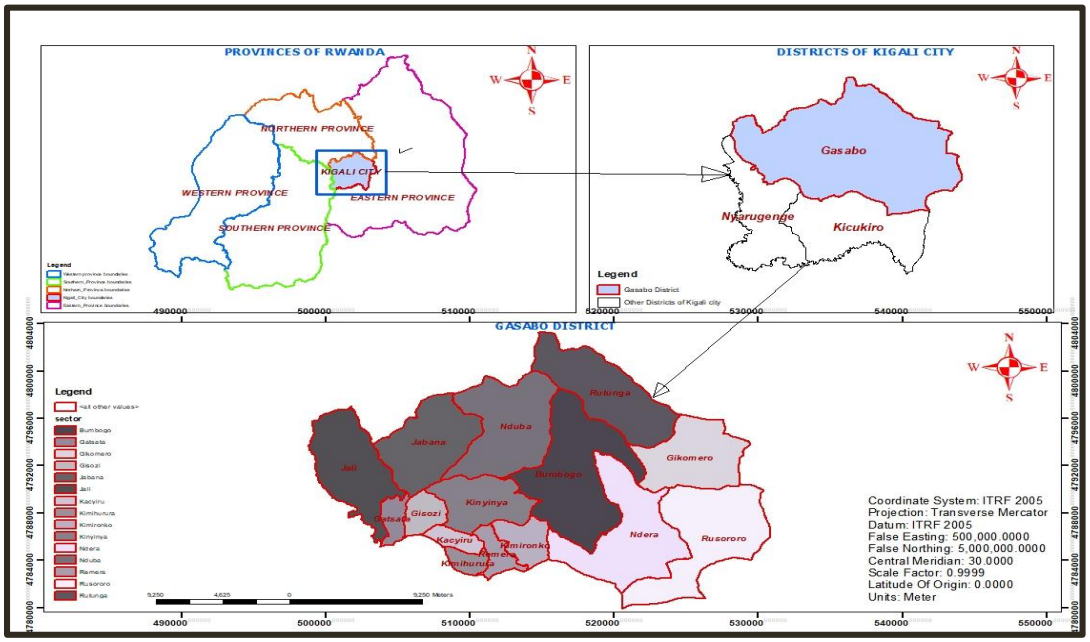

Figure 3.1. Descriptive map of the study area

Source: Researcher's Computation, 2026

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture & Environmental Sciences
Volume 10||Issue 2||Page 87-106 ||July||2026|
Email: info@stratfordjournals.org ISSN: 2616-8465

2.2. Research design and data collection methods

This study employed a mixed-methods research design integrating quantitative, qualitative, and spatial analysis approaches to assess the impact of urban growth on agricultural activities among small-scale farmers in Gasabo District. The quantitative component involved a household survey and geospatial analysis of satellite imagery from 2000 to 2024 to assess urban expansion and agricultural land-use changes. Remote sensing and GIS techniques were used to classify land use/land cover changes and quantify the conversion of agricultural land into urban areas. Statistical analyses, including descriptive statistics, correlation analysis, and regression analysis, were conducted to examine relationships between urban growth and agricultural changes.

Primary data were collected from small-scale farmers through structured questionnaires covering farm size, land ownership, crop and livestock production, productivity, income, and perceptions of urbanization impacts. Qualitative data were collected through key informant interviews, focus group discussions, and field observations involving agricultural officers, land and community settlement officers, urban planners, and representatives from the National Land Authority and City of Kigali. Secondary data were obtained from satellite imagery, including Landsat 7 and Landsat 8, Google Earth imagery, population census reports, land-use maps, policy documents, and relevant academic literature.

The target population consisted of agricultural households in four rapidly urbanizing sectors of Gasabo District: Jabana, Bumbogo, Ndera, and Rusororo. According to the Fifth Rwanda Population and Housing Census (2022), these sectors contained 26,247 agricultural households. Using the Taro Yamane formula with a 95% confidence level and a 5% margin of error, a sample size of 394 farming households was determined. The sample was distributed as follows: Jabana (91), Bumbogo (122), Ndera (98), and Rusororo (83). Stratified random sampling was used to select household respondents, while purposive sampling was applied to select approximately 12 key informants with specialized knowledge of urban planning and agriculture. Additionally, four focus group discussions were conducted to obtain deeper insights into farmers' experiences and adaptation strategies.

2.3 Data analysis and processing

Data processing and analysis were conducted using quantitative, qualitative, and spatial analysis techniques aligned with the study objectives. For assessing urban growth patterns, satellite images from 2000, 2008, 2016, and 2024 were processed using ArcGIS Pro. Image preprocessing, including geometric correction, radiometric calibration, and atmospheric correction, was conducted before applying supervised classification using the Maximum Likelihood Classifier to identify land use and land cover changes. Post-classification analysis was used to quantify urban expansion and agricultural land conversion, with results presented through maps, tables, and graphs.

For assessing agricultural activities among small-scale farmers, questionnaire data were edited, coded, entered into Microsoft Excel, and analyzed using descriptive statistics such as frequencies, percentages, means, and standard deviations. Cross-tabulations were used to examine relationships between farmers' characteristics and agricultural practices. To determine the relationship between urban growth and agricultural changes, inferential analyses, including Pearson correlation and regression analysis, were conducted to assess

associations between urban expansion indicators and agricultural variables such as farm size, crop diversity, productivity, and agricultural income. Qualitative data from interviews and focus group discussions were transcribed and analyzed thematically to explain farmers' experiences and adaptation strategies.

Research validity was ensured through expert review of instruments, literature-based development of indicators, and triangulation of multiple data sources, including satellite imagery, surveys, interviews, and focus groups. Reliability was strengthened through pre-testing of questionnaires, assessment of internal consistency using Cronbach's alpha ($\alpha \geq 0.7$ acceptable), standardized data collection procedures, and clear qualitative coding protocols.

Ethical considerations included obtaining ethical approval, informed consent, ensuring confidentiality, protecting participants' privacy, and maintaining voluntary participation. Data were securely stored and used only for academic purposes. The study limitations included potential challenges from satellite image resolution, cloud cover, recall bias among farmers, the cross-sectional design limiting causal conclusions, resource constraints, limited generalizability beyond Gasabo District, possible language barriers, and the rapidly changing nature of peri-urban environments.

3. Results

3.1 Socio-demographic characteristics of respondents

The socio-demographic findings show that small-scale farming in Gasabo District is mainly practiced by women and older adults. Female respondents represented 55%, while males accounted for 45%, indicating strong female involvement in agricultural activities. Most farmers were aged 36–60 years (58%), followed by those above 60 years (32%), while youth aged 18–35 years represented only 9%. Regarding education, 68% had primary education, 18% had no formal education, 10% had secondary education, 3% had technical education, and 0.3% had university education. Most respondents were married (54%), while 31% were widowed. Long-term residents dominated, with 63% having lived in the area for 16 years or more. Farming was the main occupation for 81% of respondents, while employment (8%), business (6%), and casual labor (5%) represented alternative livelihoods. In addition, 86% of households practiced agriculture, mainly through mixed crop and livestock farming (53%), followed by crop farming only (34%) and livestock farming only (13%). These findings demonstrate the continued importance of agriculture despite urbanization pressures.

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture & Environmental Sciences
Volume 10||Issue 2||Page 87-106 ||July||2026|
Email: info@stratfordjournals.org ISSN: 2616-8465

Table 1: Socio-demographic characteristics of respondents

Variables	Category	Frequency	Percentage (%)
Gender	Male	177	45%
	Female	217	55%
Age group	18-35 years	36	9%
	36-60 years	227	58%
	Above 60 years	131	33%
Educational level	No school	71	18%
	Primary	268	68%
	High school	41	10%
	TVET	13	3%
	University	1	0.3%
Marital status	Single	48	12%
	Married	212	54%
	Widow	121	31%
	Divorced	13	3%
Residence duration	Less than 8 years	53	13%
	8 to 16 years	89	23%
	16 to 24 years	124	31%
	More than 24 years	128	32%
Main Occupation	Farming	321	81%
	Business	24	6%
	Employment	31	8%
	Casual labor	18	5%
Households practicing agriculture	Yes	339	86%
	No	55	14%
Types of agriculture	Crop farming	115	34%
	Livestock	43	13%
	Both	181	53%

Source: primary data, 2026

3.2 The extent and patterns of urban growth in Gasabo district (2000-2024).

3.2.1 General characteristics of Gasabo District's land use land covers

The findings of field observations, research and image classification of the study area, indicated that the land use land cover of Gasabo District is mostly made up of agriculture area, forestry and built up area. In 2000 the built up area in Gasabo District were 3,449.07 hectares, and large part of District were agriculture area were 28,848 hectares, forest with 20,025.18 hectares and 784 hectares were for other LULC such as gardens, bare soil, grassland, bare land, roadside trees, waterbodies, all other areas which are not fall into agriculture area and forestry. From 2000 to 2024, urban parts had developed in the Gasabo District, with an urbanization rate of about 81.2%. This number is anticipated to rise further

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture & Environmental Sciences
Volume 10||Issue 2||Page 87-106 ||July||2026|
Email: info@stratfordjournals.org ISSN: 2616-8465

as vast tracts of agricultural land are turned into cities.

There are some changes occurred among the classes, and the results from analysis showed that there were both decrease and an increase to the different defined classes with respect to time period and from the classification of Landsat image, the results showed a decrease of farmland. This analysis examined the spatial-temporal dynamics of two critical land use categories which Agricultural Land and Urbanized Land over a 24-year period (2000 to 2024), observed at 8-year intervals. The outputs were derived from LULC classification performed in ArcGIS Pro. The central finding is a clear and accelerating inverse relationship: as urbanized land expands, agricultural land shrinks, reflecting the dominant pattern of urban encroachment on productive farmland. Land use and land cover of Gasabo District are well described by the following maps of LULC over the period of 2000-2024:

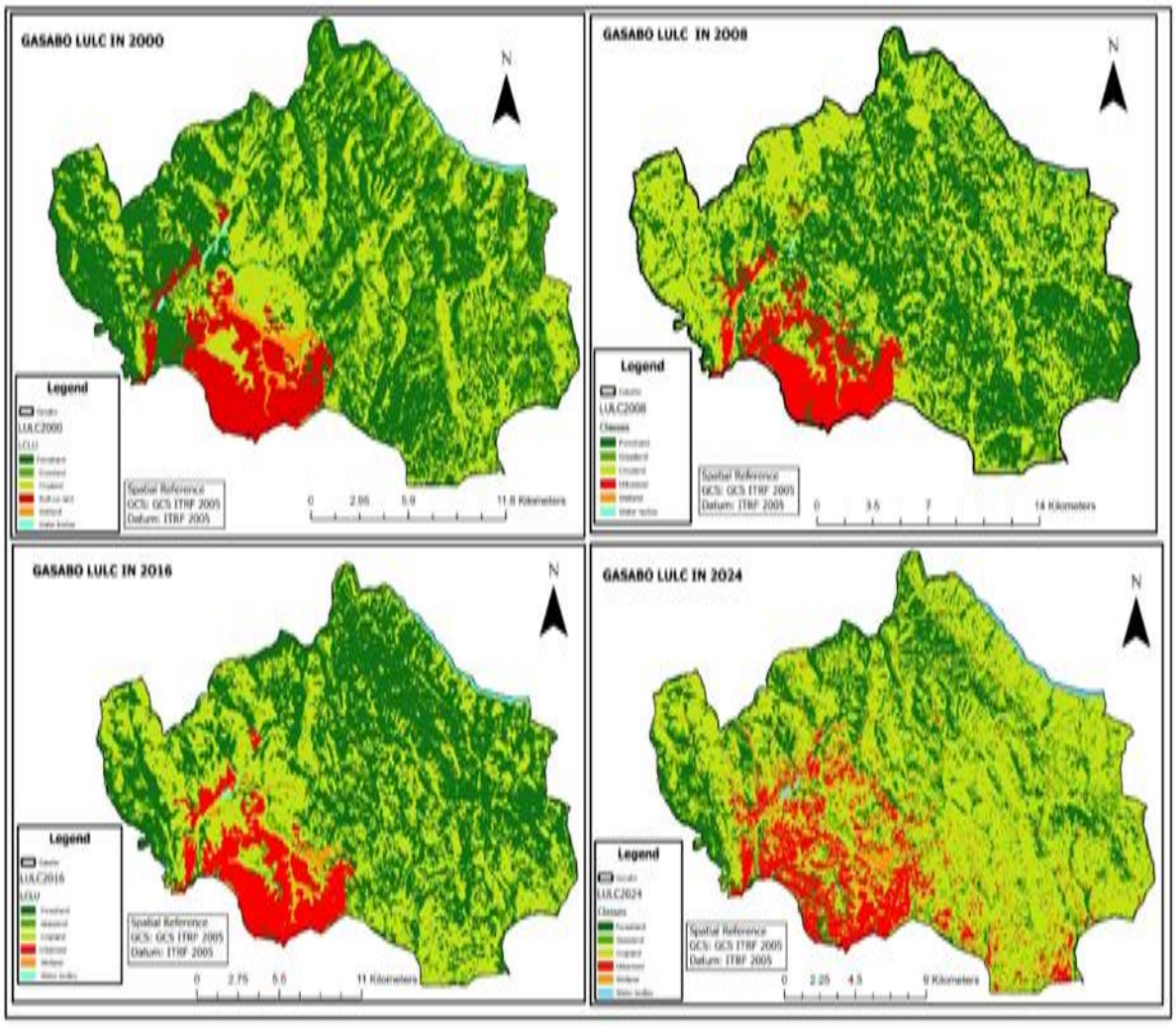

Figure 2: Land use land cover change in Gasabo district (2000 - 2024)

3.2.2 Urban growth patterns and trends in Gasabo District over the period of 2000-2024

During the initial period from 2000 to 2008, urban expansion was virtually negligible, with a net addition of only 48.87 hectares over eight years, equivalent to an annual growth rate of approximately 6.1 ha/year. This near-stagnant spatial growth suggests that urban development during this phase was largely confined within existing built-up boundaries,

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture & Environmental Sciences
Volume 10||Issue 2||Page 87-106 ||July||2026|
Email: info@stratfordjournals.org ISSN: 2616-8465

characterized more by internal densification and land-use intensification than by outward physical expansion.

A discernible shift in urbanization dynamics became apparent between 2008 and 2016, during which 238.86 hectares of new urban land were recorded. Although modest in absolute terms, this figure represents a nearly fivefold increase in the annual rate of expansion relative to the preceding period, rising from 6.1 to 29.9 ha/year. This acceleration marks a transitional phase in which urban growth began to extend beyond established boundaries, signaling the onset of more pronounced spatial sprawl. The most dramatic transformation occurred during the final period from 2016 to 2024, which recorded an urban gain of 1,177.29 hectares approximately five times the growth observed between 2008 and 2016 and accounting for roughly 80% of the total net urban expansion over the entire 24-year study period. The annual rate surged to 147.2 ha/year, reflecting what

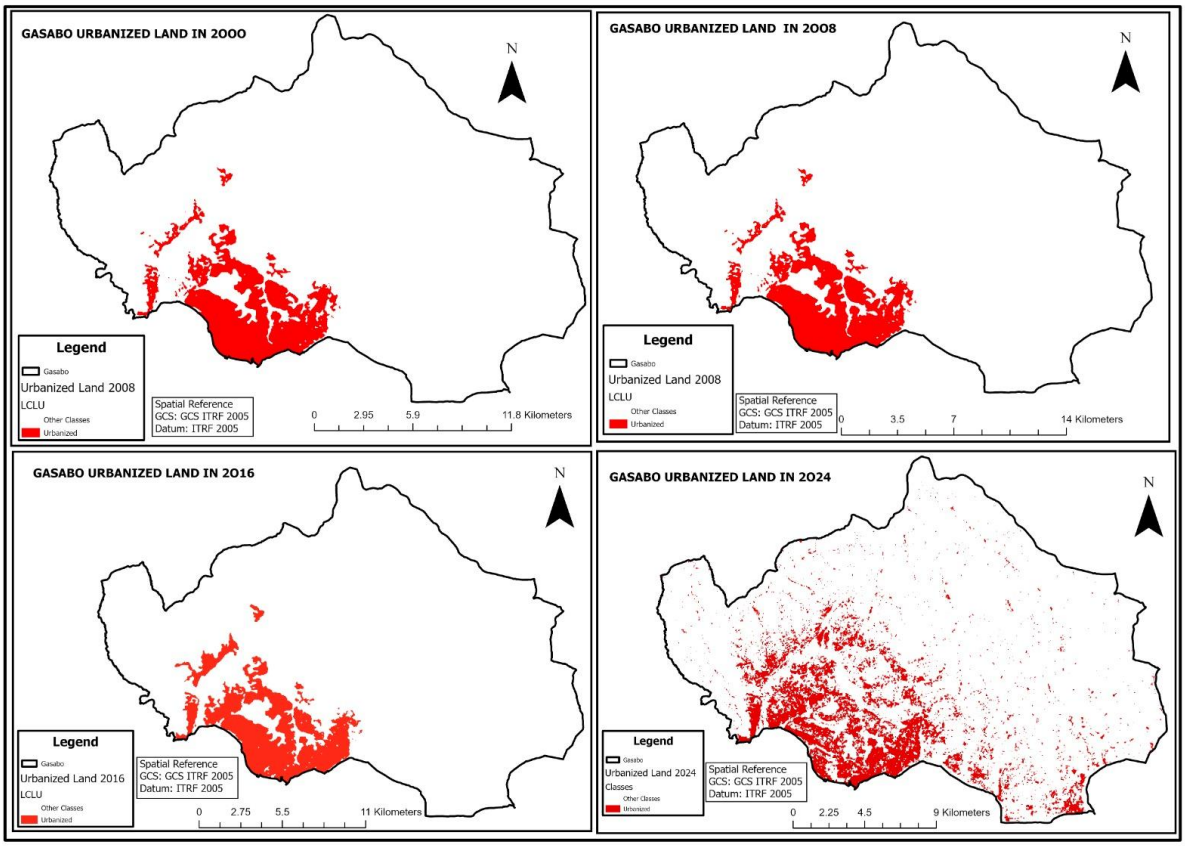

Figure 3: Urban growth pattern in Gasabo district (2000 - 2024)

The table 2 presents the temporal dynamics of urbanized land across four time points spanning 24 years. In 2000, the district recorded a baseline urban area of 3,449.07 hectares, which expanded marginally to 3,497.94 hectares by 2008, reflecting a minimal gain of 48.87 hectares (1.4%). By 2016, urbanized land had grown to 3,736.80 hectares, representing a more notable increase of 238.86 hectares (6.8%) relative to the previous period. The most substantial transformation is recorded in the 2016–2024 interval, where urban area expanded sharply to 4,914.09 hectares a gain of 1,177.29 hectares (31.5%) and an annual rate of 147.2 ha/year. Over the full study period, the district experienced a cumulative urban expansion of 1,465.02 hectares, representing a 42.5% increase from the 2000 baseline, with an overall mean annual rate of 61.0 ha/year. These figures collectively

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture & Environmental Sciences
Volume 10||Issue 2||Page 87-106 ||July||2026|
Email: info@stratfordjournals.org ISSN: 2616-8465

underscore a strongly accelerating urbanization trajectory, with growth disproportionately concentrated in the most recent period, which alone accounts for the overwhelming majority of the district's total urban land gain.

Table 2: The urban land area analysis of Gasabo District over the period 2000-2024

Year	Urbanized land (ha)	Change from Previous (ha)	Change (%)	Annual rate (ha/yr)
2000	3,449.07	-	-	-
2008	3,497.94	48.87	1.4%	6.1
2016	3,736.80	238.86	6.8%	29.9
2024	4,914.09	1,177.29	31.5%	147.2
Total		**1,465.02**	**42.5%**	**61.0**

3.2.3 Validation of urban growth patterns and trends by Google Earth Imagery

Based on observations from Google Earth imagery, Gasabo District has experienced a clear and continuous expansion of built-up areas between 2000 and 2024, accompanied by a noticeable decline in other land use and land cover types such as agricultural land, forest land, and open spaces. In the early 2000s, the district was predominantly characterized by extensive agricultural fields, scattered rural settlements, and patches of natural vegetation. However, over time, these landscapes have progressively been transformed into dense residential neighborhoods, commercial developments, road networks, and public infrastructure. The increase in built-up areas is mainly driven by rapid urban growth associated with population increase, housing demand, and economic development in and around Kigali City. As a result, previously productive agricultural land and natural vegetation have been converted into urban uses. This expansion is particularly evident in peri-urban zones, where farmland has been subdivided into smaller plots and gradually replaced by housing and other urban structures. At the same time, other land use/land cover categories have declined. Agricultural land has reduced due to land conversion and fragmentation, limiting space for farming activities. Forest and vegetation cover have also decreased, likely due to clearing for construction and settlement expansion. Open and unused land has been absorbed into urban development, further contributing to landscape transformation. Overall, the Google Earth analysis demonstrates a strong inverse relationship between built-up area expansion and the decline of other land use types. This trend reflects rapid urbanization in Gasabo District and highlights its significant impact on land availability for agriculture, environmental sustainability, and the livelihoods of small-scale farmers. Urban growth patterns and trends in Gasabo District is clearly described by the following maps from Google Earth Imagery.

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture & Environmental Sciences
Volume 10||Issue 2||Page 87-106 ||July||2026|
Email: info@stratfordjournals.org ISSN: 2616-8465

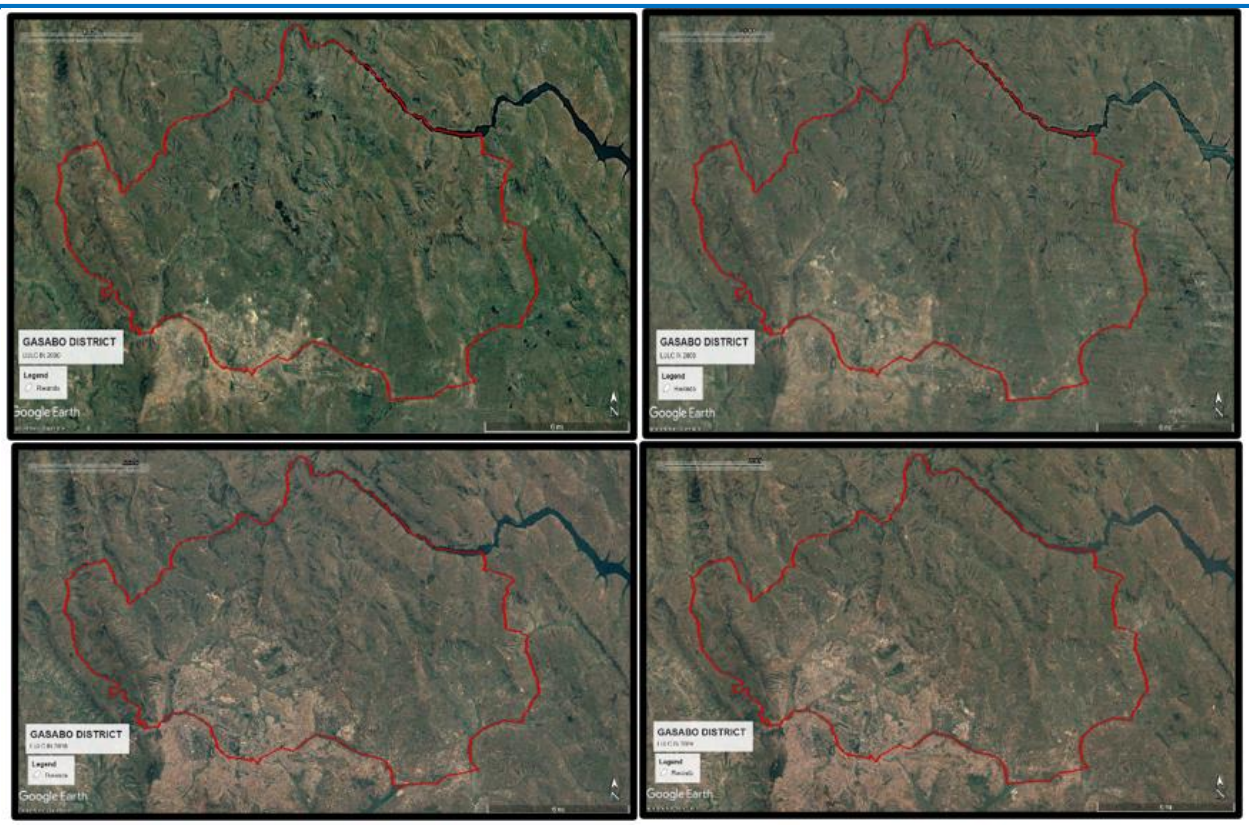

Figure 4: Google earth images validating the urban growth patterns and trends

3.3. The current state of agricultural activities among small-scale farmers in Gasabo district.

3.3.1 Agricultural land patterns and trends (2000-2024)

The most severe episode of agricultural land loss occurred during the earliest period of the study, between 2000 and 2008, during which approximately 9,554 hectares of agricultural land were lost equivalent to 33.1% of the year 2000 baseline within just eight years. With an average annual loss rate of 1,194 ha/year, this period represents the steepest rate of agricultural decline across the entire 24-year study period, suggesting that rapid and largely unregulated land conversion was the dominant process reshaping the district's land-use structure during this phase.

A marked deceleration in agricultural land loss was observed between 2008 and 2016, with a comparatively modest reduction of 892 hectares recorded over the full eight-year interval, corresponding to an annual loss rate of approximately 112 ha/year. This substantial slowdown may be attributable to a combination of factors, including a temporary plateau in urban expansion, the possible influence of land-use planning or policy interventions, or the progressive exhaustion of easily convertible peri-urban agricultural land in the vicinity of the expanding urban core.

However, the apparent stabilization of the preceding period gave way to a renewed and alarming acceleration of agricultural land loss between 2016 and 2024, during which 3,685 hectares were lost representing a 20.0% decline at an average rate of 461 ha/year. This resurgence of land conversion pressure likely reflects the intensification of large-scale urban development programs, expansion of infrastructure networks, and population-driven

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture & Environmental Sciences
Volume 10||Issue 2||Page 87-106 ||July||2026|
Email: info@stratfordjournals.org ISSN: 2616-8465

encroachment into the outer agricultural zones of the district. Taken together, the three periods reveal a non-linear but cumulatively severe pattern of agricultural land loss that poses significant long-term challenges to food security, rural livelihoods, and sustainable land management within the study area.

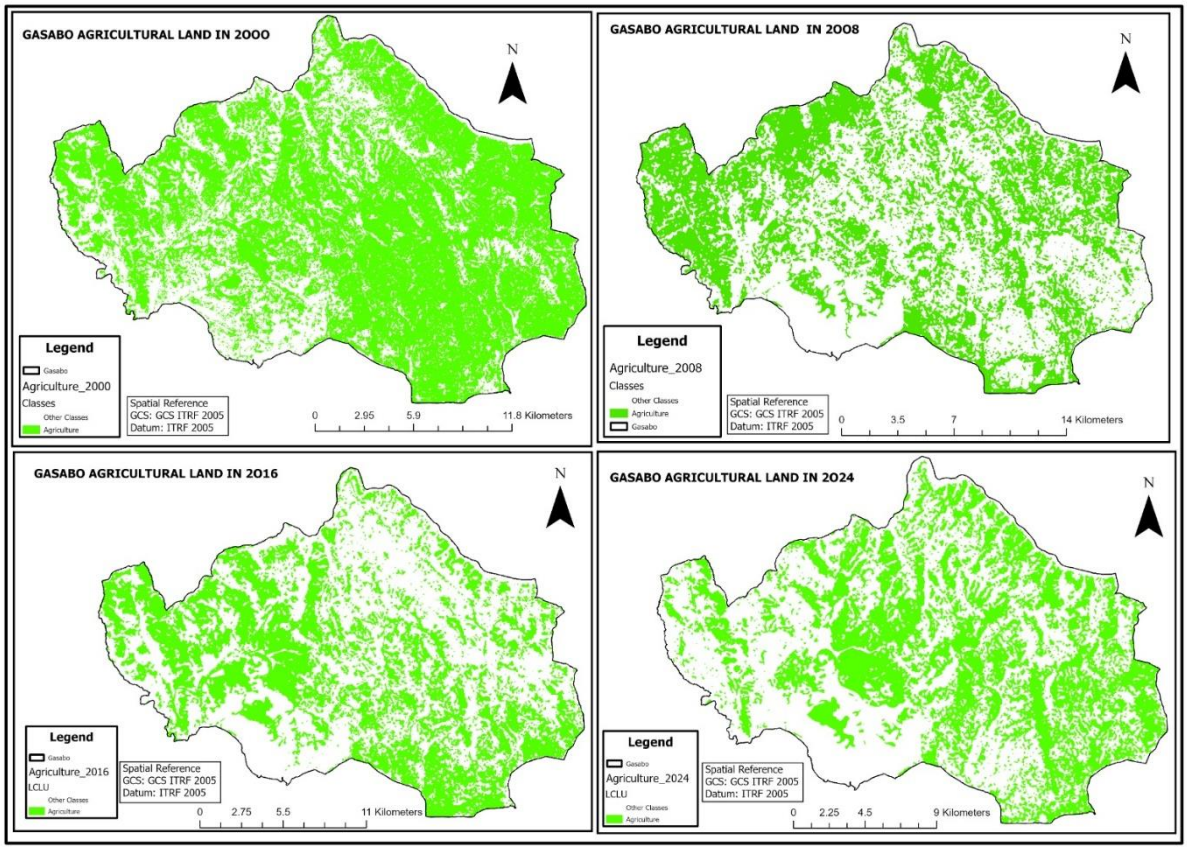

Figure 5: Map of the agricultural land patterns and trends in Gasabo District.

The table below a consistent and substantial decline in agricultural land extent across the four time points of the study period. Beginning from a baseline of 28,848 hectares in 2000, agricultural land contracted sharply to 19,294 hectares by 2008, reflecting a loss of 9,554 hectares (−33.1%) at an annual rate of 1,194 ha/year the most severe single-period reduction recorded in the dataset. A notable deceleration followed between 2008 and 2016, during which agricultural land decreased marginally from 19,294 to 18,402 hectares, representing a comparatively limited loss of 892 hectares (−4.6%) at 112 ha/year. This interval stands in marked contrast to the periods preceding and succeeding it. The final period from 2016 to 2024 saw agricultural land decline further to 14,717 hectares, with a loss of 3,685 hectares (−20.0%) and a renewed annual rate of 461 ha/year, signaling a resurgence in land conversion pressure. Cumulatively, the district lost a total of 14,131 hectares of agricultural land over the 24-year study period, representing a reduction of nearly half (−49.0%) of the year 2000 baseline, with an overall mean annual loss rate of 589 ha/year. These figures highlight an alarming long-term erosion of the district's agricultural land base, with profound implications for food production capacity and rural land-use sustainability.

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture & Environmental Sciences
Volume 10||Issue 2||Page 87-106 ||July||2026|
Email: info@stratfordjournals.org ISSN: 2616-8465

Table 3: The agricultural land area analysis of Gasabo District over the period 2000-2024

Year	Agriculture (ha)	Change from Previous (ha)	Change (%)	Annual Rate (ha/yr)
2000	28,848	-	-	-
2008	19,294	−9,554	−33.1%	−1,194
2016	18,402	−892	−4.6%	−112
2024	14,717	−3,685	−20.0%	−461
Total		**−14,131**	**−49.0%**	**−589**

4.3.2 Perception of respondents, key informants and focus group participants on the current state of agricultural activities among the small-scale farmers in Gasabo district.

The findings demonstrate that urban growth has significantly affected agricultural activities among small-scale farmers in Gasabo District. Land-use change was identified as a major driver of agricultural land loss, with 89% of respondents agreeing (73% agree and 16% strongly agree) that land conversion has reduced agricultural land availability (mean = 4.04, SD = 0.58). Qualitative findings supported this, as the National Land Authority land-use planning specialist explained that rapid urban expansion has converted farmland into residential areas, commercial buildings, roads, and infrastructure. Focus group participants further reported reduced cultivation areas, increased land fragmentation, and smaller plots that are insufficient for sustainable farming.

Population growth and increasing density also contributed to declining agricultural production, with 94% agreement (76% agree and 18% strongly agree) (mean = 4.08, SD = 0.59). Key informants and farmers highlighted that increased demand for housing, roads, schools, and other services has accelerated farmland conversion and forced farmers to either intensify production or shift to non-farm livelihoods.

Infrastructure development influenced farming practices, with 77% of respondents agreeing (58% agree and 19% strongly agree) (mean = 3.91, SD = 0.79). The City of Kigali urban planner noted that roads, markets, electricity, and water services improved access to inputs and promoted technologies such as greenhouse farming and zero-grazing. However, focus groups emphasized that infrastructure expansion reduced traditional farming spaces.

Increasing land values affected agricultural profitability, with 79% agreement (59% agree and 20% strongly agree) (mean = 3.90, SD = 0.82). Farmers reported higher land costs and pressure to sell land, although proximity to markets created opportunities for selling vegetables and livestock products.

Urban services influenced food security, with 98% agreement (22% agree and 76% strongly agree) (mean = 4.74, SD = 0.88). While services improved food access, farmers reported declining food production due to shrinking farmland. Similarly, 98% agreed that farmers are shifting to off-farm activities (18% agree, 80% strongly agree; mean = 4.77, SD = 0.89)

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture & Environmental Sciences
Volume 10||Issue 2||Page 87-106 ||July||2026|
Email: info@stratfordjournals.org ISSN: 2616-8465

because of declining agricultural profitability.

Crop and livestock production declined according to 98% of respondents (28% agree and 70% strongly agree) (mean = 4.66, SD = 0.85). Nevertheless, technology adoption was viewed positively, with 95% agreement (50% agree and 45% strongly agree) (mean = 4.38, SD = 0.72). Land tenure and policy influences were also significant, with 84% and 96% agreement, respectively, demonstrating the importance of secure land rights and inclusive urban planning for sustaining agriculture in Gasabo District.

Table 4: Shows the perceptions of respondents on the indicators of urban growth and indicators of agricultural activities

Statement	SA	A	N	D	SD	Mean	Stdv
Land use change has significantly affected land availability for agriculture, so as increasing urban expansion leads to the conversion of farmland into non-agricultural uses	65 16%	286 73%	37 9%	4 1%	2 1%	4.04	0.58
Population growth and density have reduced agricultural production due to land conversion for urban uses.	71 18%	298 76%	15 4%	7 2%	3 1%	4.08	0.59
Infrastructure development has affected farming practices by promoting the adoption of improved and intensive techniques while constraining traditional farming methods among small-scale farmers.	75 19%	228 58%	75 19%	11 3%	5 1%	3.91	0.79
Land value and property prices have significantly affected the agricultural income and profitability by raising production costs and reducing available farmland while also providing urban market opportunities for small-scale farmers.	77 20%	231 59%	65 16%	13 3%	8 2%	3.90	0.82
Urban services and amenities have influenced food security both positively and negatively; while it may improve access to food through urban markets but it often reduces local agricultural production, thereby threatening the availability and stability of food for small-scale farmers.	301 76%	88 22%	2 1%	1 0%	2 1%	4.74	0.88
Farmers are shifting from agriculture to off-farm activities	315 80%	71 18%	4 1%	3 1%	1 0%	4.77	0.89
Crop and livestock production has reduced over the past 24 years.	275 45%	109 50%	7 2%	1 0%	2 1%	4.66	0.85
Urban planning and farming policies have directly influenced changes in agricultural activities by shaping land use, access to resources, and farming	181 45%	196 50%	13 3%	2 1%	2 1%	4.40	0.73

practices, thereby affecting the productivity and sustainability of agriculture in urban and Peri-urban areas.							
Land tenure and ownership patterns significantly influence changes in agricultural activities, as secure land rights encourage farmers to invest in farming, while insecure or fragmented ownership can limit agricultural productivity and reduce farming activities.	201 51%	131 33%	42 11%	11 3%	9 2%	4.28	0.95
Technology and innovation adoption significantly influence changes in agricultural activities, as the use of modern tools, improved seeds, and innovative farming methods can increase productivity, efficiency, and sustainability among small-scale farmers.	177 45%	197 50%	15 4%	4 1%	1 0%	4.38	0.72

Source: primary data, 2026.

Therefore, this study examined changes in farming land size among small-scale farmers in Gasabo District over two time periods (2000–2014 and 2014–2024) in order to understand the current state of agricultural activities among the small-scale farmers. For the period 2000–2014, the results showed that the majority of respondents (73%) owned or farmed on land sizes of 0.5–1 hectare, while 27% had land sizes of below 0.5 hectare. This indicates that during this period, relatively larger farming plots were still common, and most households had sufficient land to engage in more extensive agricultural activities. In contrast, during the period 2014–2024, there was a significant shift in land size distribution. The proportion of respondents farming on below 0.5 hectare increased sharply to 78%, while those with 0.5–1 hectare declined to 22%. This shows a clear reduction in available farmland over time.

These findings indicated a strong downward trend in farming land size over the 24-year period. The shift from larger plots (0.5–1 ha) being dominant in 2000–2014 to very small plots (below 0.5 ha) dominating in 2014–2024 suggests increasing land fragmentation and conversion of agricultural land to urban uses. The observed reduction in farm sizes can be attributed to several factors, including rapid urban expansion, increased demand for residential and commercial land, population growth, and rising land values. As a result, many farmers have either subdivided their land through inheritance or sold portions of their farms for non-agricultural uses. In fact, the findings demonstrate that farming land size in Gasabo District has significantly decreased over time, with a shift toward very small-scale farming systems. This trend reflects the growing pressure of urbanization on agricultural land and has important implications for agricultural productivity, food security, and the sustainability of small-scale farming in peri-urban areas.

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture & Environmental Sciences
Volume 10||Issue 2||Page 87-106 ||July||2026|
Email: info@stratfordjournals.org ISSN: 2616-8465

3.4. The relationship between urban growth and changes in agricultural activities of small-scale farmers in Gasabo district.

4.4.1 Correlation analysis

The urbanized land to agricultural land ratio has nearly tripled from 0.12 in 2000 to 0.33 in 2024, meaning that for every 1 ha of agricultural land remaining, there is now 0.33 ha of urban area compared to only 0.12 ha in 2000. If current trends continue, this ratio will continue rising sharply.

Table 5: Urbanized land to agricultural land Ratio

Year	Agricultural land (ha)	Urbanized land (ha)	Urbanized and agricultural land ratio
2000	28,848	3,449.07	0.1195
2008	19,294	3,497.94	0.1813
2016	18,402	3,736.80	0.2031
2024	14,717	4,914.09	0.3339

The data confirmed a strong inverse correlation between the two land classes. While agricultural land fell down by 14,131 ha while urbanized land gained 1,465 ha. The two trends are not numerically equivalent because urban expansion is not the only driver of agricultural loss, other land classes (forests, wetlands, bare land) also absorb converted farmland, and vice versa. However, the temporal alignment of agricultural decline with urban growth strongly implies that urbanization is the primary or contributing driver of farmland loss.

Agricultural land has declined by 49% over 24 years, from 28,848 ha in 2000 to 14,717 ha in 2024, a loss of 14,131 ha. Urbanized land has grown by 42.5%, from 3,449 ha to 4,914 ha, increased by 1,465 ha. The most severe agricultural loss occurred in 2000–2008 (−9,554 ha, −33.1%), coinciding with a period of post-stabilization reconstruction and early urban growth. The fastest urban expansion occurred in 2016 to 2024 (+1,177 ha, +31.5%), with annual rates of urban growth reaching 147 ha/year which is 24 times the rate recorded in 2000 2008. Urban growth is accelerating exponentially while agricultural land continues to shrink, tightening pressure on food production capacity and land availability. The urban-to-agriculture ratio nearly tripled from 0.12 in 2000 to 0.33 in 2024, indicating a fundamental restructuring of land use in the study area. Using the Pearson correlation coefficient to assess the relationship between urbanized land and agricultural land in Gasabo District from 2000 to 2024, the analysis indicates a very strong negative relationship between the two variables. As urbanized land increased from 3,449.07 hectares in 2000 to 4,914.09 hectares in 2024, agricultural land decreased significantly from 28,848 hectares to 14,717 hectares over the same period.

The calculated Pearson correlation coefficient is approximately r = -0.97, which shows a very strong inverse relationship between urban growth and agricultural land. This means that as urban growth and urbanized land expansion increase, agricultural land and related agricultural activities among small-scale farmers decline significantly. The negative

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture & Environmental Sciences
Volume 10||Issue 2||Page 87-106 ||July||2026|
Email: info@stratfordjournals.org ISSN: 2616-8465

correlation suggests that urban expansion has contributed to land conversion from agricultural to non-agricultural uses such as residential settlements, commercial infrastructure, and roads. Consequently, small-scale farmers face shrinking farm sizes, reduced crop and livestock production, and increased pressure to adopt intensive farming methods or shift toward off-farm activities. Therefore, the findings confirm that rapid urban growth has had a substantial negative impact on agricultural activities in Gasabo District.

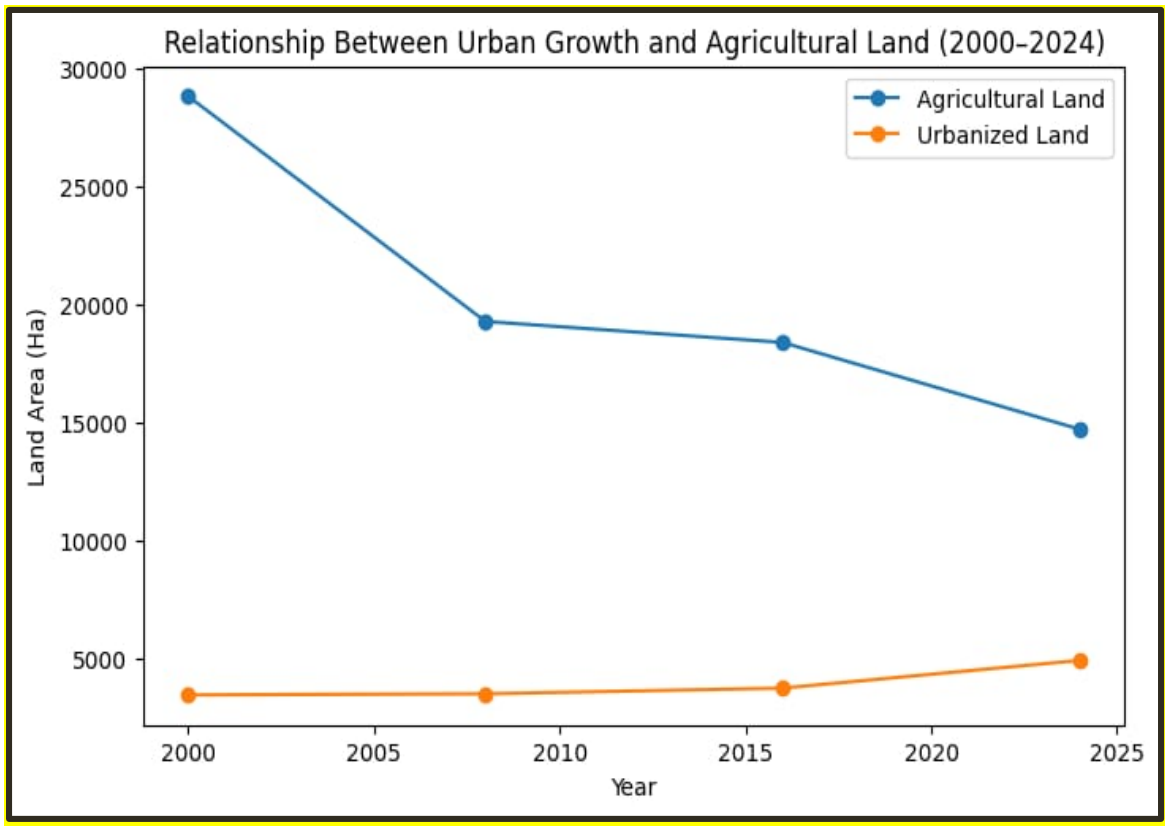

Figure 6: Relationship between the urban growth and changes in agricultural activities.

The Pearson correlation coefficient matrix shows a very strong negative correlation (r = -0.970) between urbanized land and agricultural land in Gasabo District. This indicates that as urbanized land increases, agricultural land decreases significantly. The negative relationship confirms that urban growth has substantially contributed to the decline of agricultural land and agricultural activities among small-scale farmers over the study period (2000–2024).

Table 6: Correlation coefficient matrix

Variables	Urbanized land	Agricultural land
Urbanized land	1.000	-0.970
Agricultural land	-0.970	1.000

Stratford Peer Reviewed Journals and Book Publishing
Journal of Agriculture & Environmental Sciences
Volume 10||Issue 2||Page 87-106 ||July||2026|
Email: info@stratfordjournals.org ISSN: 2616-8465

3.4.2 Regression analysis

The regression results indicate a very strong relationship between urban growth and agricultural land. The coefficient of determination ($R^2 = 0.94$) implies that approximately 94% of the variation in agricultural land is explained by changes in urbanized land, while only 6% is explained by other factors not included in the model.

Table 7: Regression analysis

Model	R	R Square (R^2)	Adjusted R^2	Std. Error of Estimate
1	0.97	0.94	0.91	1468.52

The regression coefficient for urbanized land (B = -9.07) indicates that an increase of one hectare in urbanized land leads to an estimated decrease of approximately 9.07 hectares of agricultural land. The negative beta coefficient confirms the inverse relationship between urban growth and agricultural activities in Gasabo District.

Table 8: Regression coefficient results

Model	Unstandardized Coefficients (B)	Std. Error	Beta	t	Sig.
Constant	59,238.45	5,421.37		10.92	0.008
Urbanized land	-9.07	1.34	-0.97	-6.76	0.021

3.4.3 ANOVA Analysis

The ANOVA results show that the regression model is statistically significant (F = 45.67, p = 0.021). Since the significance value is less than 0.05, the model is considered statistically reliable in explaining the relationship between urban growth and changes in agricultural land in Gasabo District.

Table 9: ANOVA results analysis

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	98,542,317	1	98,542,317	45.67	0.021
Residual	4,315,284	2	2,157,642		
Total	102,857,601	3			

Conclusively, the reduction in agricultural land due to urban growth likely caused major changes in agricultural activities among small-scale farmers, including: Reduction in land available for crop cultivation, Decline in livestock keeping due to reduced grazing space, Shift from extensive farming to intensive farming on smaller plots, Increased use of kitchen gardens, greenhouse farming, and zero-grazing systems, Lower agricultural output for some households, Diversification into business, employment, and casual labor and Rising land prices encouraging sale or conversion of farmland Although urban growth reduced

agricultural land, it may also have created some opportunities such as: Improved roads and transport**,** Better market access for fresh produce and Higher demand for vegetables, milk, eggs, and poultry in urban areas. Generally, the findings demonstrate that there is a strong inverse relationship between urban growth and changes in agricultural activities among small-scale farmers in Gasabo District from 2000 to 2024. The expansion of built-up land corresponded with a continuous reduction in agricultural land, forcing farmers to adapt through smaller-scale and more intensive farming systems. This shows that urbanization has significantly reshaped agricultural livelihoods in the district.

3.5. Discussion of findings

This study demonstrates that urban growth between 2000 and 2024 significantly transformed agricultural activities among small-scale farmers in Gasabo District. Built-up land increased by 126.2%, while agricultural land declined by 20.9%, resulting in reduced farm sizes, increased land scarcity, and changing livelihood strategies. Although agriculture remained the main occupation for most respondents, many farmers adapted through intensified production, market-oriented farming, and diversification into business, employment, and casual labor. Women's strong participation highlighted their important role in food production, while limited youth involvement raised concerns about future agricultural sustainability. The findings emphasize the need for integrated land-use planning, farmland protection, secure land tenure, modern farming technologies, and participatory policies to balance urban development with agricultural resilience.

4. Conclusion

This study concluded that urban growth in Gasabo District between 2000 and 2024 significantly transformed land use patterns and agricultural activities among small-scale farmers. Rapid expansion of residential areas, commercial centers, roads, and infrastructure increased built-up land while reducing agricultural and forest areas. Despite these pressures, agriculture remains an important livelihood, with many households practicing mixed crop and livestock farming. However, farmers face challenges including shrinking farmland, fragmented plots, limited grazing areas, and reduced youth participation. The study also concluded that urban growth has reshaped farming systems through increased adoption of intensive practices such as greenhouse farming, zero-grazing, and market-oriented agriculture, while encouraging livelihood diversification. Therefore, sustainable urban planning is essential to balance development with agricultural resilience and food security.

5. References

African Development Bank (2018). African Economic Outlook 2018. Abidjan: African Development Bank Group.

Burgess, E. W. (1925). The Growth of the City: An Introduction to a Research Project.

City of Kigali. (2020). Kigali City Master Plan 2020. Kigali City Council.

FAO (2017). The Future of Food and Agriculture: Trends and Challenges. Rome: Food and Agriculture Organization.

Gasabo District. (2018). District Development Strategy 2018-2024. Kigali: Gasabo District.

Government of Rwanda (2020). National Strategy for Transformation (NST1) 2017-2024. Kigali: Ministry of Finance and Economic Planning.

Mugisha, S. (2014). Effects of land use changes on agricultural systems in peri-urban areas: A case of Kigali City. African Journal of Agricultural Research, 9(35), 2659-2668.

National Institute of Statistics of Rwanda (NISR) (2022). Rwanda Population and Housing Census 2022: Main Indicators Report. Kigali: NISR.

Nsengiyumva, J. B. (2021). Assessment of the impact of urban expansion on agricultural land: A case study of Gasabo District, Rwanda. Journal of Sustainable Development, 14(2), 85-96.

Tacoli, C. (2003). The links between urban and rural development. Environment and Urbanization, 15(1), 3–12.

Tacoli, C. (2006). The Earthscan reader in rural–urban linkages. *Earthscan Publications*.

Tacoli, C. (2017). Food (in)security in rapidly urbanizing, low-income contexts. International Journal of Urban Sustainable Development, 9(1), 1–12.

Tacoli, C. (2017). Urbanization, rural transformation and food systems: The role of smallholder farmers. International Institute for Environment and Development Working Paper, 24, 1-18.

Thebo, A. L., Drechsel, P., & Lambin, E. F. (2014). Global assessment of urban and peri-urban agriculture: Irrigated and rainfed croplands. Environmental Research Letters, 9(11), 114002.

Todaro, M. P., & Smith, S. C. (2015). Economic Development (12th ed.). Pearson Education.

Turner, B. L., Skole, D., Sanderson, S., Fischer, G., Fresco, L., & Leemans, R. (1995). Land-use and land-cover change: Science/research plan. IGBP Report No. 35.

Twambazimana, J. D. D., & Mupenzi, C. (2021). Urban sprawl and agricultural land loss in Uganda. Land, 13(7). https://www.mdpi.com/2073-445X/13/7/1056

UNEP. (2015). State of the Environment Report. Nairobi : UNEP.

UN-Habitat. (2015). Urbanization and development: Emerging futures (World Cities Report 2016). United Nations Human Settlements Programme.

UN-Habitat (2016). World Cities Report 2016: Urbanization and Development – Emerging Futures. United Nations Human Settlements Programme.

UN-Habitat (2020). The State of African Cities 2020: The Role of Cities in Building Inclusive and Sustainable Societies. Nairobi: United Nations Human Settlements Programme.

UN-Habitat (2020). World Cities Report 2020: The Value of Sustainable Urbanization. United Nations Human Settlements Programme. Nairobi: UN-Habitat.

United Nations Department of Economic and Social Affairs (2018). World Urbanization Prospects: The 2018 Revision. New York: United Nations.

United Nations, Department of Economic and Social Affairs, Population Division. (2022). World Urbanization Prospects 2022 (highlights) urban share and projections. https://www.un.org/en/desa.

United Nations. (2018). World Urbanization Prospects: The 2018 Revision. New York: UN DESA.

Uwayezu, E., & de Vries, W. T. (2018). Indicators for measuring spatial justice and land tenure security for poor and low-income urban dwellers. Land, 7(3), 84.

Uwiringiyimana, J., & Nsengiyumva, A. (2023). Monitoring land use challenges driven by peri-urbanisation around Kigali City, Rwanda. Rwanda Journal of Geography and Development Studies, 5(2), 33–49.

World Bank (2021). Agriculture and Food in Sub-Saharan Africa. Washington, DC: The World Bank Group.

World Bank. (2018). Leveraging Urbanization for Rwanda's Economic Transformation. Washington, DC: World Bank.