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University Establishment and Its Role in Urban Sprawl in Kenya

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Abstract:

Kenya's policy on university education is to establish a university in every county of the 47 counties in the country (Universities' Act 2012). Already there are 23 universities and 10 university constituent colleges in 26 counties. Most of these universities are established in small and medium urban centres. Although the universities are being established in various urban centres in Kenya, their impact on the rate of urbanization of these urban centres is not understood. This study set out to examine the role of universities on urban development in Kenya. The specific objective of the study was to determine the spatial and temporal growth of JuJa, Kakamega, and Narok urban centres from 1989 to 2014. A comparison of the classified Landsat satellite imageries of three-time period were used to detect land use change. The comparison revealed that prior to the establishment of the universities in the urban centres in the country, sprawl in these centres grew at an annual rate of 0.13 percent and after establishment of the Universities in the towns they grew at 0.53 percent. Thus the rate of sprawl in urban centres in Kenya has accelerated after establishment of universities in these centres by 0.4 percent above or about three times their normal annual growth rate. The findings of this study will assist urban managers to plan for systematic establishment of estates and provision of services and infrastructural facilities.

Keywords: University, tertiary industry, urban centre, township, urbanization, sprawl

1. Introduction

Population trend worldwide is accelerating towards urban centres. UN Report in 2008 (Waugh, 2009) claimed that 74 per cent of total population lived in urban areas of developed countries, and 45 per cent in the developing countries. It predicted that by 2050, 86 per cent and 67 per cent respectively will be living in urban areas. The 2009 population census in Kenya showed that urban population was growing at the annual rate of at least 7 per cent (GoK, 2009). The Vision 2030 report of the government of Kenya predicted that by 2030 more than half of the country's population will be living in urban centres. According to Kenya Urban Review (World Bank, 2016), rate of urban growth in Kenya between 2003 and 2013 averaged 4.5% and the country is urbanizing currently at about 4% a year. There is normally a correlation between industrialization and urbanization where industry attracts labour from the rural economy (World Bank, 2016). A University is tertiary industry which attracts learners and employees. The learners and employees create demand for accommodation, goods and services. The investors will be attracted to invest in hostels, rental houses and in businesses that will provide these goods and services. Businesses started provide employment opportunities for job seekers. Establishment of a university in a place may trigger urban growth. Urban growth entails three major components namely population increase, physical expansion (space change) and land use changes (Morrill, 1974).

There has been considerable increase in demand for higher education in Kenya from mid 1980 to the present time leading to increase in students' enrolment for university. In response, the government and private entrepreneurs have established many universities and constituent university colleges outside major cities especially in rural areas or in small towns. For example, twenty-three (23) public universities and ten (10) university constituent colleges in addition to seventeen (17) private Chartered universities, five (5) private university colleges, thirteen (13) private universities with letters of interim Authority and one (1) registered private university have been established and authorized by the Commission for University Education (CUE) to operate in the country between 1985 and 2015 (CUE, 2015). Only five of the twenty three (23) public universities and one (1) public constituent university college are in cities such as Nairobi and Mombasa. The rest are established in small and medium urban centres with population of less than 100,000 people. The government policy is to establish a public university in each of the forty-seven (47) counties in the country (Universities Act, 2012, CUE, 2014, GoK vision 2030). Although universities are increasingly being established in various urban centres in Kenya, their impact on the urban areal expansion is not well known.

This study was undertaken in three universities located in small and medium urban centres namely Jomo Kenyatta University of Agriculture and technology (JKUAT) located in Juja township, Masinde Muliro University of Science and Technology (MMUST) in Kakamega town and Maasai Mara University (MMU) in Narok town among 33 public universities and constituent colleges

established across the country. Students' enrolment and staff recruitment in each university will be examined over a period of time from the time of establishment to 2013.

2. Materials and Methods

2.1. Study Sites

The study was undertaken in three universities located in small urban centres namely Jomo Kenyatta University of Agriculture and Technology (JKUAT) in Juja township, Masinde Muliro University of Science and Technology (MMUST) in Kakamega town and Maasai Mara University (MMU) in Narok town among the thirty-three (33) public universities and constituent university colleges established across the country. They were purposively chosen on the ground of their varied ages since establishment. The three institutions each represent a length of period in an urban centre where they are sited. JKUAT was established in 1989 in Juja township. It is now about 27 years old. MMUST was established in 2002 in Kakamega town. It is about 14-year-old and MMU was established in 2008. It is about 8 years old. Figure 1 shows the location of these urban centres in the Kenya.

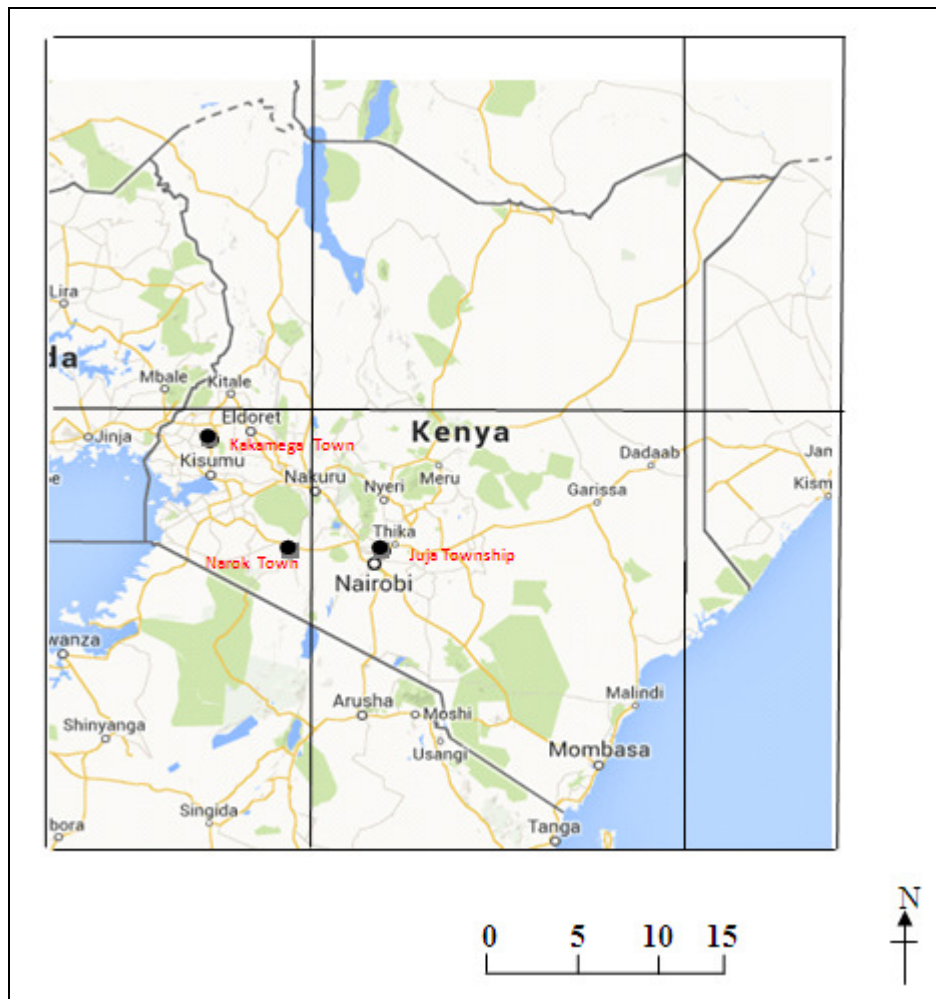


Figure 1: Map showing location of study sites in Kenya
Source: Research (2014)

2.1.1. Juja Town

Juja is a small urban centre with a population of 40,446. It is situated at latitude 1.18330°S and longitude 37.1167°E . The urban centre is located in Kiambu County in Central Kenya. The dominant ethnic community in the surrounding areas is Kikuyu. Juja is located 40 kilometres North East of Nairobi city and 8 kilometres South West of Thika town. Figure 2 shows the site map of Juja town. The area around the urban centres is semi arid region and, therefore, receives very low rainfall annually. The urban centre lies at an altitude of 1422metres above sea level. The area has black cotton soil which becomes water logged during the wet season. The main crops grown around the town are sisal on the Southern and Eastern parts and coffee on Northern and Western parts. In 1989 when Jomo Kenyatta University College of Agriculture and Technology was established, Juja township was a market centre with just three shops owned by Asian investors who were operating sisal business. The urban centre does not have any manufacturing industry.

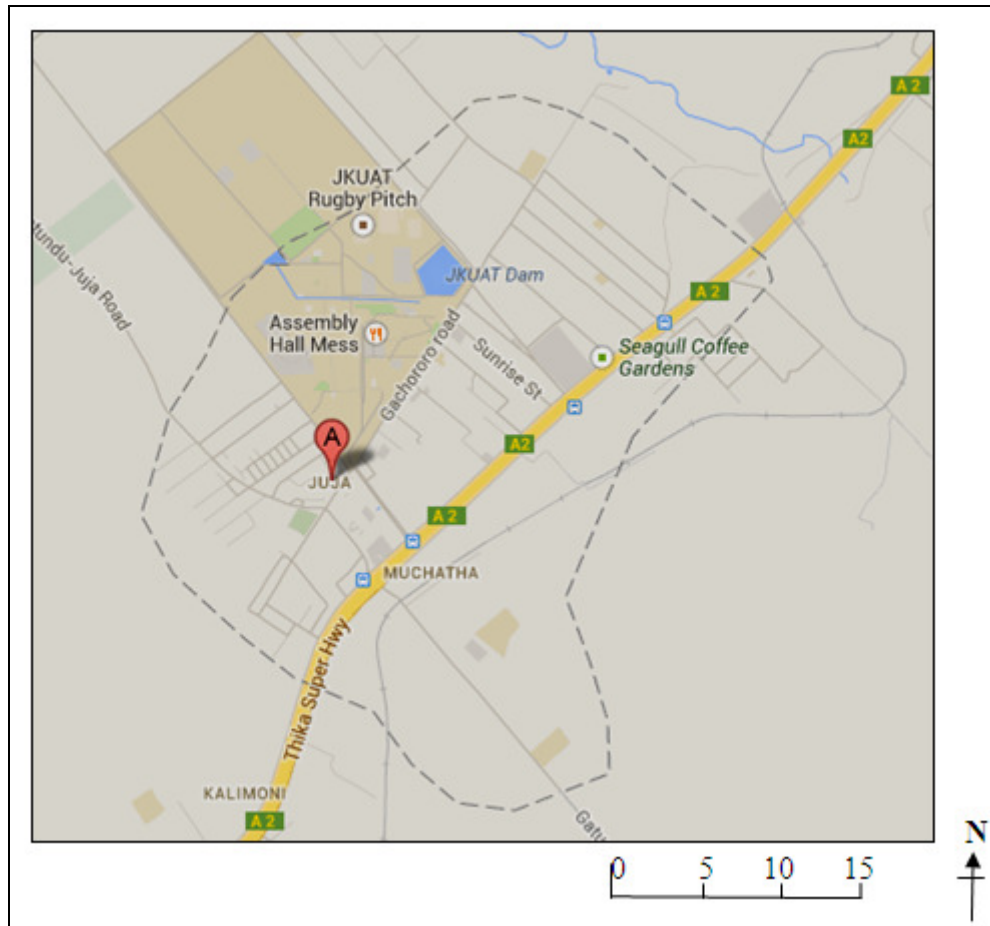


Figure 2: Site map of Juja town in Kiambu County, Kenya
Source: Researcher (2014)

2.1.2. Kakamega Town

According to 2009 census, Kakamega town has a population of 91,768 people. It is located in Kakamega county in Western Kenya. It is the headquarters of the Kakamega County. Kakamega town is about 500 Kilometres west of Nairobi city and about 52 Kilometres north of Kisumu city. The town is situated at latitude 0.2833° N. and longitude 35.8667° E. It is surrounded by densely populated area. The ethnic community surrounding Kakamega town is Isukha of Luhya tribe. Figure 3 shows the site map of Kakamega municipality. The town is located in the tropical equatorial rain forest and lies at an altitude of 1575metres above sea level. It receives high rainfall throughout the year (Kenya Met., 2013) because of the influence of the tropical forest. Its location near equator makes it have high temperatures all the year round. The climate of Kakamega town can be described hot and wet climate. It does not experience marked dry or wet seasons. The soils are rich and productive in agricultural crops such as sugar cane, tea, maize and forest products such as timber.

Prior to the establishment of the University in 2002, Kakamega was an administrative town with no major industry. Only two residential estates existed; one for public civil servants and the other one for business people and their employees. The estate for public civil servants is Mulimani Estate while that of the other residents is Amalemba. The main economic activities were retail shops, petrol stations, transport services such as *boda boda* bicycle transporters within and around town, limited banking services and limited social services. Currently the town has several universities operating in the CBD other than MMUST which is located on the eastern outskirts of the town. These universities include, University of Nairobi, Kenyatta University, Jomo Kenyatta University of Agriculture and Technology, Mount Kenya University.

Many residential estates have come up residential houses continue being built in the urban centre.

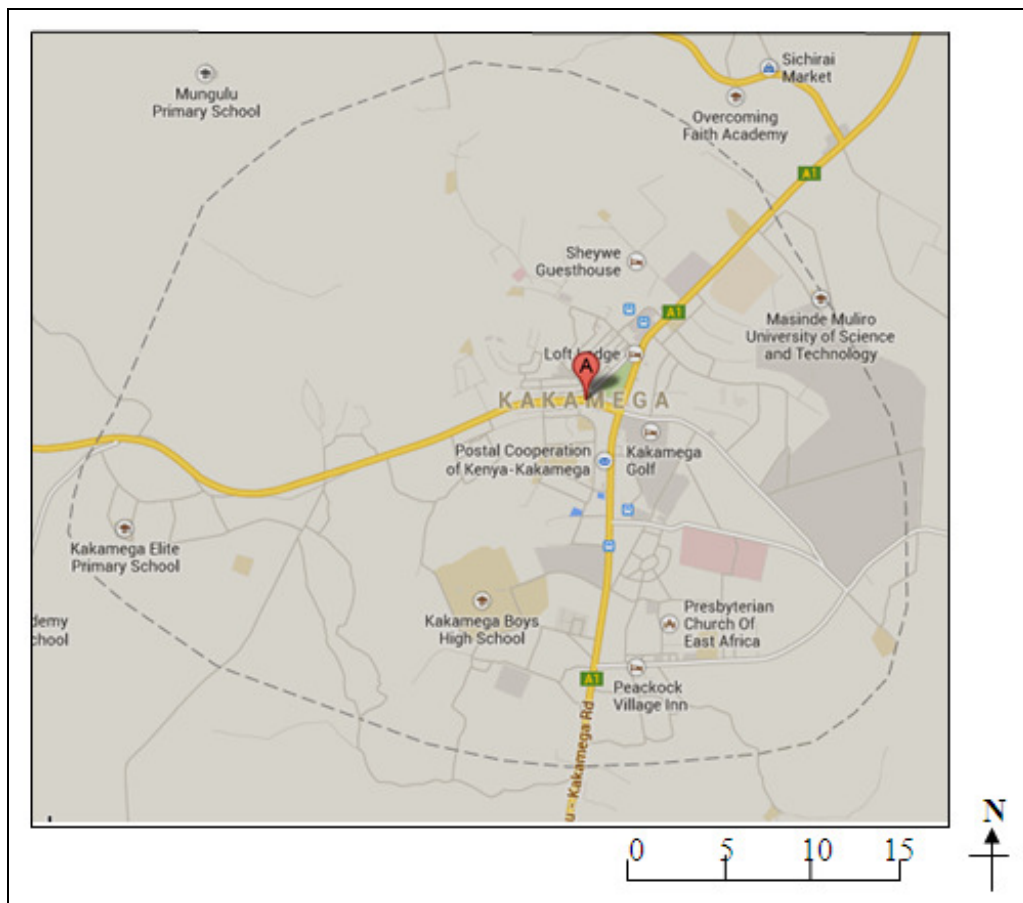


Figure 3: Site map of Kakamega town in Kakamega County, Kenya
Source :Researcher (2014)

2.1.3. Narok Town

Narok town has population of 67,505 people according to 2009 census. It is located in Narok County in South Rift region of Kenya. It is the headquarters of Narok County. The town is about 250 kilometres south west of Nairobi City. Narok town is situated in savannah grassland region at latitude 1.0833° S. The region receives seasonal rains in two regimes – the long rains falling between March and May and short rains between August and September. The average rainfall received range from 500 to 1800mm per annum. The town lies at an altitude of 1827metres above sea level. The area has black cotton soils rich in agricultural production. The main crops produced in the hinter land are Maize and wheat. It does not have any manufacturing industry. The Figure 4 shows the site map of Narok town. The Community in the hinterland is the Maasai who are livestock herders.

The town is the home for Maasai Mara University. The University started in 2008 as a constituent college of Moi university. It was upgraded to fully fledged university in 2013. It has current population of student and staff is 7,028 and 657 respectively.



Figure 4: Site map of Narok town in Narok County, Kenya
Source: Researcher (2014)

3. Methodology

The study was both descriptive and analytical. Descriptive because part of the data was primary data collected in the field from the key informants who are the officials of staff welfare associations and Savings and Credit Cooperative Societies (SACCOs) in the universities and members of the SACCOs who are university staff. The SACCO officials were interviewed on land buying and selling of plots to the members. Staff members were asked whether or not they belonged to a staff welfare association in the university and or to a university SACCO and where they invested the money acquired from SACCOs as loans. The data was summarised in charts and tables for purpose of comparison and interpretation to draw the conclusions. The study population comprised SACCO officials and staff members in the three universities.

Part of the study was also analytical because the Landsat satellite imageries were used to classify land uses and analysed to detect land use change. Three-time period Landsat satellite imageries of each urban centre were used in working out the land use change detection. Each image set has been classified into four different categories viz., bare land, agriculture land, forest and water body. The two methods were used consecutively.

4. Results and Discussion

4.1. Land Purchased in the Urban Centres

The staff welfare associations have bought land in the urban centres for their members. Figure 5 shows the percent of urban land purchased by staff welfare associations in the various urban centres. The land has been subdivided into plots and sold to the members.

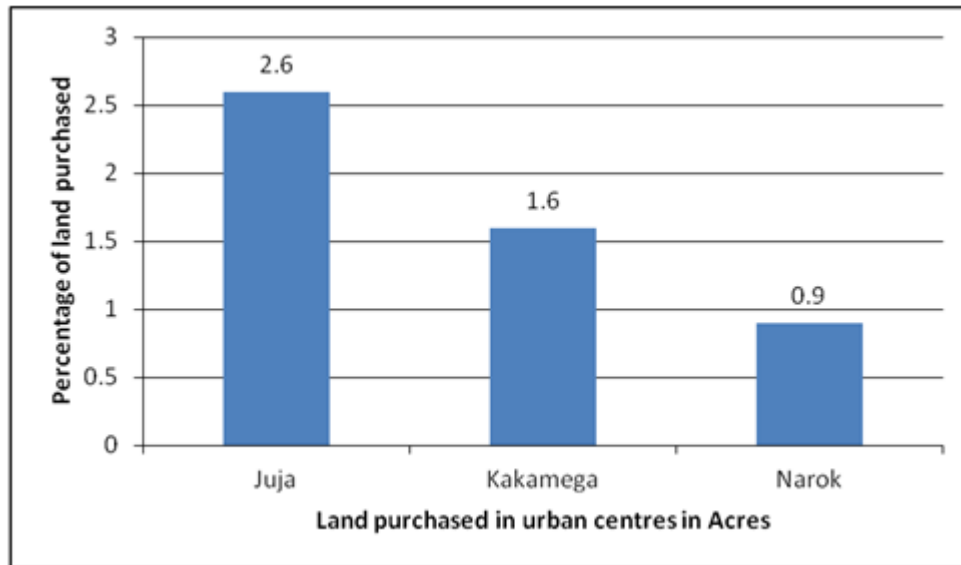


Figure 5: Percent of land purchased in the urban centres (N=4150)

The percentage of land purchased in the urban centres is shown to increase with the age of the university. This may be explained by the fact the SACCOs in the older universities will have accumulated enough money to use to purchasing land for members. Jomo Kenyatta University of Agriculture and Technology is the oldest of the universities sampled for study and Maasai University is the youngest. The land purchased is located in distance ranging between three (3) to twenty (20) kilometres from the Central Business Districts (CBDs) of the urban centres. The land purchased is mostly agricultural land bought from farmers. Staff members have constructed owner occupier residential houses and also rental houses turning the agricultural land into residential estate. Although staff contribution to urban sprawl appear insignificant, with time and as the university expands its programmes and recruits more staff more land will be purchased resulting in significant contribution to urban sprawl. Secondly, investors who are not particularly university staff members have also purchased land on the outskirts and built hostels and rental houses contributing significantly to urban sprawl as seen in the land sat imageries.

4.2. Landsat Satellite Imageries

Landsat satellite imageries of three-time period of each urban centre were used to detect the magnitude of sprawl. The three-time period Landsat satellite imageries of Juja, Kakamega and Narok are for the periods before and after the establishment of the universities in the respective urban centres. The first Land sat satellite imageries acquired on 2nd December, 1984 for Juja town, on 10th August, 1984 for Kakamega town and on 28th January, 1986 for Narok town are used. These are way back before establishment of the universities in the urban centres viz JUKAT, MMUST and MMU. The next time frame used is Land sat satellite imageries acquired on 30th January 1995 for Juja town, on 6th February, 2000 for Kakamega town and on 7th February 1995 for Narok town. This is seven years after establishment of JKUAT in

Juja town, two years before establishment of MMUST in Kakamega town and twelve years before establishment of MMU in Narok town. The third time frame used is Land sat imageries acquired on 3rd February, 2014 for Juja town, 19th April, 2013 for Kakamega town and 16th December, 2010. This is twenty-six (26) years after establishment of the JKUAT in Juja town, twelve (12) years after establishment of MMUST in Kakamega town and three (3) years after establishment of MMU in Narok town. These three time periods for each urban centre assisted the analysis of the direction and magnitude of sprawl before and after establishment of universities.

The land use patterns and changes in the years, 1984, 1986, 1995, 2000, 2010, 2013 and 2014 are shown in the Figure 6 for all urban centres and Land sat imageries (Figures 7, 9, 11, 14, 16, 18, 21, 23, 25) of each respective urban centres.

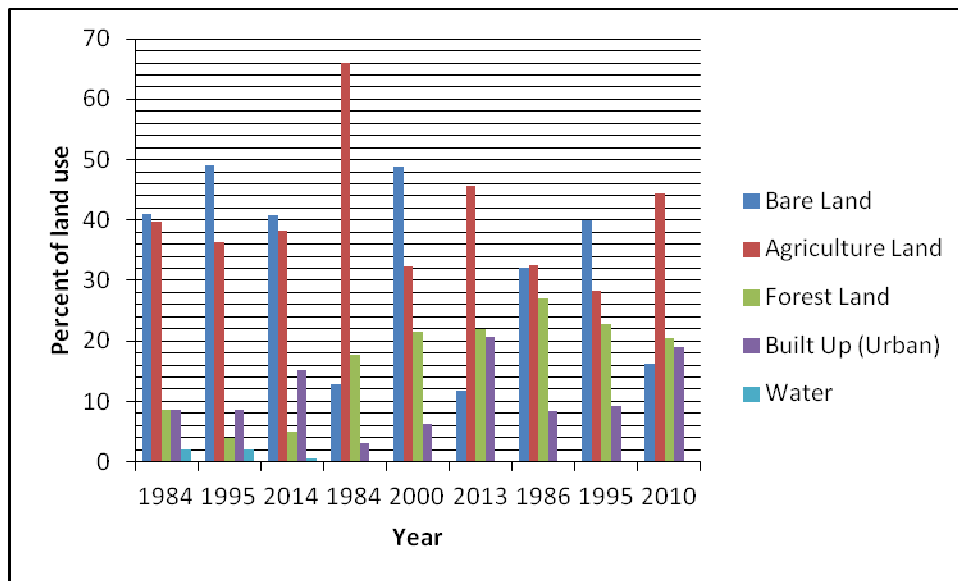


Figure 6: land use patterns and changes in each urban centre from 1984-2014 for Juja, 1984-2013 for Kakamega and 1986-2010 for Narok.

The scenario in the year 1984 depicts Juja town (Figure 7) has basically bare and agricultural land covering about eighty point eight (80.8%) per cent of the total land. The area has built up (urban) land of merely eight point five (8.5%) per cent. The forest land covering only about eight point seven (8.7%) per cent is mostly near water bodies. The Figure 7 depicts the bare land covering predominantly the South-Western areas. This is the area between Juja and Ruiru towns. The agricultural land covers the area far from the urban area on the Northern and North – Western areas. Figure 8 shows Juja town per cent proportion of land use to total land in 1984

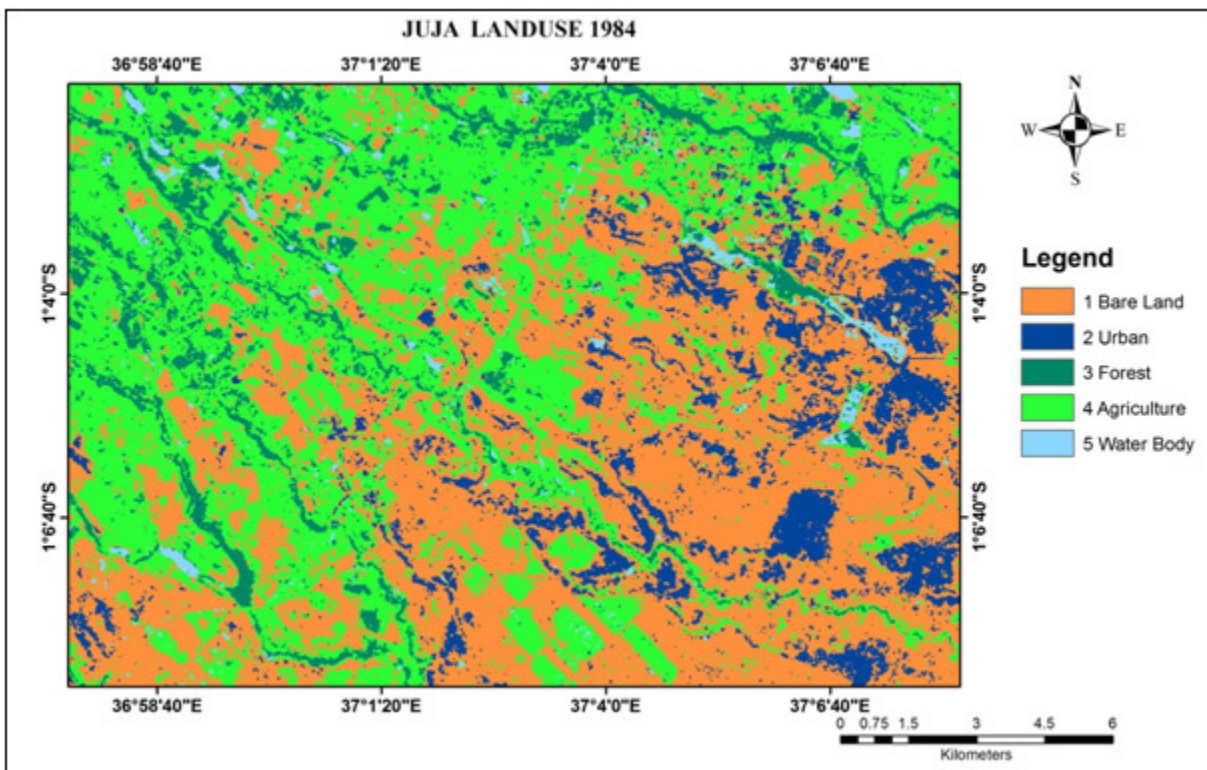


Figure 7: Juja town Land Use Classification, 1984
Source: Landsat satellite imagery

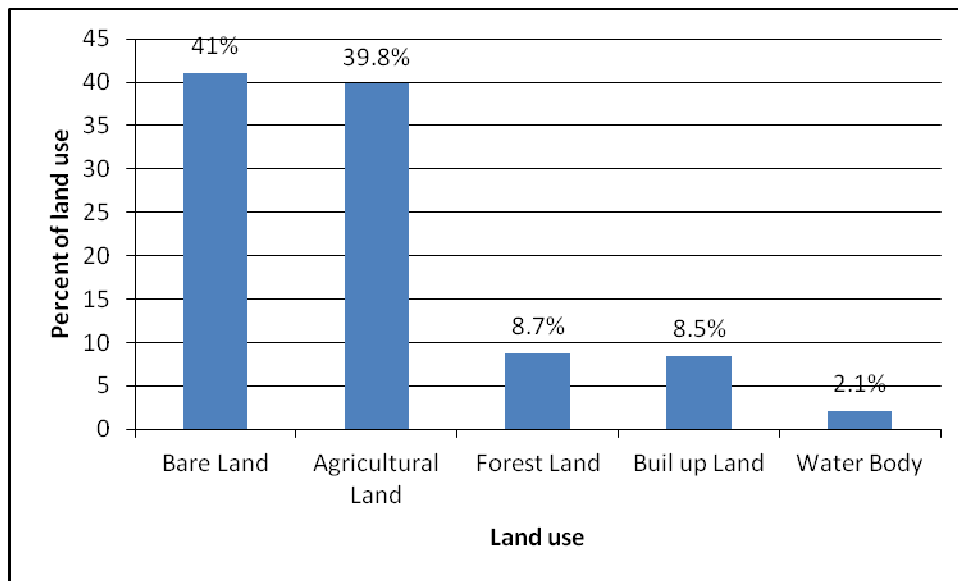


Figure 8: Juja town per cent proportion of land use to total land in 1984
 Source: Analysis of Landsat satellite imagery (N = 49 Sq. Km.)

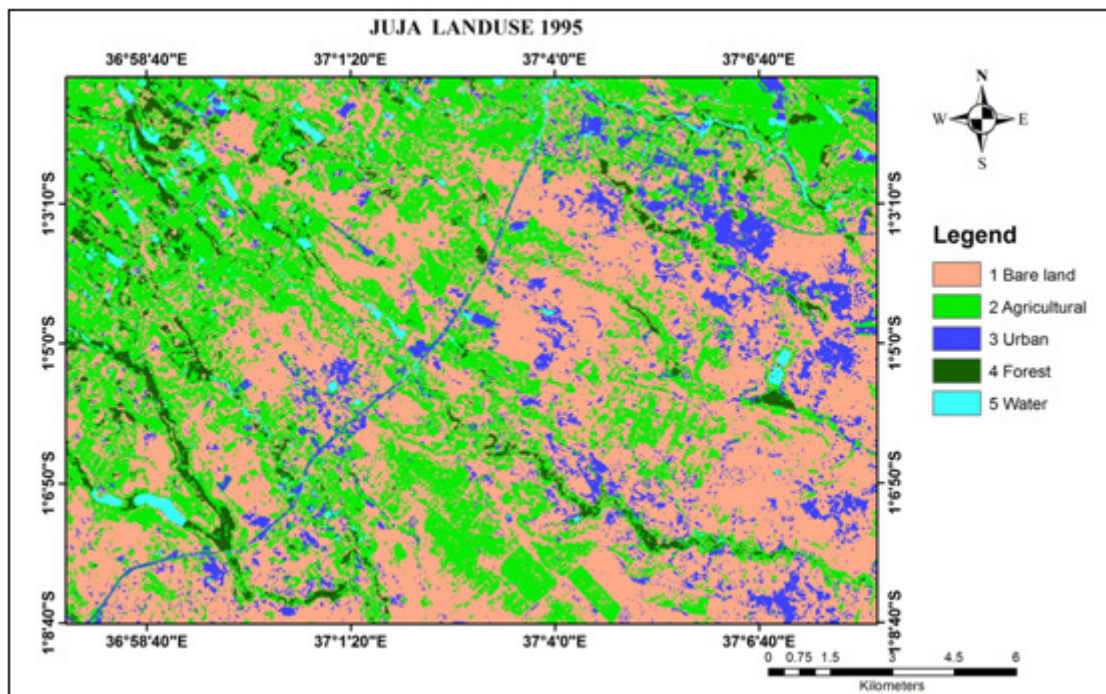


Figure 9: Juja town Land Use Classification, 1995
 Source: Landsat satellite imagery

The scenario in the year 1995, six (6) years after establishment of JKUAT, depicts Juja town (Figure 9) has increased bare land covering the southern and south- western parts of the urban area. The built up (urban) land has increased spreading towards South- western and North- Western sides. Figure 10 depicts that bare land and built up (Urban) land have increased to forty-nine (49%) and eight point (8.7%) per cent respectively. Agricultural land has reduced to thirty-six point three (36.3%) per cent of the total land, forest land has decreased to four (4%) per cent and water bodies have decreased to two (2%) per cent. The increase in bare land depicts that a process of land acquisition has taken place by clearing forest, annexation of agricultural land and reclaiming of wet lands but not much of this acquired land has yet been developed into a built up area. The high percentage of bare land may also be explained by the fact that the Landsat satellite imagery was acquired during off farming season in the month of January when the land is bare.

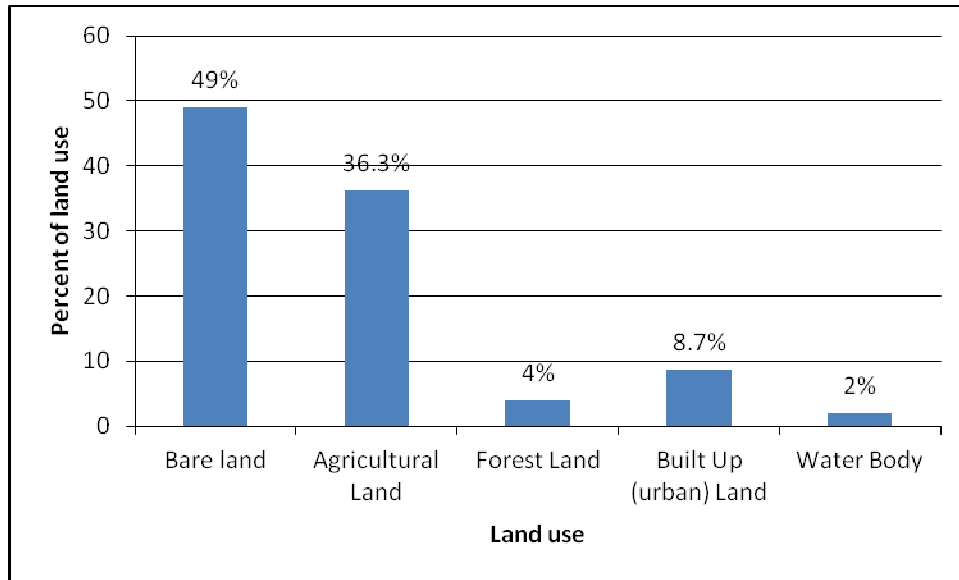


Figure 10: Juja town per cent proportion of land use to total land in 1995
 Source: Analysis of Landsat satellite imagery (N = 49 Sq. Km.)

The scenario in the year 2014, twenty-seven (27) years after establishment of JKUAT, depicts Juja town (Figure 11) has decreased bare land covering mostly the southern parts of the urban area. This could be an indication that part of the bare land is either now being farmed because the Landsat satellite imagery was taken in the month of February which is the starting season for farming or has now been developed into built up (urban) land and hence the built up (urban) land has increased spreading towards South- western and North-Western sides. Figure 12 depicts that agricultural land has increased from thirty-six point three (36.3%) per cent to thirty-eight point one (38.1 %) of the total land, forest land has increased from four (4%) per cent to five point one (5.1%) per cent and water bodies have decreased to zero point six (0.6%) per cent. The increase in percentage of agricultural land may be because either the Landsat satellite imagery was acquired during the farming season as explained above or because wet land is being reclaimed and part of it used for farming. The increase in percentage of forest land may be because part of the reclaimed wet land is yet to be developed and, therefore, left to grow into forest land. This is also the possible explanation why the wet land has drastically reduced from two (2%) per cent to only zero point six (0.6%) per cent of the total land.

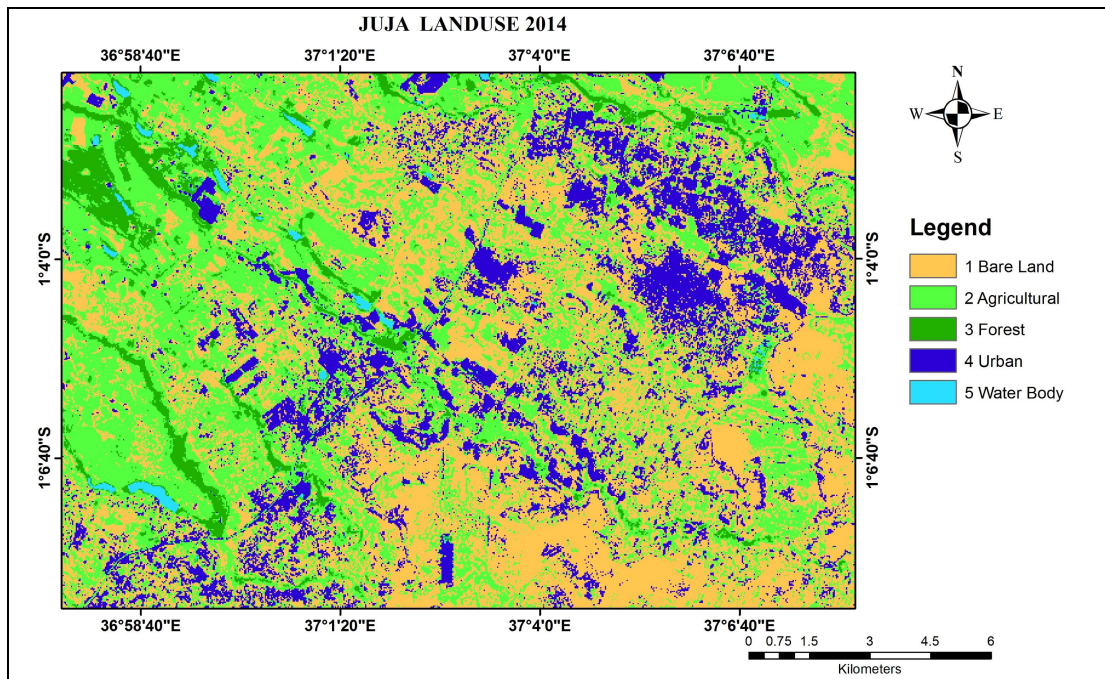


Figure 11: Juja town Land Use Classification, 2014
 Source: Landsat satellite imagery

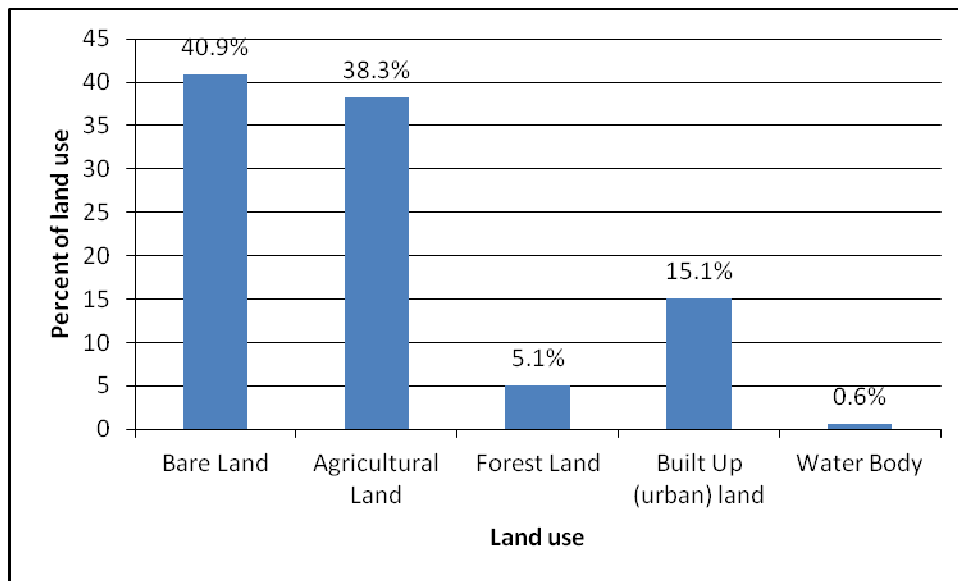


Figure 12: Juja town per cent proportion of land use to total land in 2014
Source: Analysis of Landsat satellite imagery (N = 49 Sq. Km.)

The post university establishment period from 1995 up to 2014, analysis depicts a drastic change in the normal course of urbanization in the urban centre. The period records the built up (urban) land increasing to 15.1 per cent from 8.7 per cent. The built up areas have extended south west towards Ruiru town. The bare land which was grass land has have been sold out in the commercial market and has been turned into infrastructural developments. The wet lands have been reclaimed through draining of water and also developed into settlements. This has reduced the water in percentage drastically from two (2) per cent to zero point six (0.6) per cent. A Rank Order on the land uses in Juja urban centre was done from 1984 to 2014 as shown in Table 1.

Land use	1984	1995	2014
Bare land	1	1	1
Agriculture land	2	2	2
Forest land	3	4	4
Built up (Urban) land	4	3	3
Water Body	5	5	5

Table 1: Rank Order of land uses in Juja urban centre from 1984 to 2014

Spearman's Rank Order Correlation was performed to test relationship in the rankings of land uses between 1984 and 1995; and between 1984 and 2014. The relationship in the rank order of land uses between 1984 and 1995; and between 1984 and 2014 is highly significant ($P > 0.05$). This indicates that there were no changes in the rankings of the land uses. However, the Built up (urban) land use increased in ranking from four (4) in 1984 to three (3) in 1995 and 2014. In the same period forest land decreased in ranking from three (3) to four (4). The explanation here may be that the forest was annexed by the built up (urban) land or was cleared in readiness for building constructions. The built up (urban) will continue to sprawl with time as is indicated in the increasing percentage change in relation to other land uses which fluctuates in percentage change. From observation, high-rise buildings in the urban centres contribute to limitation of the urban sprawl. Thus the economic activities which have been noted to be increasing are concentrated in the central business district (CBD) competing for limited space based on central place theory of Walter Christaller explained by David Waugh (2009) rather than spreading out in the urban centre.

In summary, the temporal growth and trend of urban sprawl of Juja town is analyzed with help of change in the percentage of various land use categories during the period 1980-2014 shown in Figure 13.

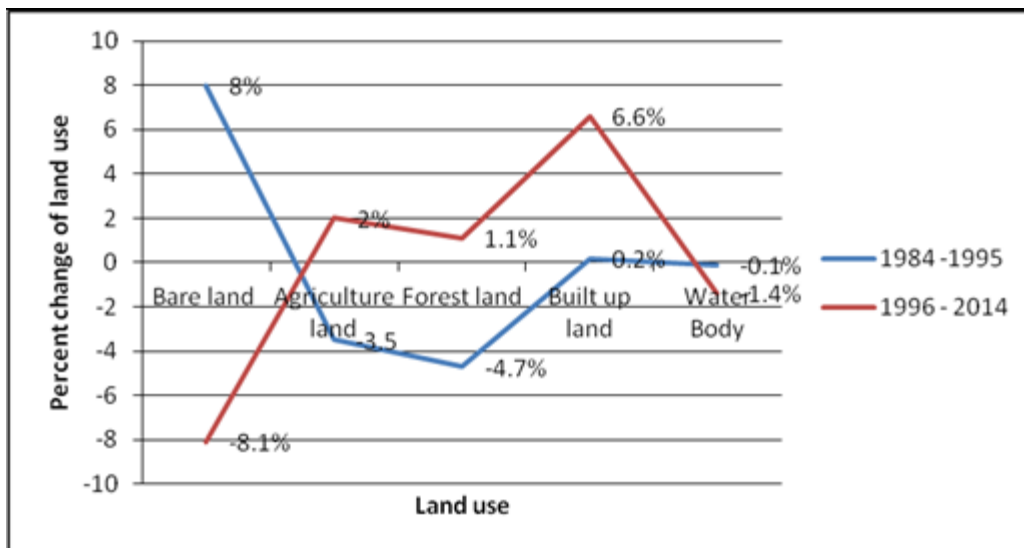


Figure 13: Temporal per cent change of land use patterns in Juja town from 1980-2014
 Source: Analysis of Landsat satellite imageries (N = 49 Sq. Km.)

Prior to the establishment of the University in the urban centre, the built up (urban) land increased by only 0.2 per cent in span of eleven (11) years and after establishment of the University the built up (urban) land increased by 6.6 per cent in the span of nineteen (19) years. This translates into annual growth rate of sprawl of the urban centre before establishment being 0.02 per cent and 0.35 per cent after establishment of the University. This confirms the fact that the rate of urban sprawl accelerated after establishment of the University.

In the case of Kakamega urban imagery, the scenario in the year 1984 depicts Kakamega town (Figure 14) has forest, bare and agricultural land covering about ninety-six point eight (96.8%) per cent of the total land and built up (urban) land covering a merely three point two (3.2%) per cent the total land. Fig. 4.7 depicts that bare land accounts for twelve point nine (12.9%) per cent of the total land. The bare land is predominantly on the eastern side next to the forest land. This could be the cleared zone separating the gazetted national forest reserve and the settled areas. There are patches of bare land within the dense and sparse agricultural land surrounding the built up area but tending towards western and the south western sides.

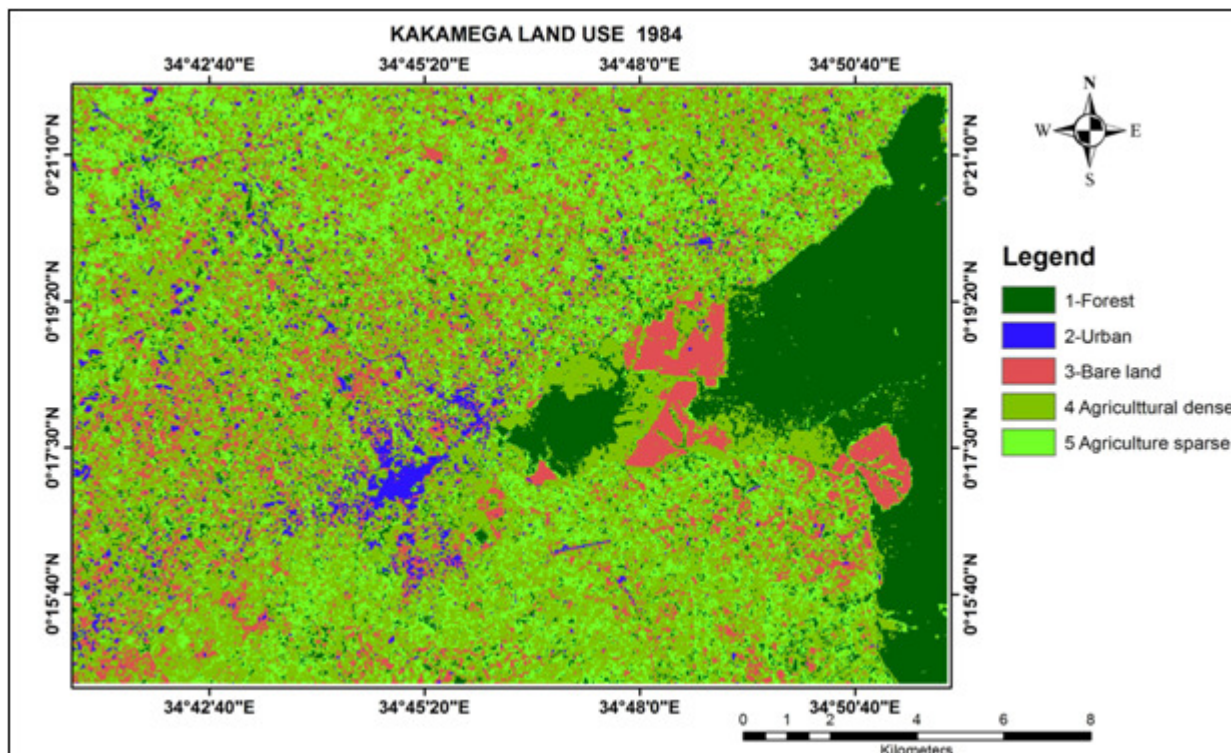


Figure 14: Kakamega town Land Use Classification, 1984
 Source: Landsat satellite imagery

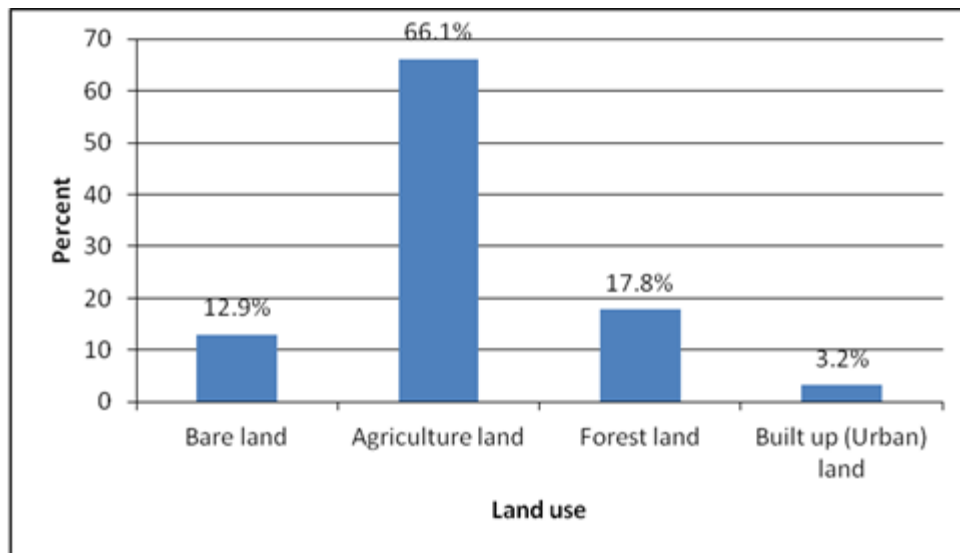


Figure 15: Kakamega town per cent proportion of land use to total land in 1984
 Source: Analysis of Landsat satellite imagery (N= 25 Sq. Km)

The scenario in the year 2000, two (2) years before the establishment of MMUST, depicts Kakamega town (Figure 16) has increased bare land covering forty-eight point eight (48.8%) percent of the total land predominantly the northern and south- western parts of the urban area. The built up (urban) area has increased to six point three (6.3%) per cent spreading along South-Western - North-Eastern axis following Kisumu – Kakamega road and Kakamega – Webuye road. Figure 17 depicts that Agricultural land has reduced to twenty-three point three (23.3%) per cent of the total land, forest land has increased to twenty-one point six (21.6%) per cent. The increase in bare land depicts, either, that a process of land acquisition has taken place by annexation of agricultural land but has not yet been developed into a built up area, or it is agricultural land which has not been planted as the imagery was acquired off planting season in February. The isolated patch of forest land has grown another small patch in the sparse agriculture land on the northern side of it and has also extended towards the western side. This could be due to government protection against on encroachment on the protected forest. The result is the increase of forest land by three point eight (3.8%) per cent.

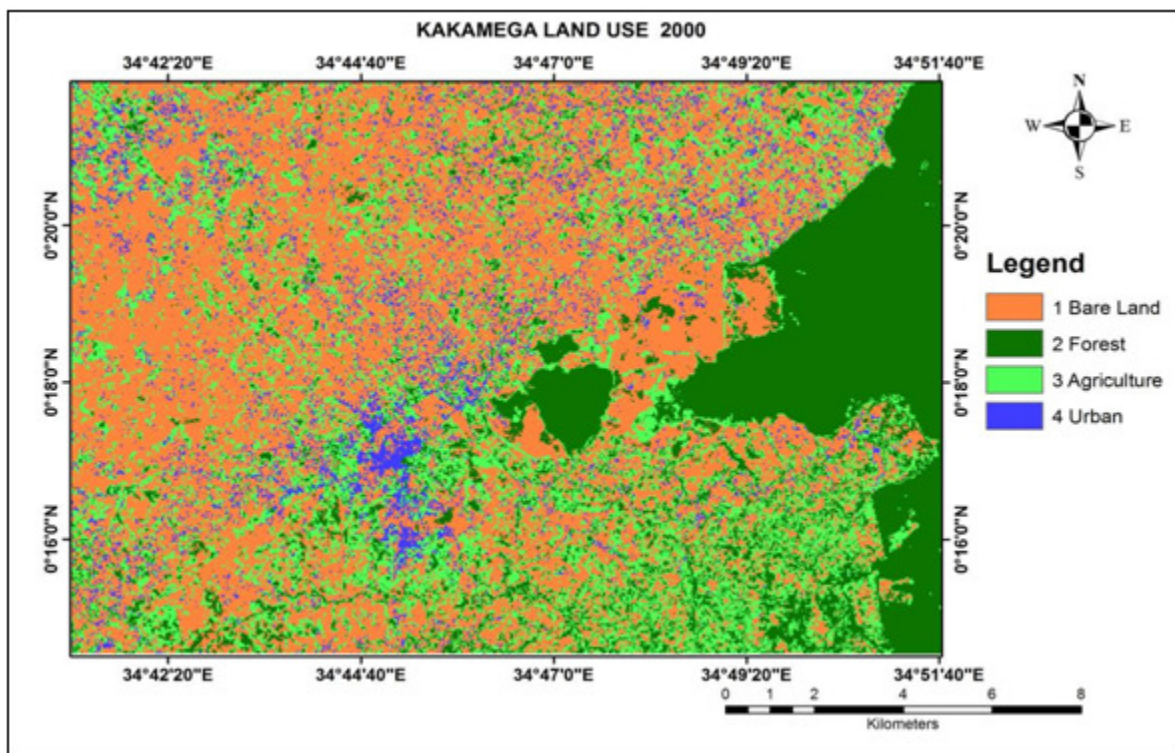


Figure 16: Kakamega town Land Use Classification in, 2000
 Source: Landsat satellite imagery

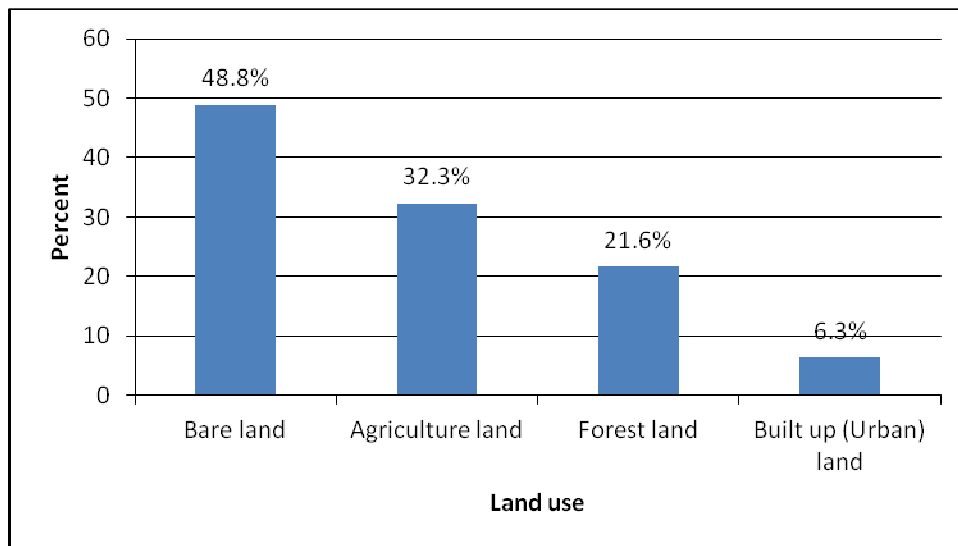


Figure 17: Kakamega town per cent proportion of land use to total land in 2000
 Source: Analysis of Landsat satellite imagery (N= 25 Sq. Km.)

The scenario in the year 2013, eleven (11) years after the establishment of MMUST, depicts Kakamega urban area (Figure 18) has decreased bare land from forty-eight point eight (48.8%) percent to twenty-one point seven (21.7%) percent of the total land. The built up area has had tremendous increase from six point three (6.3%) per cent in 2000 to twenty-one point six (20.6%) per cent along the South -West North - East axis and covering mostly North Western parts of the urban area. This is an indication that part of the bare land has now been developed into built up (urban) area. Figure 19 depicts that agricultural land has increased from twenty-three point three (23.3%) per cent to forty-five point seven (45.7 %) of the total land, forest land has slightly increased from twenty-one point six (21.6%) per cent to twenty-two (22%) per cent. The increase in percentage of agricultural land is as result of the bare land being farmed because the Landsat satellite imagery was acquired in the month of April. The month of April is the planting in Kakamega region. The slight increase in forest land could be as result of the bare land which had been cleared for development regenerating into forest awaiting development by the investors.

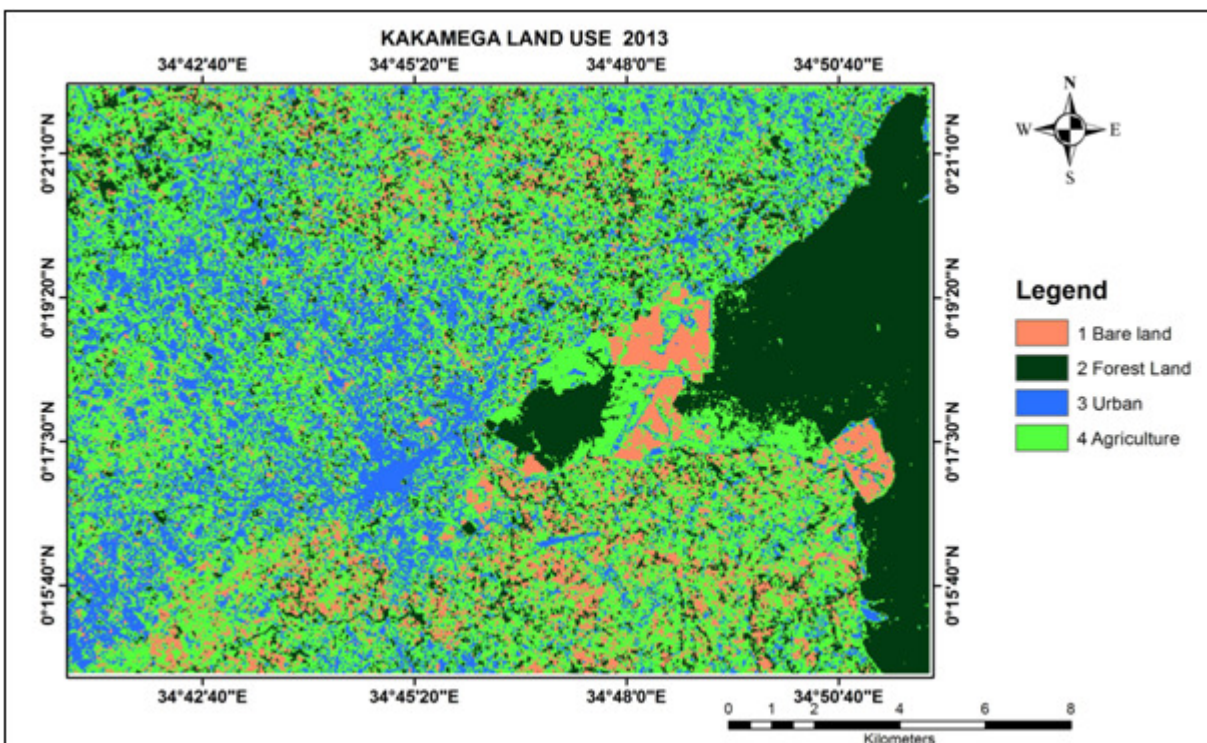


Figure 18: Kakamega town Land Use Classification in, 2013
 Source: Landsat satellite imagery

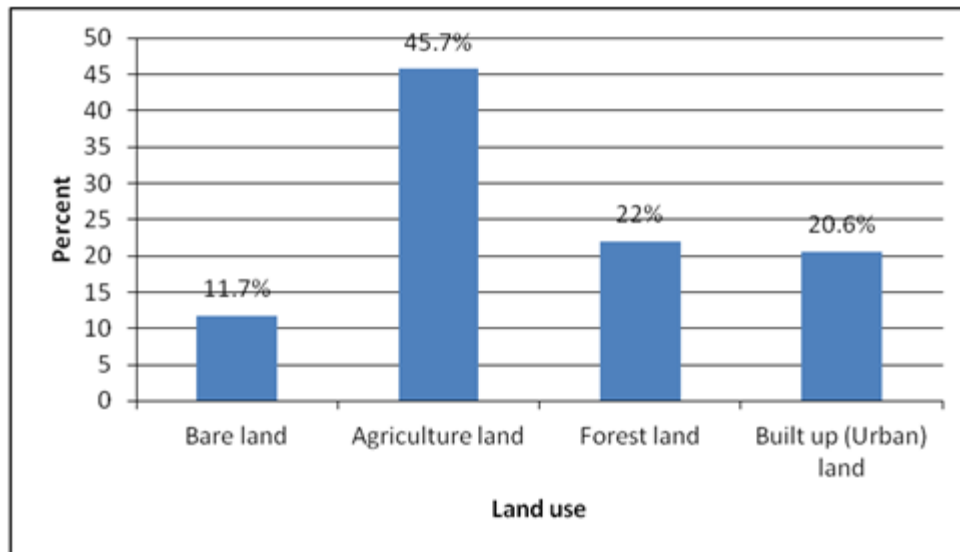


Figure 19: Kakamega town per cent proportion of land use to total land in 2013
Source: Analysis of Landsat satellite imagery (N= 25 Sq. Km.)

The post establishment of university in Kakamega in 2002 period depicts an analysis from 2000 up to 2013 revealing a big change in the normal course of urbanization in medium town. The period records the built up (urban) land increasing to 20.6 per cent from 6.3 per cent of the total land. The built up areas have extended south west along Kakamega-Kisumu road towards Isiukhu river, westwards in general towards Kakamega-Mumias road and north east along Kakamega- Webuye road. This confirms the assumption that establishment of a university in Kakamega town has accelerated the urban sprawl.

The temporal growth and trend of urban sprawl of Kakamega town is analyzed with help of change in the percentage of various land use categories during the period 1980-2013 shown in Figure 20.

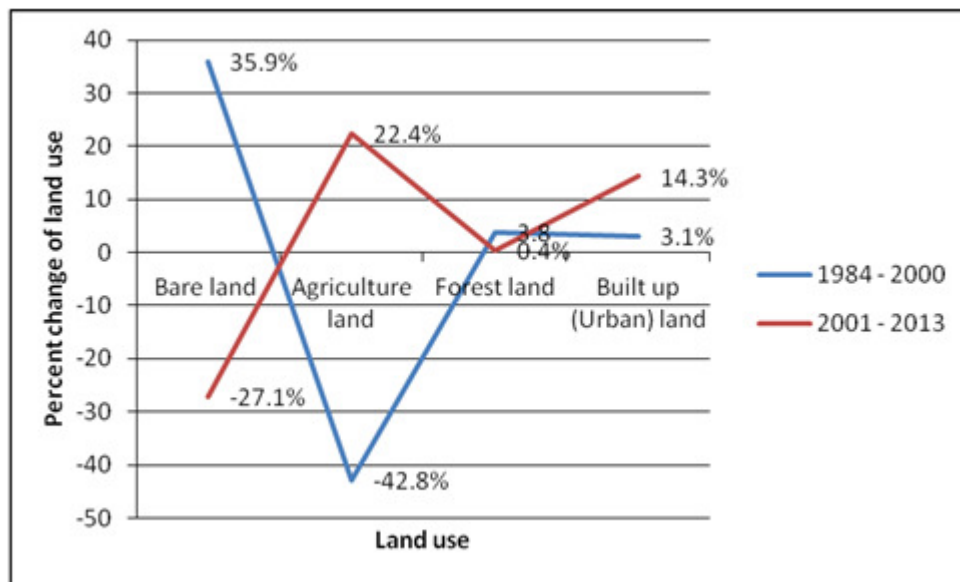


Figure 20: Temporal per cent change of land use patterns in Kakamega town from 1984 to 2013
Source: Analysis of Landsat satellite imageries (N = 25 sq. Km.)

The analysis indicates that before the establishment of the University in the urban centre, the built up (urban) land increased by only 3.1 per cent in span of sixteen (16) years and after establishment of the University the built up (urban) land increased by 14.3 per cent in the span of thirteen (13) years. The annual rate of sprawl, therefore, before establishment of the university was 0.2 per cent and 1.1 per cent after establishment of the University in the town. This confirms the fact that the rate of urban sprawl accelerated after establishment of the University.

A Rank Order on the land uses in Kakamega urban centre was done from 1984 to 2013 as shown in Table 2.

Land use	1984	2000	2013
Bare land	3	1	4
Agriculture land	1	2	1
Forest land	2	3	2
Built up (Urban) land	4	4	3

Table 2: Rank Order of land uses in Kakamega urban centre from 1984 to 2013

Spearman’s Rank Order Correlation was performed to test relationship in the rankings of land uses between 1984 and 2000; and between 1984 and 2013. The relationship in the rank order of land uses between 1984 and 2000 is not significant at $P= 0.05$ indicating that there were major changes in the rankings of the land uses. The same applies to the between 2000 and 2013. The Built up (urban) land use increased in ranking from four (4) in 1984 and 2000 to three (3) in 2013 as other land uses fluctuated in the rankings especially between the year 2000 and 2013. The built up (urban) will continue to sprawl with time as is indicated in the increasing percentage change in relation to other land uses which fluctuates in percentage change.

The Landsat Satellite imagery of Narok town in the year 1986 (Figure 21) depicts Narok urban area has forest, bare and agricultural land covering ninety-seven point seven (97.7%) per cent of the total land and built up (urban) land covering of eight point three (8.3%) per cent. Figure 22 depicts that bare land accounts for thirty-two point one (32.1%) per cent of the total land. The bare land is predominantly on the Southern side of the built up area. The imagery was acquired in January which is not planting season. This bare land could, therefore, also be agricultural land which has not been planted. The forest and agricultural land covering thirty-two point five (32.5%) per cent and twenty-seven point one (27.1%) per cent of the total land respectively are on Northern side of the urban area.

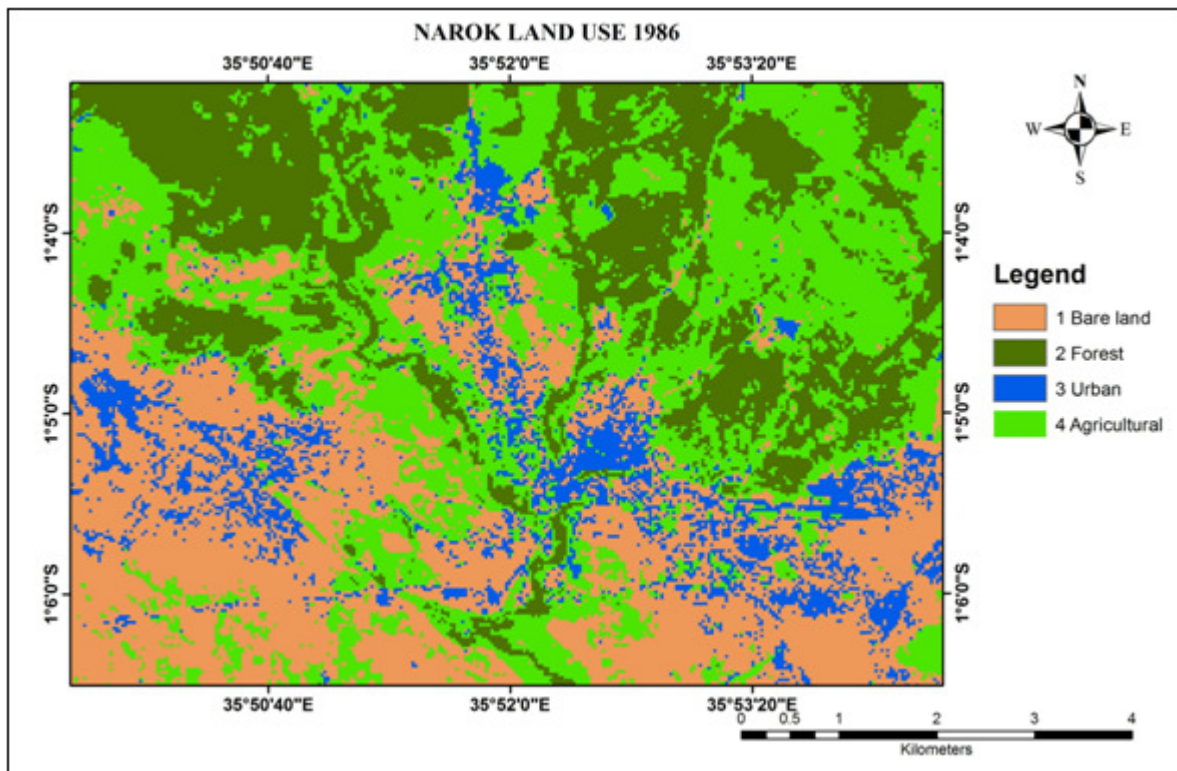


Figure 21: Narok town Land Use Classification, 1986
 Source: Landsat satellite imagery

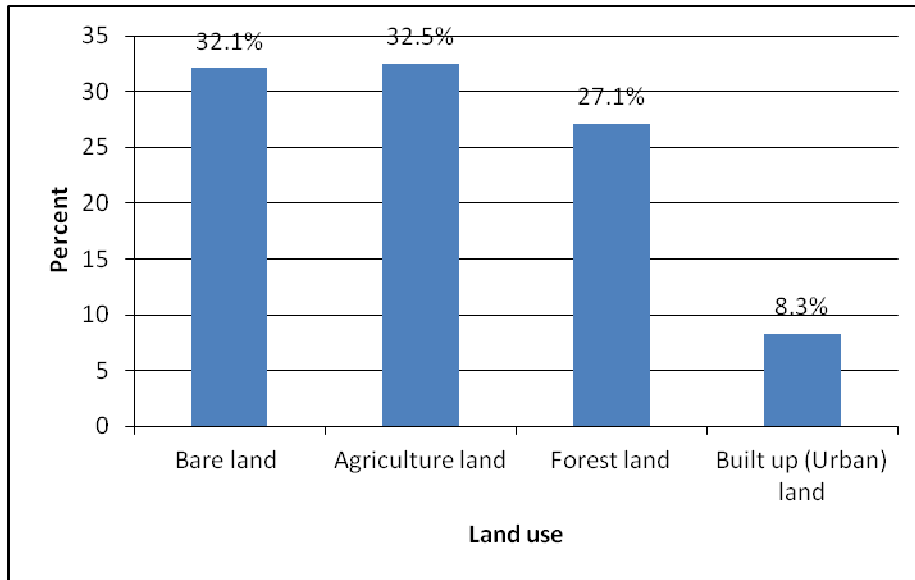


Figure 22: Narok town per cent proportion of land use to total land in 1986
 Source: Analysis of Landsat satellite Imagery (N= 49 Sq. Km)

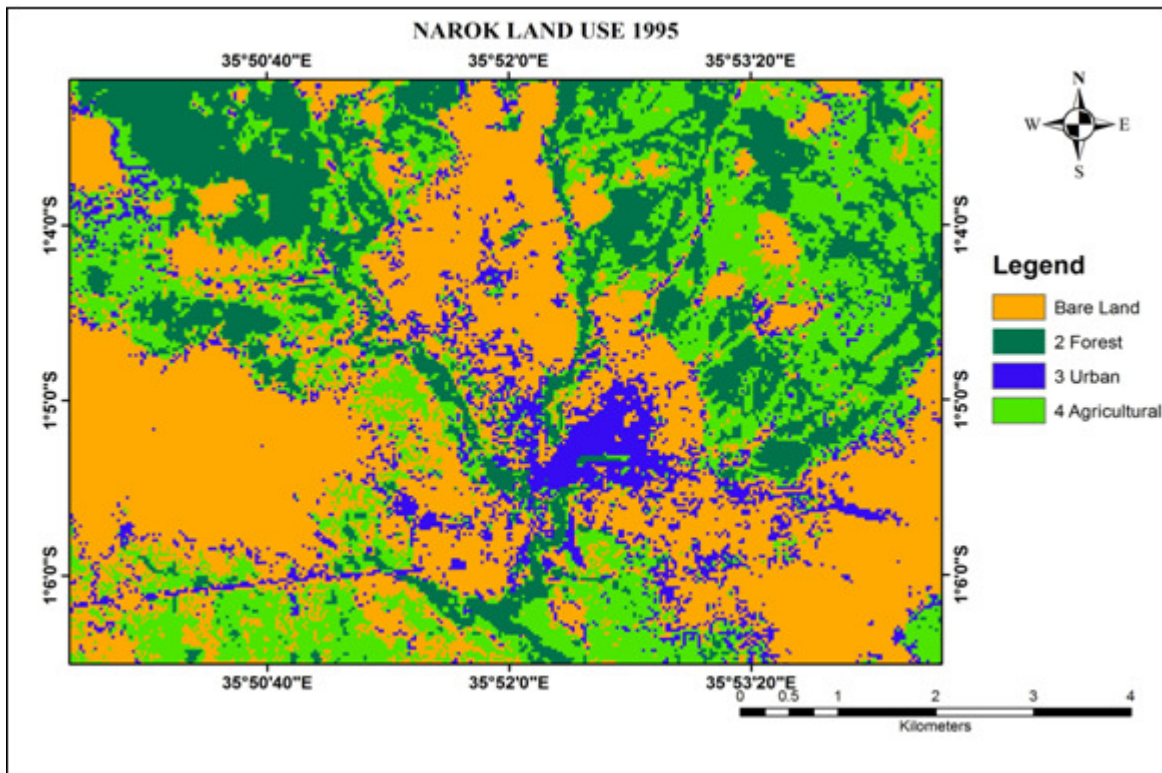


Figure 23: Narok town Land Use Classification, 1995
 Source: Landsat satellite imagery

The scenario in the year 1995, twelve (12) years before the establishment of MMU, depicts Narok town (Figure 23) has increased bare land covering thirty-nine point nine (39.9%) percent of the total land predominantly in the north, in the west and south-eastern parts of the built up (urban) area. The built up (urban) land has increased to nine point two (9.2%) per cent extending radial in all directions from Central Business District. Figure 24 depicts that agricultural land has decreased slightly to twenty-eight point two (28.2%) per cent of the total land, forest land has also decreased to twenty-two point seven (22.7%) per cent. The acquisition of forest land for either construction of projects or agricultural purposes could be explanation for its decrease. The decrease in agricultural land corresponds with an increase bare land seen above. This is being explained by period when the Landsat satellite imagery was acquired. The Landsat satellite imagery was acquired in February which is a ploughing period in Narok in readiness for planting in April.

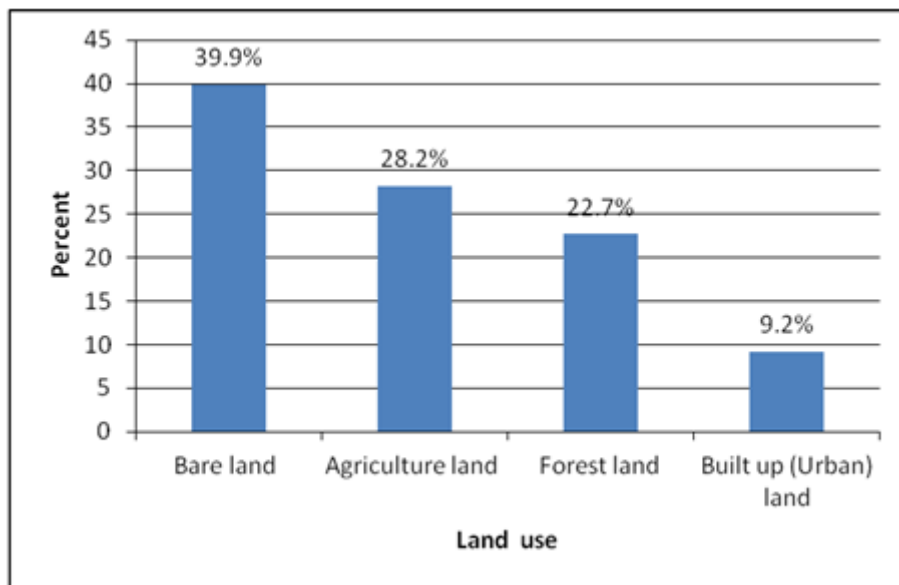


Figure 24: Narok town per cent proportion of land use to total land in 1995
 Source: Analysis of Landsat satellite imagery (N= 25 Sq. Km.)

The scenario in the year 2010, three (3) years after the establishment of MMU, depicts Narok urban area (Figure 25) has bare land decreased from thirty-nine point nine (39.9%) percent to sixteen point two (16.2%) percent of the total land. The built up area has had tremendous increase by doubling up from nine point two (9.2%) per cent in 2000 to nineteen (19%) per cent spreading towards the western side of the Central Business District. The decrease of the bare land and increase in built up land is an indication that part of the bare land is now farmed and the other part is now developed into built up (urban) area. Figure 26 depicts that agricultural land has increased from twenty-eight point two (28.2%) per cent to forty-four point four (44.4 %) of the total land, forest land has decreased from twenty-two point seven (22.7%) per cent to twenty point four (20.4%) per cent. The increase in percentage of agricultural land is as result of the bare land being farmed. The decrease in forest land could be as result acquisition and clearance of the forest for construction of buildings.

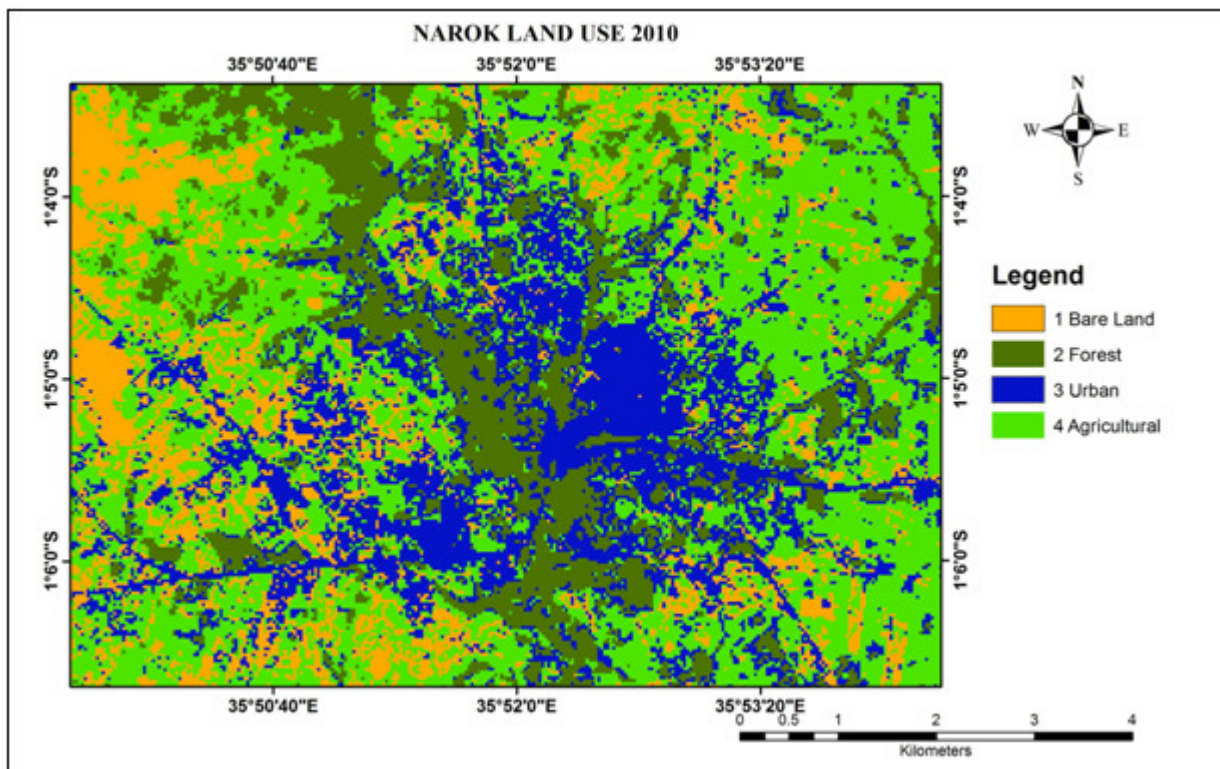


Figure 25: Narok town Land Use Classification in, 2010
 Source: Landsat satellite imagery

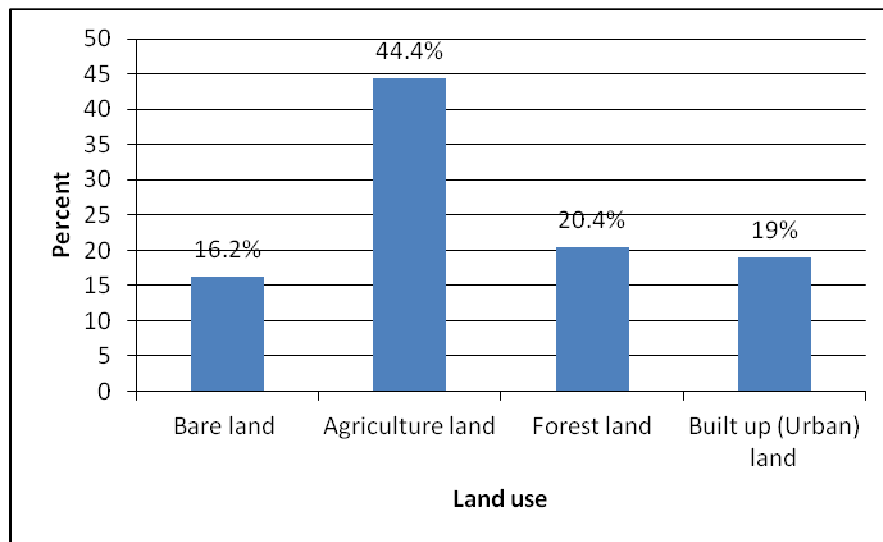


Figure 26: Narok town per cent proportion of land use to total land in 2010
 Source: Analysis of Satellite Imagery (N = 25Sq. Km.)

The post establishment of university in Narok town in 2007 period depicts an analysis from 1995 up to 2010 revealing accelerating change in the normal course of urbanization in medium town. The period records the built up (urban) land increasing to 19 per cent from 9.2 per cent. The built up area has extended westwards along Narok – Bomet road. This is also the direction where Maasi Mara University is located from Central Business District of Narok town. This confirms the assumption that establishment of a university on this side of town has influenced the trend and sprawl of town towards the direction and also has accelerated the urban sprawl. The temporal growth and trend of urban sprawl of Narok town is similarly analyzed with help of change in the percentage of various land use categories during the period 1995-2010 shown in Figure 27.

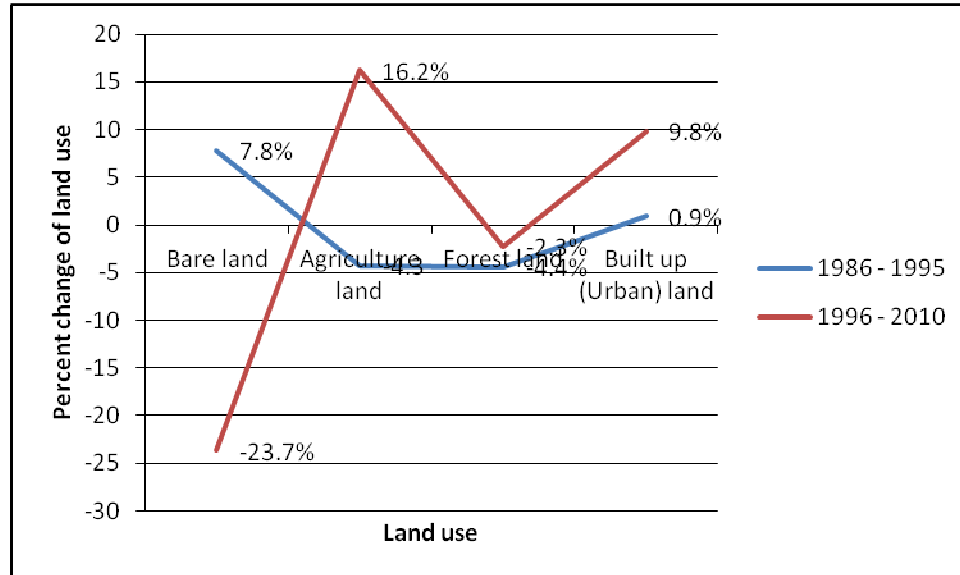


Figure 27: Temporal per cent change of land use patterns in Narok town from 1986 to 2010
 Source: Analysis of Landsat satellite imageries (N = 25 Sq. Km.)

Before the establishment of the University in the urban centre, the built up (urban) land increased by only 0.9 per cent in span of eleven (11) years and after establishment of the University the built up (urban) land increased by 9.8 per cent in the span of nineteen (19) years. Annual rate of sprawl before establishment of the university was, therefore, 0.08 per cent and 0.5 per cent after university establishment. This confirms assumption that the rate of urban sprawl accelerated after establishment of the University.

The post establishment of universities in urban centres from 1995 up to 2014 reveals accelerated change in the course of urbanization in the urban centres. The period records the built up (urban) land having increased to 10.1 per cent up from 1.4 per cent giving a change in per cent of 8.7 per cent. The other land uses such as bare land, forest and water body have reduced because of acquisition of land by urban sprawl. The increase in agriculture land use might be explained by gardens and livestock structures in the compounds of

residential houses where it has been noted in Kenyan urban centres (Fellmann J.D. et al, 2005). With time such agriculture land use will diminish because there will be need for more accommodation and the gardens will be developed into rental houses by the owners for higher economic returns. The livestock will be phased out by the urban by-laws.

A Rank Order on the land uses in Narok urban centre was done from 1986 to 2010 as shown in Table 3.

Land use	1986	1995	2010
Bare land	2	1	4
Agriculture land	1	2	1
Forest land	3	3	2
Built up (Urban) land	4	4	3

Table 3: Rank Order of land uses in Narok urban centre from 1986 to 2010

Spearman's Rank Order Correlation was performed to test relationship in the rankings of land uses between 1986 and 1995; and between 1995 and 2010. The relationship in the rank order of land uses between 1986 and 1995 is highly significant at $P= 0.05$ indicating that there is no change in the rankings of the land uses. However, the relationship in the rank order of land uses between 1995 and 2010 is not significant at $P= 0.05$ showing that there were major changes in the rankings of the land uses. The Built up (urban) land use increased in ranking from four (4) in 1986 and 1995 to three (3) in 2010 as other land uses fluctuated in the rankings. The built up (urban) will continue to sprawl with time as is indicated in the increasing percentage change in relation to other land uses which fluctuates in percentage change.

The overall influence of universities on the sprawl of urban centres is analyzed by looking at the combined change in percentage of various categories of land use over a period of thirty (30) years running from 1984 to 2014 shown in the Figure 28

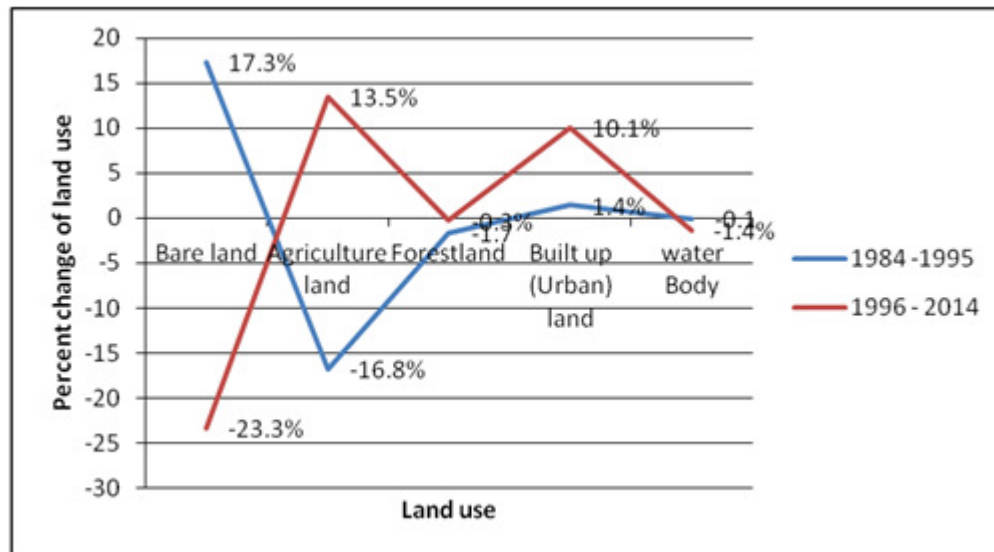


Figure 28: Temporal per cent change of land use patterns in urban centres- 1984-2014
Source: Analysis of Satellite Imageries (N = 33 Sq. Km.)

The analysis indicates that prior to the establishment of the universities in the medium urban centres in the country sprawl in these centres grew by only 3.1 per cent in span of eleven (11) years and after establishment of the universities sprawl grew by 14.3 per cent in the span of nineteen (19) years. This gives annual rate of sprawl before establishment of universities as 0.13 per cent and 0.53 per cent after establishment of the Universities in the towns. This confirms the fact that the rate of sprawl in urban centres in Kenya has accelerated after establishment of universities in these centres.

4.3. Conclusions and Recommendations

A university is a tertiary industry providing education. University population has created demand for goods and services including accommodation which in turn has attracted investors to the urban centre. The investors are investing in businesses such as provision of accommodation. Residential estates have arisen in urban centres that had otherwise none. This is as a result of demand for accommodation created by increased population. Investors have bought land on the outskirts of the municipalities, which is cheaper, to build hostels and houses for students and also accommodation for the increased urban population. In this process the private investors are contributing significantly to urban sprawl.

Universities, through their staff members contribute, though not significantly to the urban sprawl in the towns they are sited. Staff associations purchase the land wherever it is available. This explains why the sprawl seen in the imageries of urban centres is not in any pattern such linear or concentric. The built up areas spread all over towns in all directions.

Urban Authorities in towns where universities are established should partner with the universities to use the suitable programmes, staff expertise and technology for development of their urban centres. Physical plans should be developed to enable the urban centres grow systematically. Urban Authorities should develop strategic plans for their urban centres for provision of roads, water, sewerage and sanitation facilities as the centres expand.

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