

# Quantifying Tree Cover Loss in Urban Forests within Nairobi City Metropolitan Area From Earth Observation Data

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**TECHNICAL UNIVERSITY OF KENYA**

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# Background

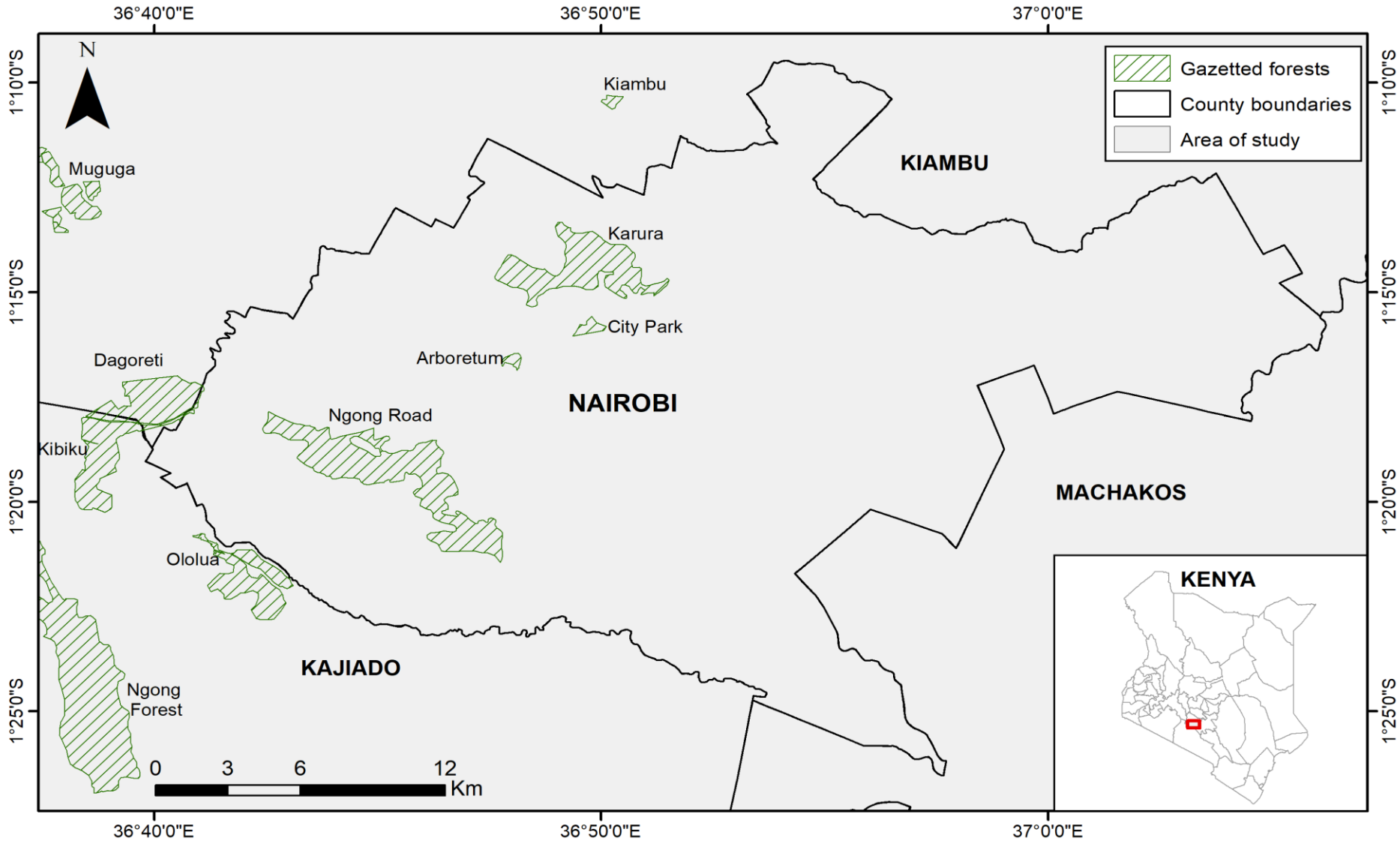
- Urban forests contribute significantly to the ecological integrity of urban areas and the quality of life of urban dwellers.
- Through air quality control, energy conservation, improving urban hydrology, and regulation of LST.
- However, urban forests are under threat due to human activities, natural calamities, and bio-invasion.



# Objectives

1. To assess forest cover change and changes in vegetation health using satellite-derived tree cover data and NDVI imagery for the period from 2000 to 2019 .
2. To understand the link between forest cover changes and land use characteristics.
3. Visualize the potential drivers of urban forest loss in the study area.

# Study Area

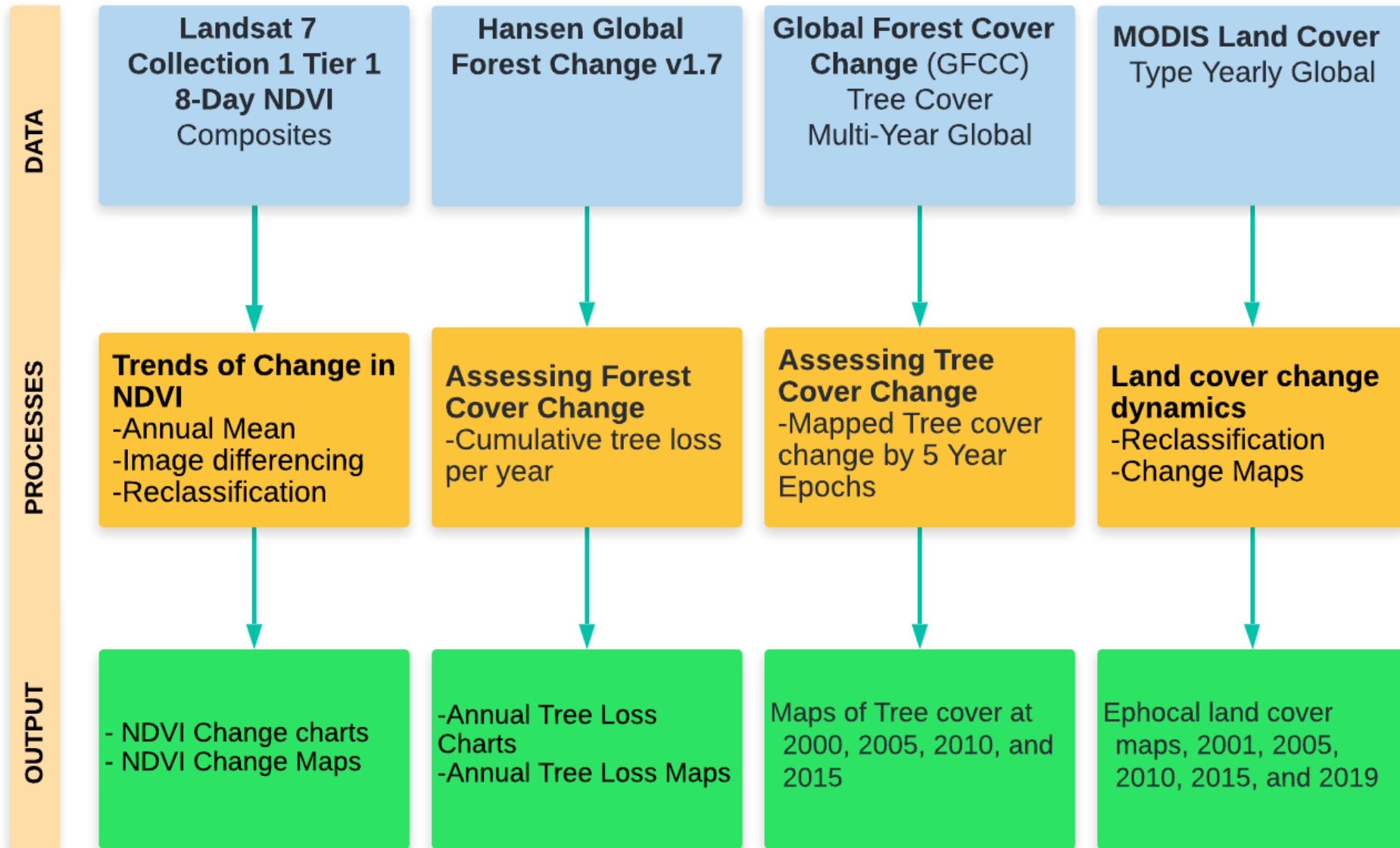


- There were 10 gazetted forests in the study areas.
- The total gazetted area of the **forests was approximately 6,700 Ha.**

# Data

<b>Theme</b>	<b>Data Type</b>	<b>Resolution</b>	<b>Time</b>	<b>Source</b>
Landsat 7 Collection 1 Tier 1 8-Day NDVI Composite	Raster	30m	2000 - 2019	USGS/ hosted in GEE
Hansen Global Forest Change v1.7	Raster	30m	2001 - 2019	Hansen hosted on Google Earth Engine
Global Forest Cover Change (GFCC) Tree Cover Multi-Year Global	Raster	30m	2000 - 2019	NASA Land Processes Distributed Active Archive Center (LP DAAC) at USGS EROS Center
MODIS Land Cover Type Yearly Global	Raster	500m	2001- 2019	NASA Land Processes Distributed Active Archive Center (LP DAAC) at USGS EROS Center

# Data Processing



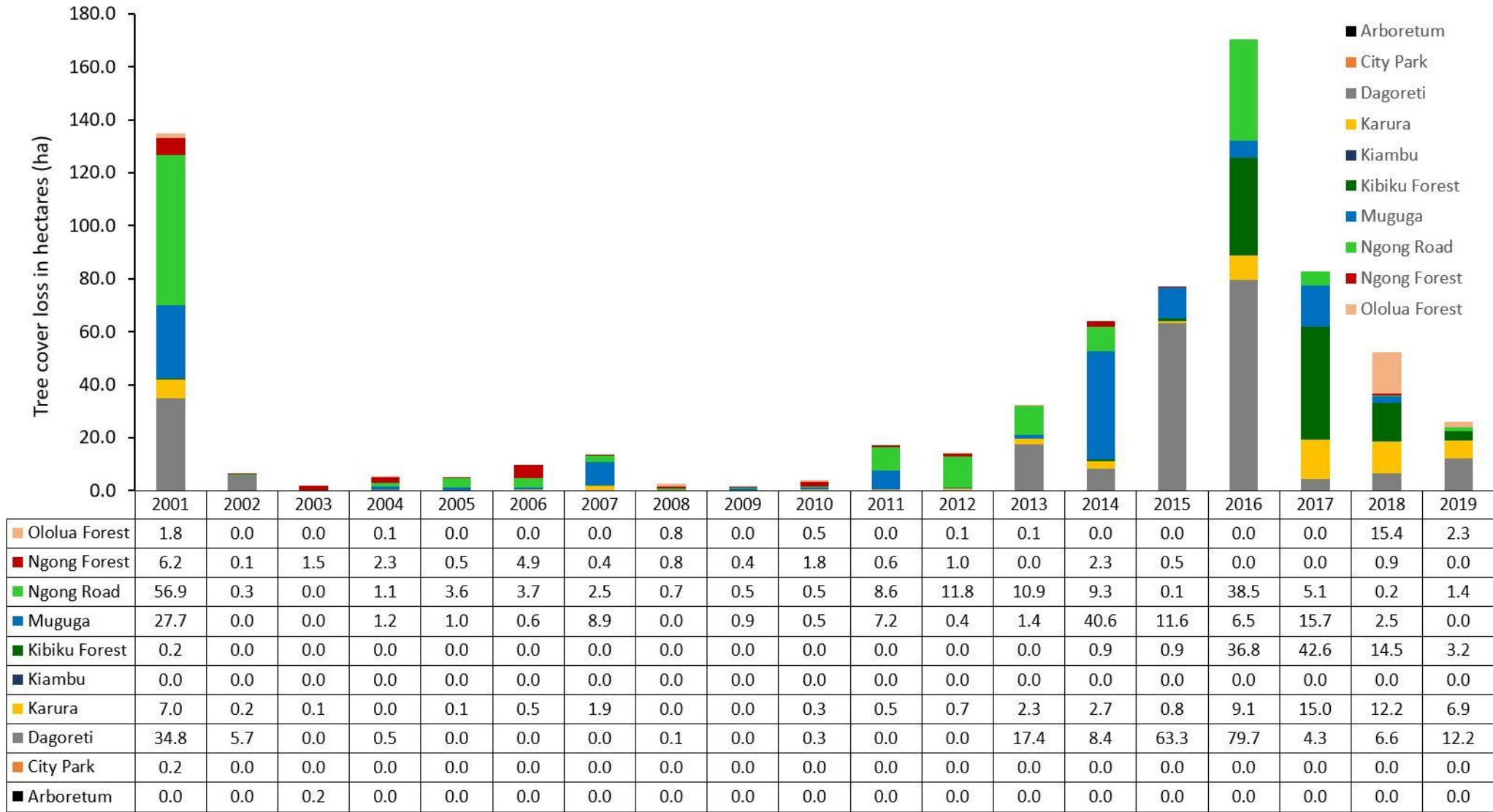
# Tree cover loss

- Between 2001 to 2019, 11% (720.5 ha) of the original 6620 ha in the study area was lost.

Forest	Losses between 2000-2010 (Hectares)
Dagoreti	233.1
Ngong Road	155.7
Kibiku	99.1
Karura	60.3
Ngong' Forest	24.1
Ololua	21.1

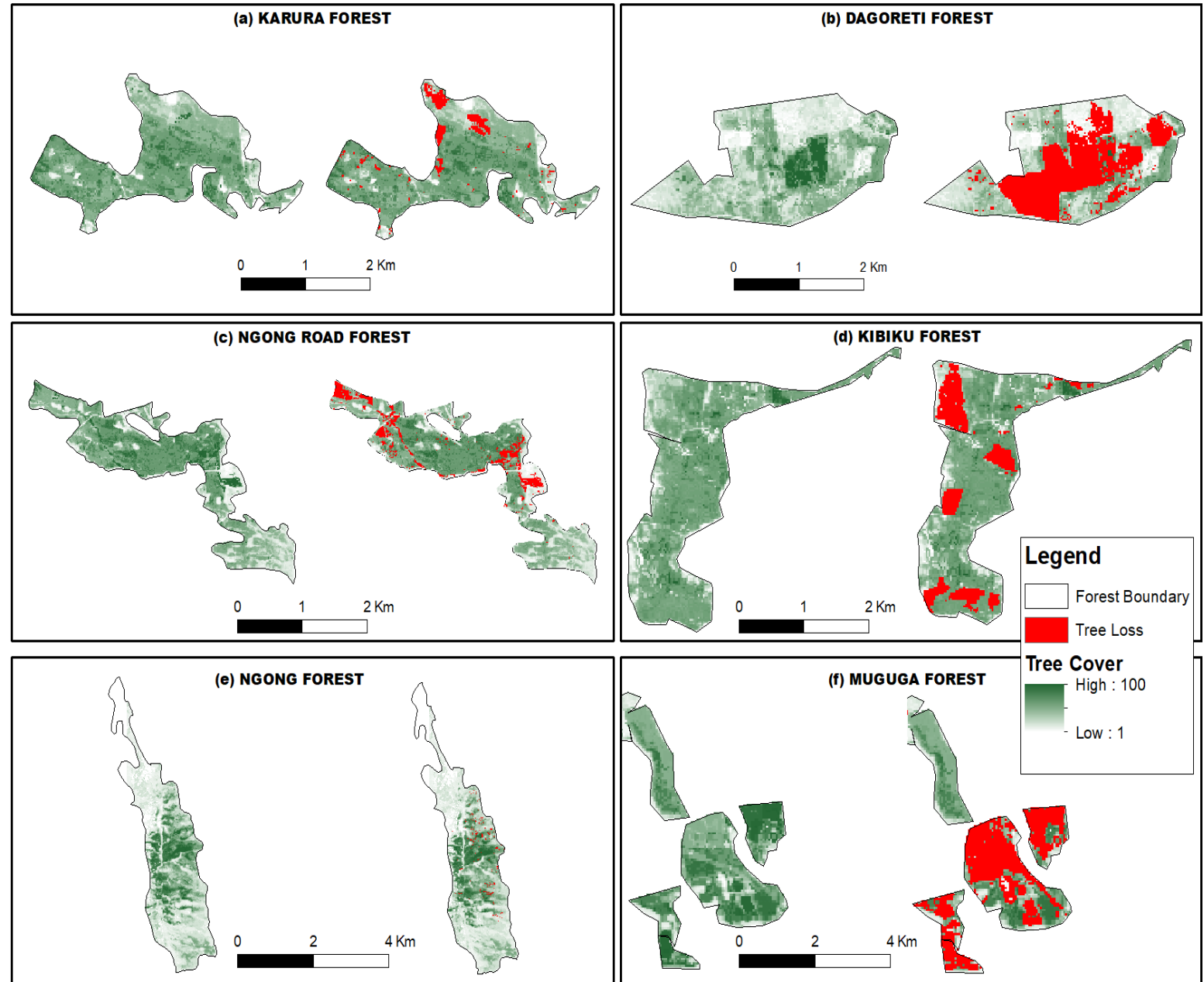


# Annual Tree cover loss

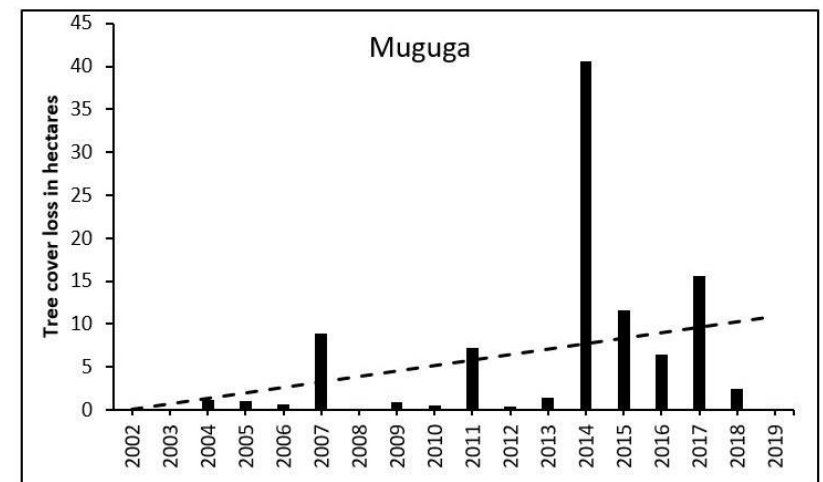
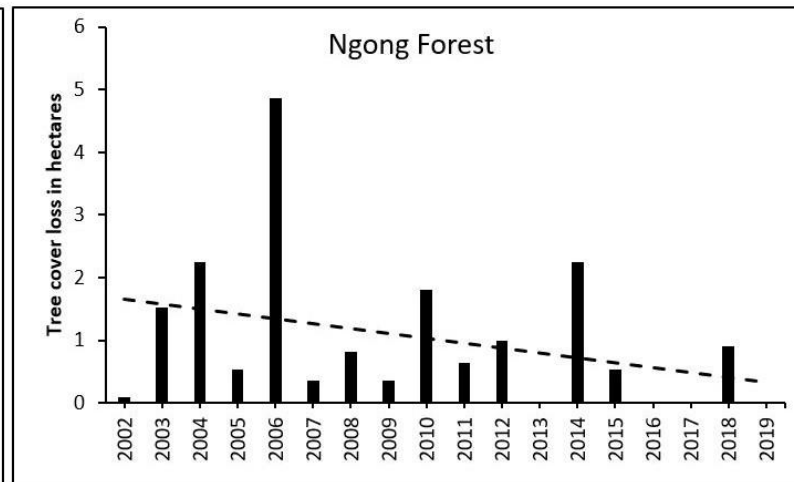
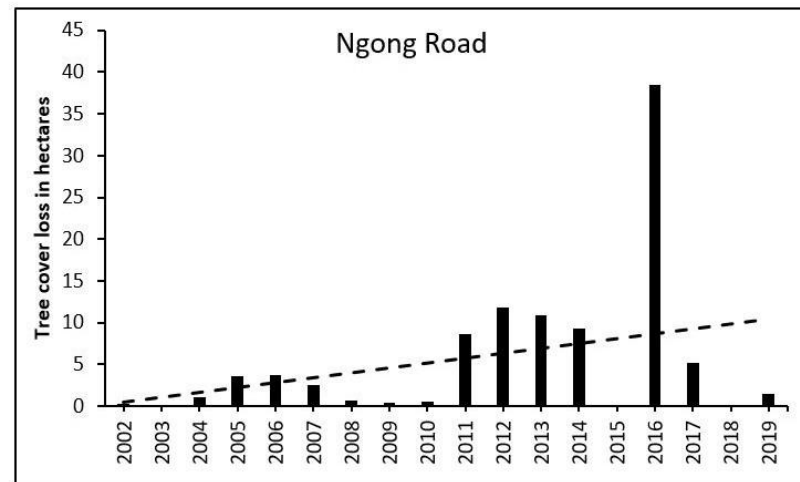
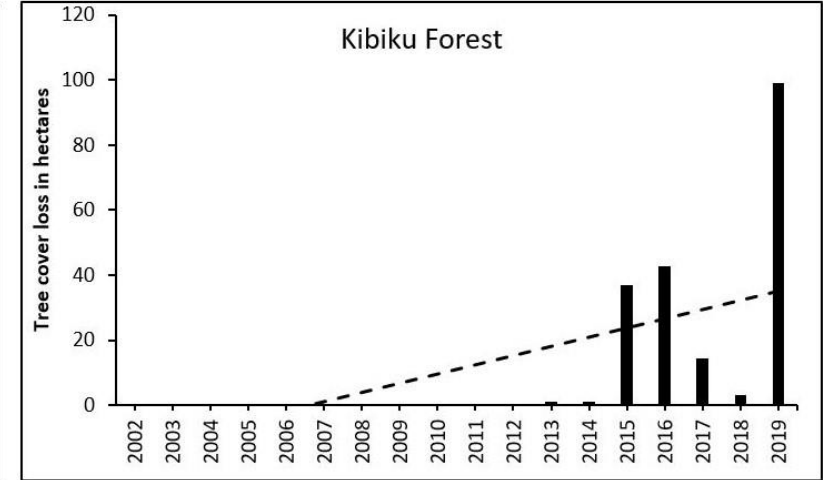
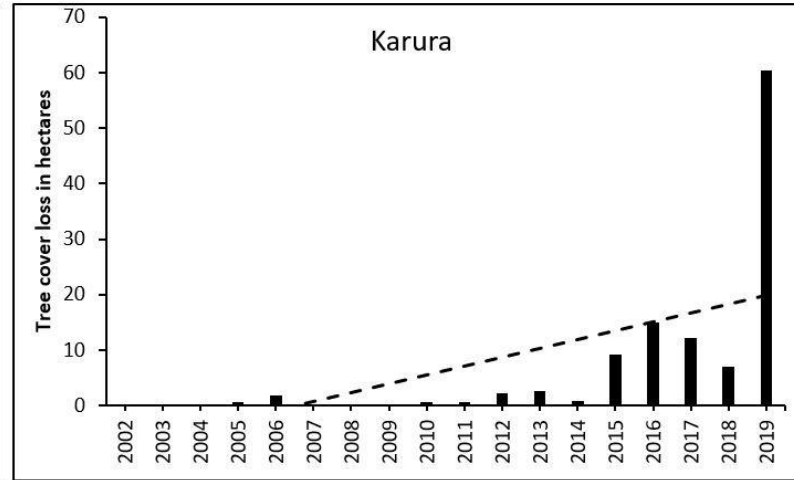
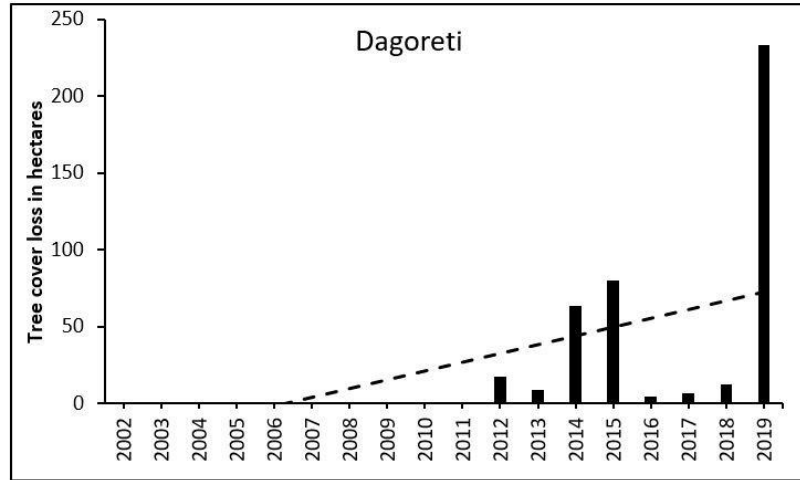


# Spatial patterns of loss per forest

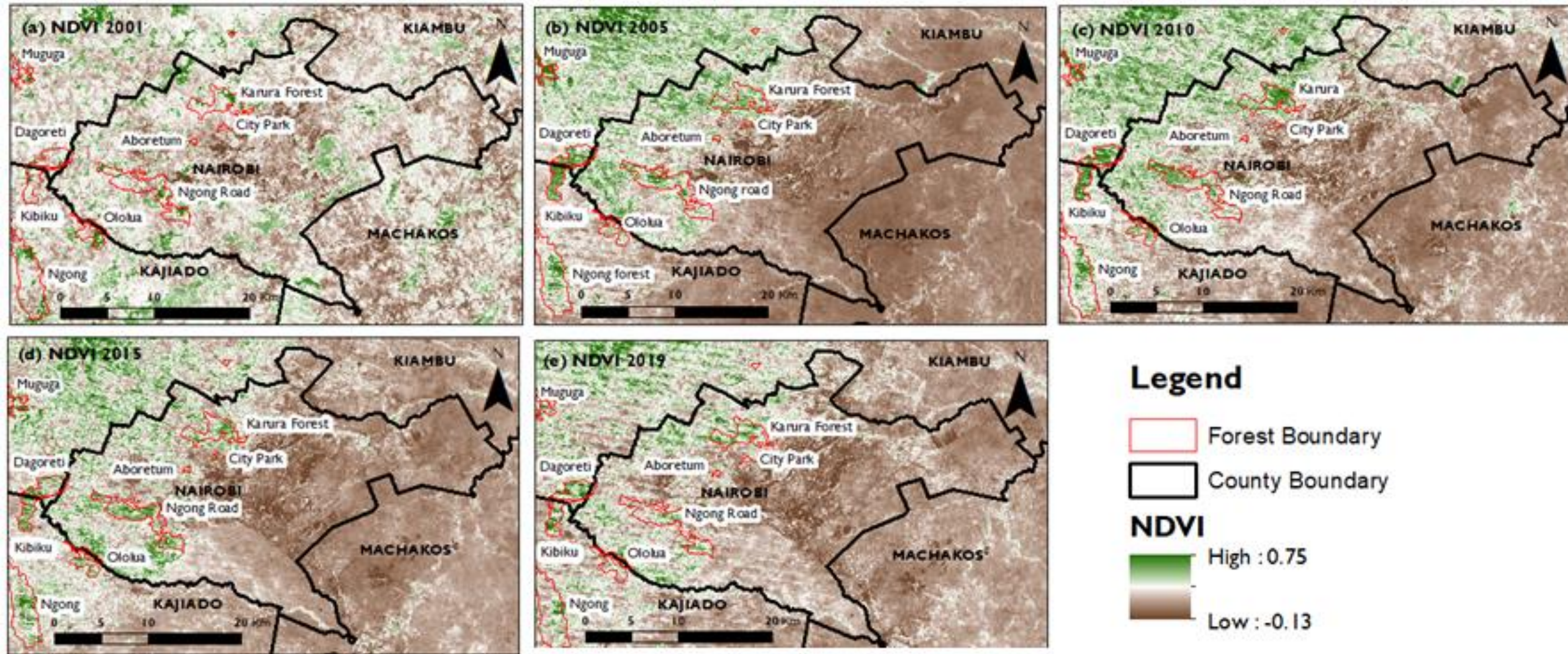
- Major losses were recorded in Dagoreti, Kibiku, Muguga, Ngong road and Ngong forests
- Losses were not random but were in contiguous patches indicating a pattern of expansion of original loss areas.



# Annual Tree Loss per Forest

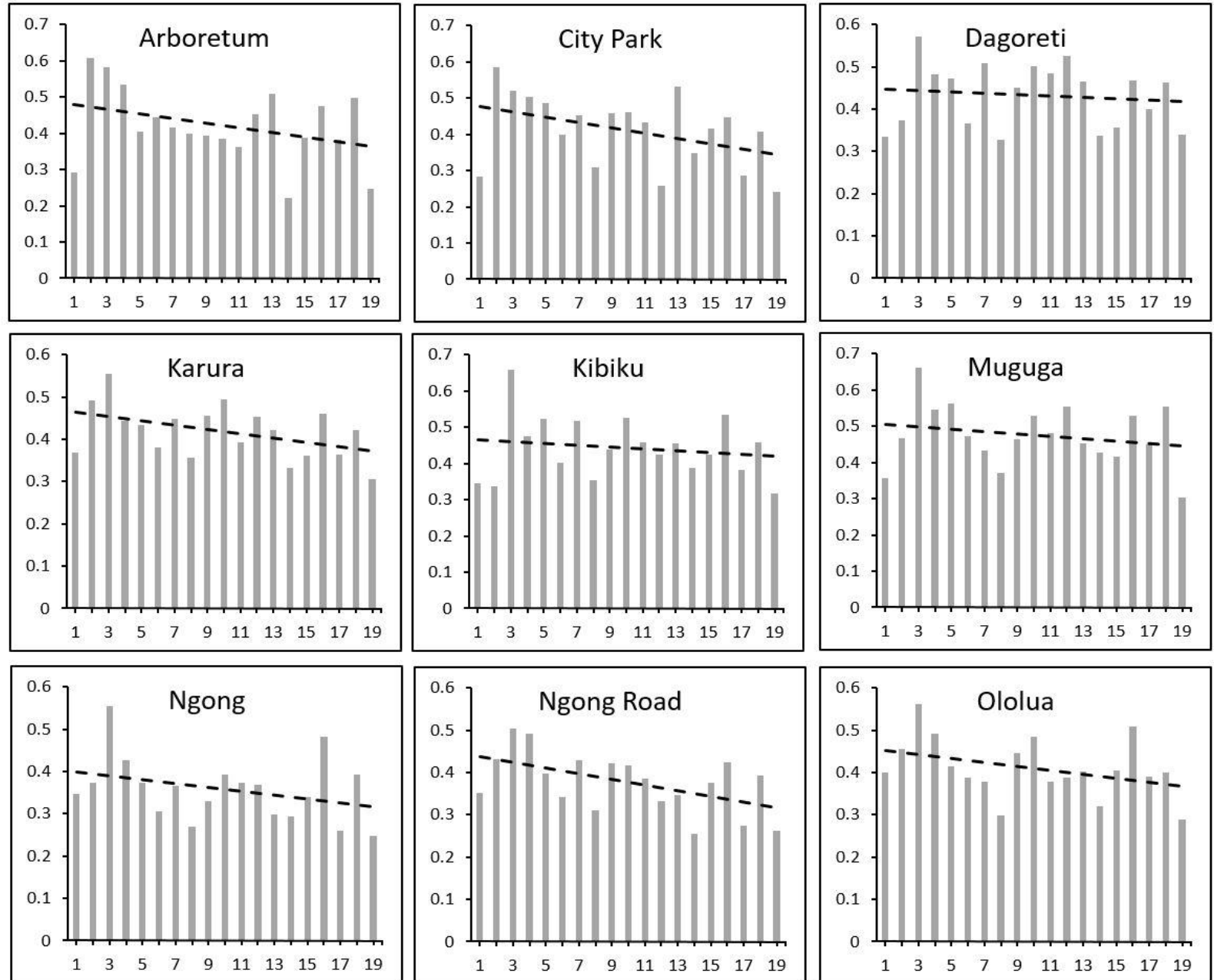


# NDVI Change characteristics

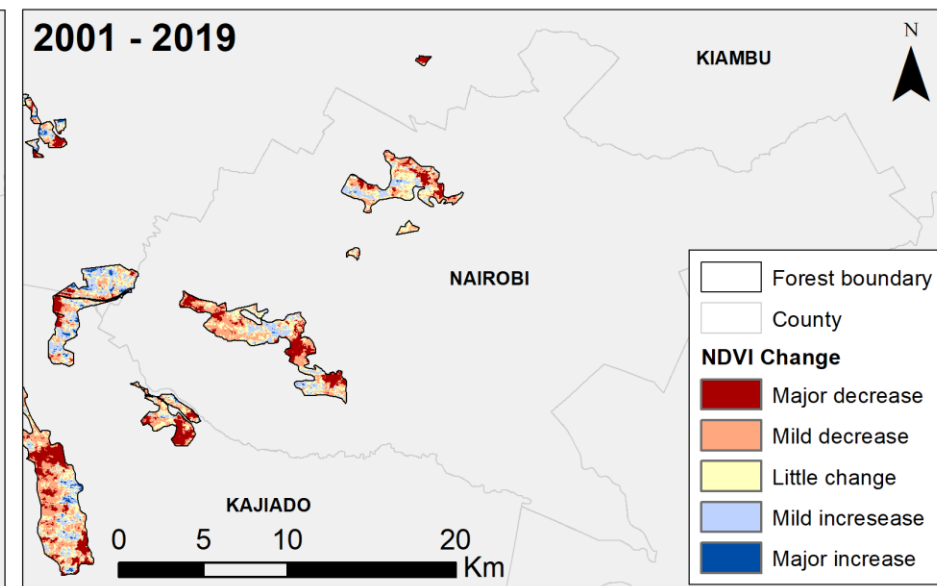
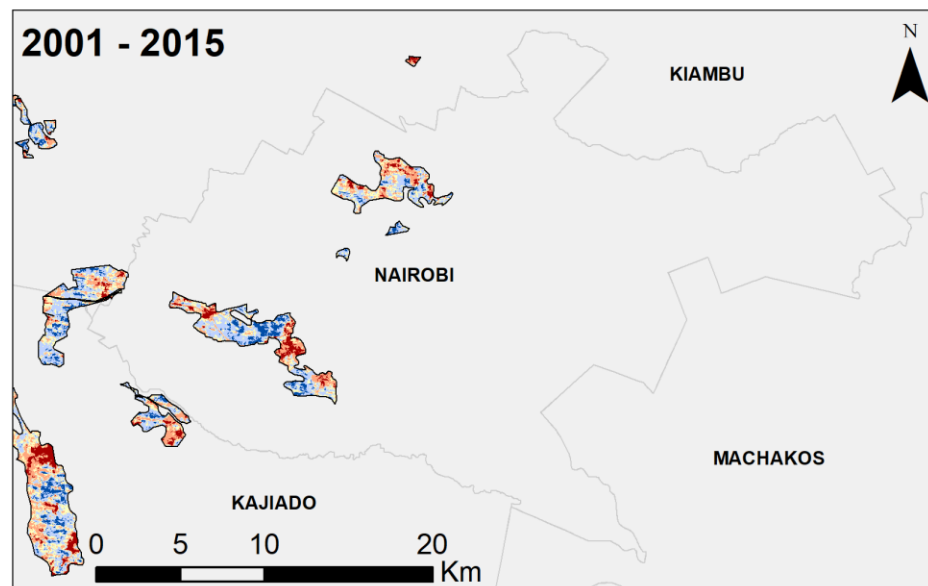
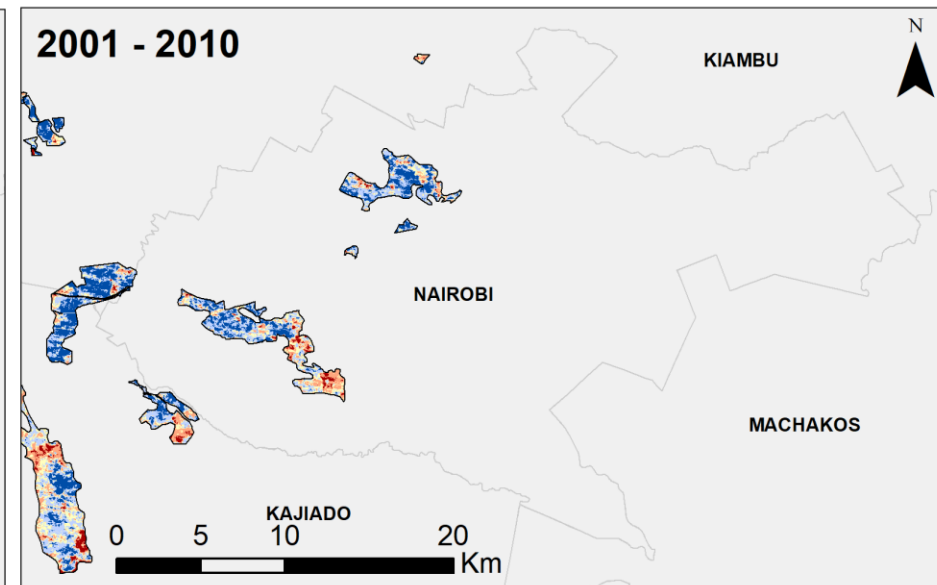
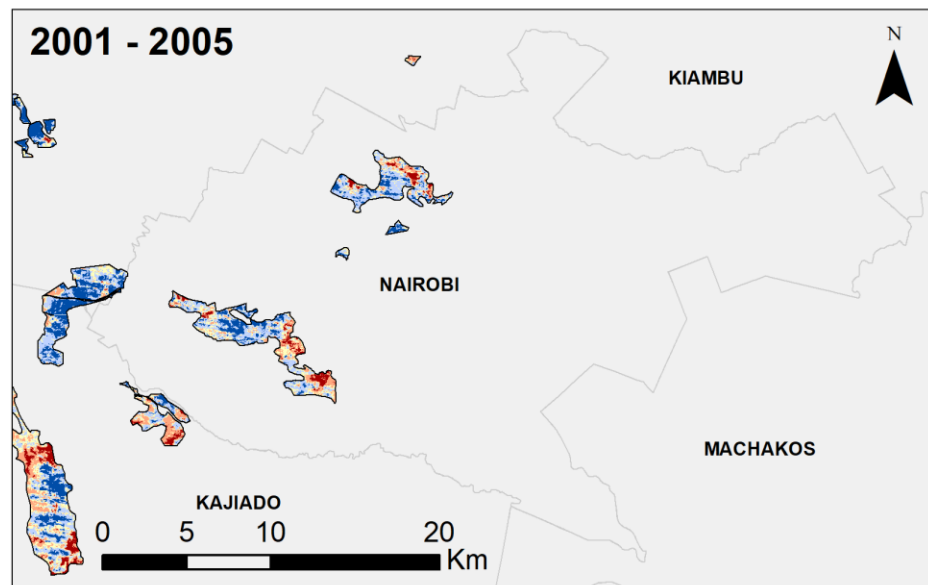


# NDVI Trend

- Annual NDVI values for each forest from 2001 to 2019 indicate that in each of the 9 forests, there is a negative trend of annual mean NDVI values.
- This could be indicative of the ongoing degradation or stress on the vegetation of the urban forest.



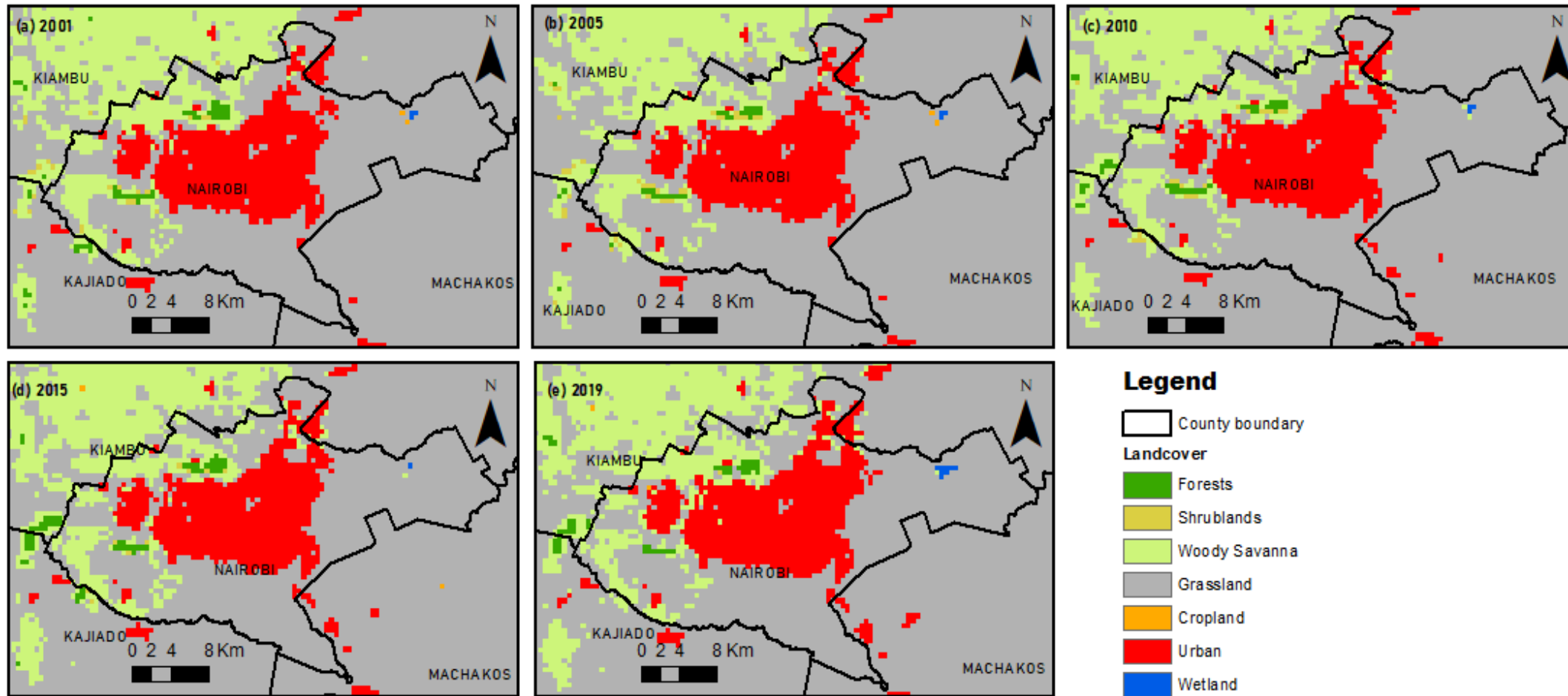
# Spatial of NDVI loss the forest



# NDVI Change characteristics

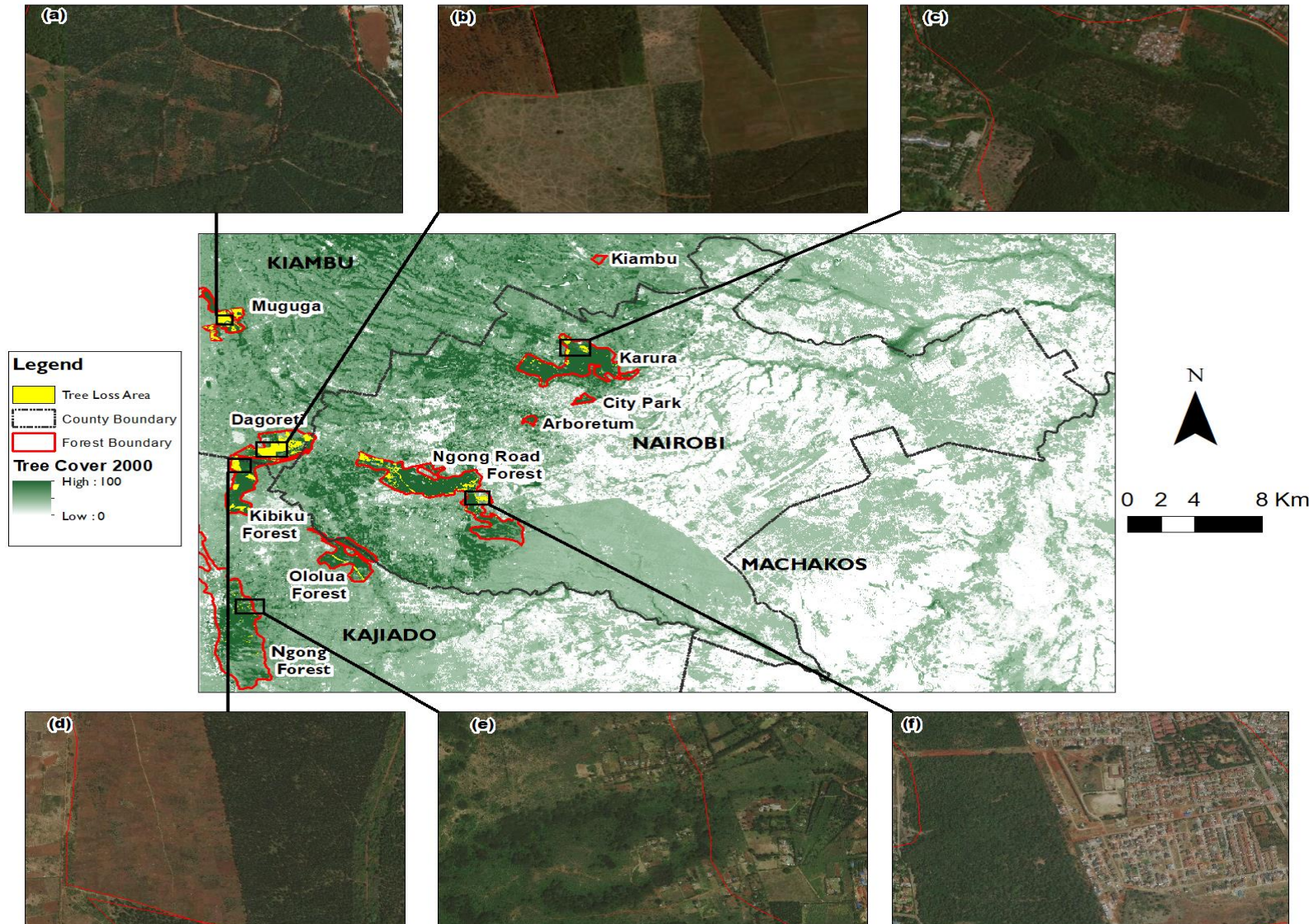
NDVI Change	2001-2005		2001-2010		2001-2015		2001-2019	
	Pixels	% percentage	Pixels	% percentage	Pixels	% percentage	Pixels	% percentage
Major decrease	5411	7.1	3075	4	7203	9.5	14886	19.6
Mild decrease	12643	16.6	11229	14.8	17363	22.8	25576	33.6
Little change	15057	19.8	14359	18.9	17557	23.1	20856	27.4
Mild increase	25812	33.9	26442	34.8	26095	34.3	13120	17.2
Major increase	17143	22.5	20961	27.6	7848	10.3	1628	2.1
<b>Total</b>	<b>76066</b>	<b>100</b>	<b>76066</b>	<b>100</b>	<b>76066</b>	<b>100</b>	<b>76066</b>	<b>100</b>

# Land cover change





# Potential drivers of forest loss



# Discussion

- Approximately 11% of forest cover in the Nairobi City Metropolitan area has been lost in the period between 2000 – 2019, representing an annual loss of 0.58%.
- The rate of tree loss around the city was marginally higher than the reported overall forest cover loss in Kenya at 0.32%.
- The results showed that it is possible to use tree cover data and NDVI to assess and understand the changing dynamics in forests. In terms of the management of urban forests in Kenya, we observed that it is not enough to merely gazette the forests, it is more important to monitor the status of the forests by using existing satellite-derived data. Also, incorporating local community associations in the management of urban forests may contribute to their sustainable conservation.
- Further research should be carried out to determine appropriate sustainable management strategies and policies for urban forests in Kenya in the face of ongoing urbanization and the rapid rise of urban populations.