



AFRICAN FORUM
ON URBAN FORESTS

2nd African Forum On Urban Forests

Green Horizons: Shaping the Future Resilience of African Cities through Urban Forests

18 March 2025 - 21 March 2025



in partnership with:



Assessing the impact of land cover/land use changes on urban heat Island in Bulawayo metropolitan city, Zimbabwe.

SETHI DUBE



Introduction and background

- Urbanisation coupled with industrialisation cause massive LULC changes which result in UHI.
- UHI is known to result from urban landscape surface features that make urban areas warmer
- Changes in LULC also accelerate climate change through increased UHI (Kafy et al., 2021)
- The Urban Heat Island effect has been exacerbated by climate change with severe consequences for human health and environmental sustainability.



Introduction and background

- Urban and rural areas in Africa has a temperature difference of between 0.17 and 2.21 degrees Celsius. In Zimbabwe, Harare's urban heat island intensity was found to be 1.5⁰C by 2015.
- African cities are increasingly urbanizing and thus, experiencing increased UHI
- Numerous studies have used remote sensing to study LULC and LST globally and in Africa



Introduction Cont--

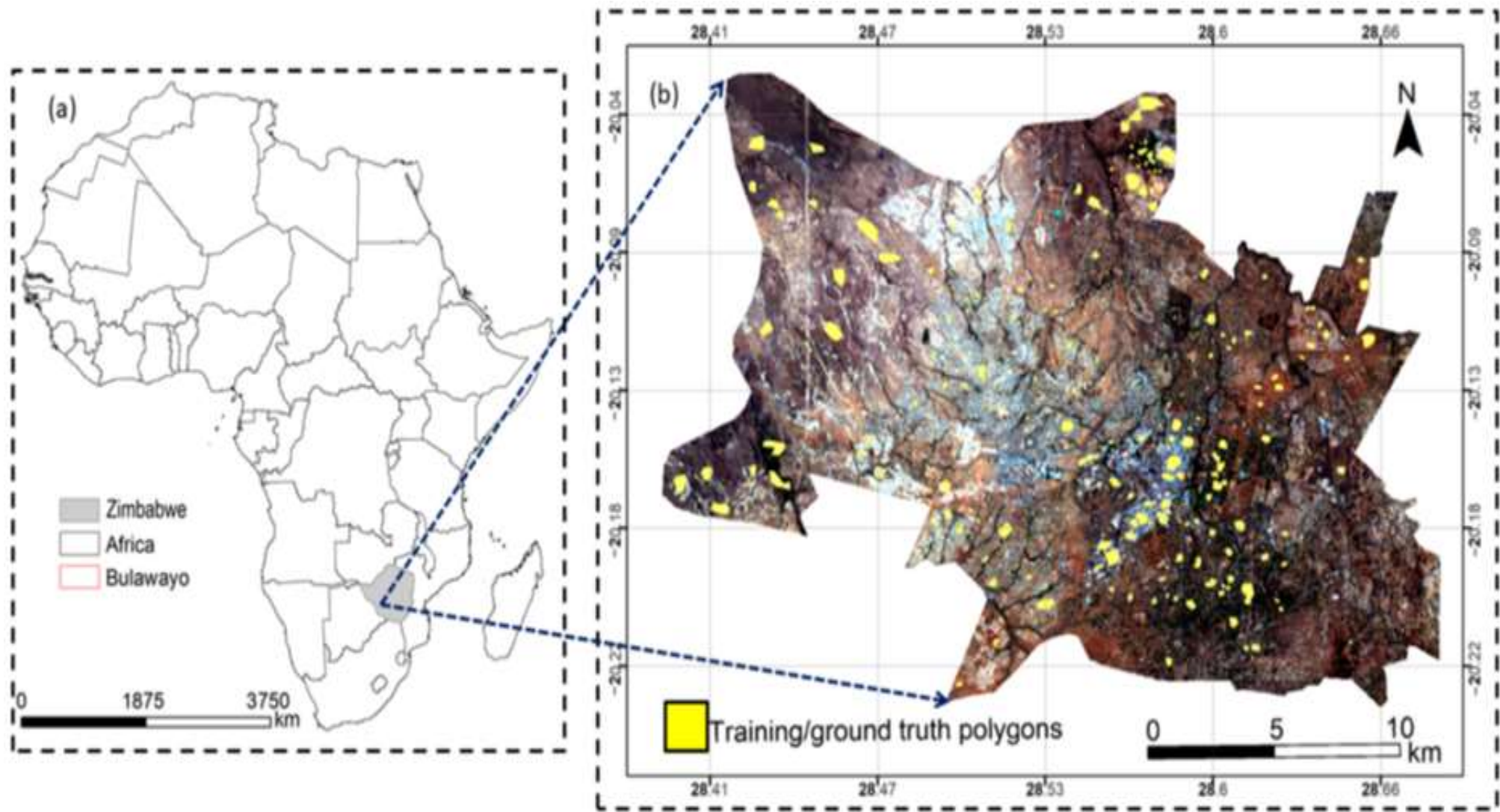
- Therefore, GIS and remote sensing technologies provide useful and spatially explicit tools for monitoring urban environments
- LULC indices such as NDVI, NDBI, UHI and NDWI has been widely to assess LULC change and their effects on LST and UHI
- However, few studies have studied UHI in Zimbabwe, thus, this study sought to understand the spatio-temporal dynamics of LULC changes and their influence on land surface temperature and urban heat island in Bulawayo between 1990 and 2020



Study Area

- Bulawayo is the second largest city located in the south west of Zimbabwe, and has been experiencing high urbanization
- The city has a sub-tropical climate
- However, the daily minimum temperatures have risen approximately by 2.6°C while the daily maximum have increased by 2°C in the region (Brown et al, 2012)





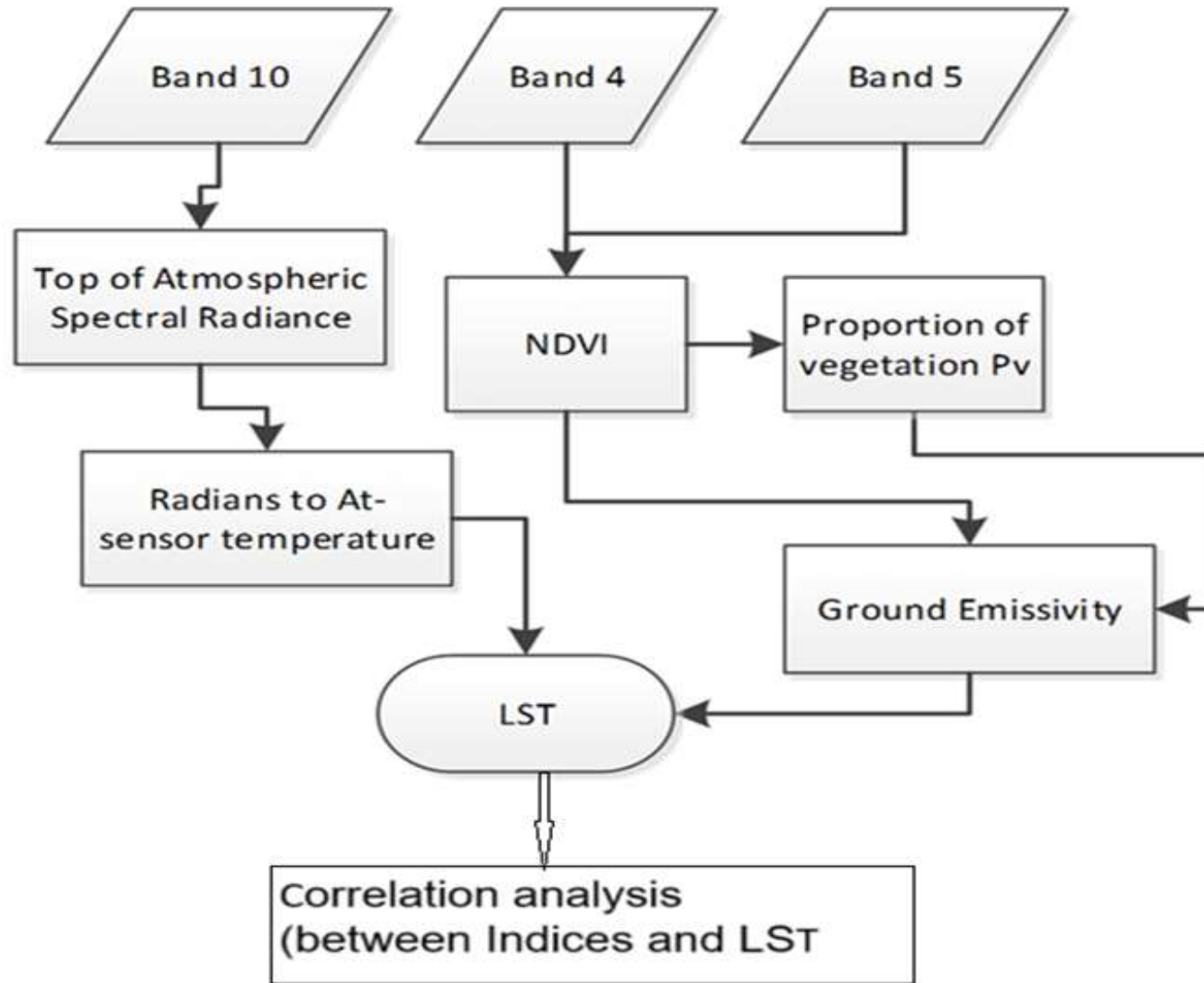
Methods

- This study employed thermal remote sensing and GIS technology to investigate the relationship between land use/land cover changes and UHI in Bulawayo Metropolitan City.
- Landsat TM and Landsat 8 OLI imagery were used for LULC classification in 1990 and 2020, respectively obtained from USGS Earth explorer
- The spatio-temporal pattern of LST, NDVI and UHII were computed from Landsat 5 and 8 imagery and correlated with land use type and indices .

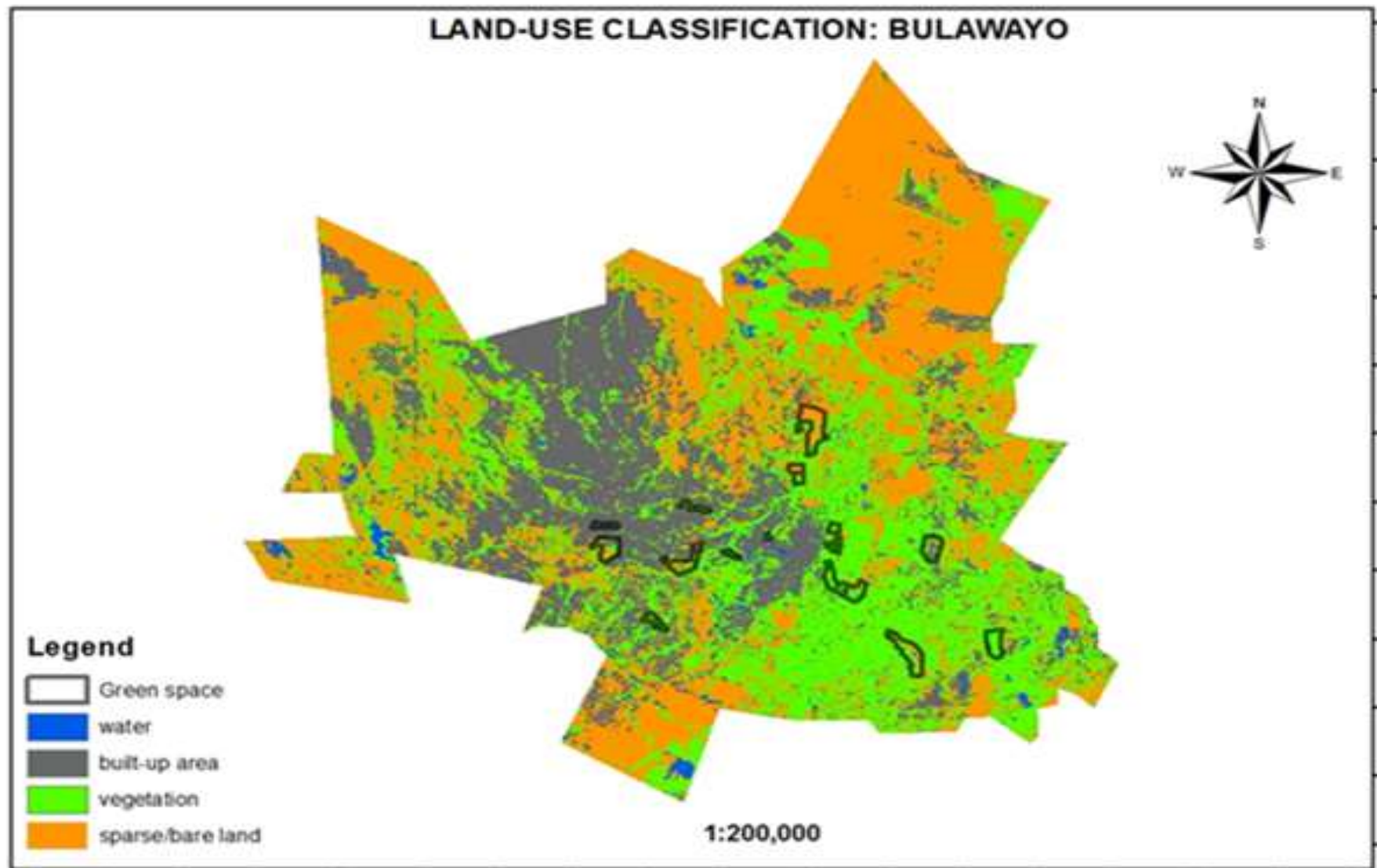


Methods Cont--

- The methodology is diagrammatically represented as a flow chart



Results



Results Cont---

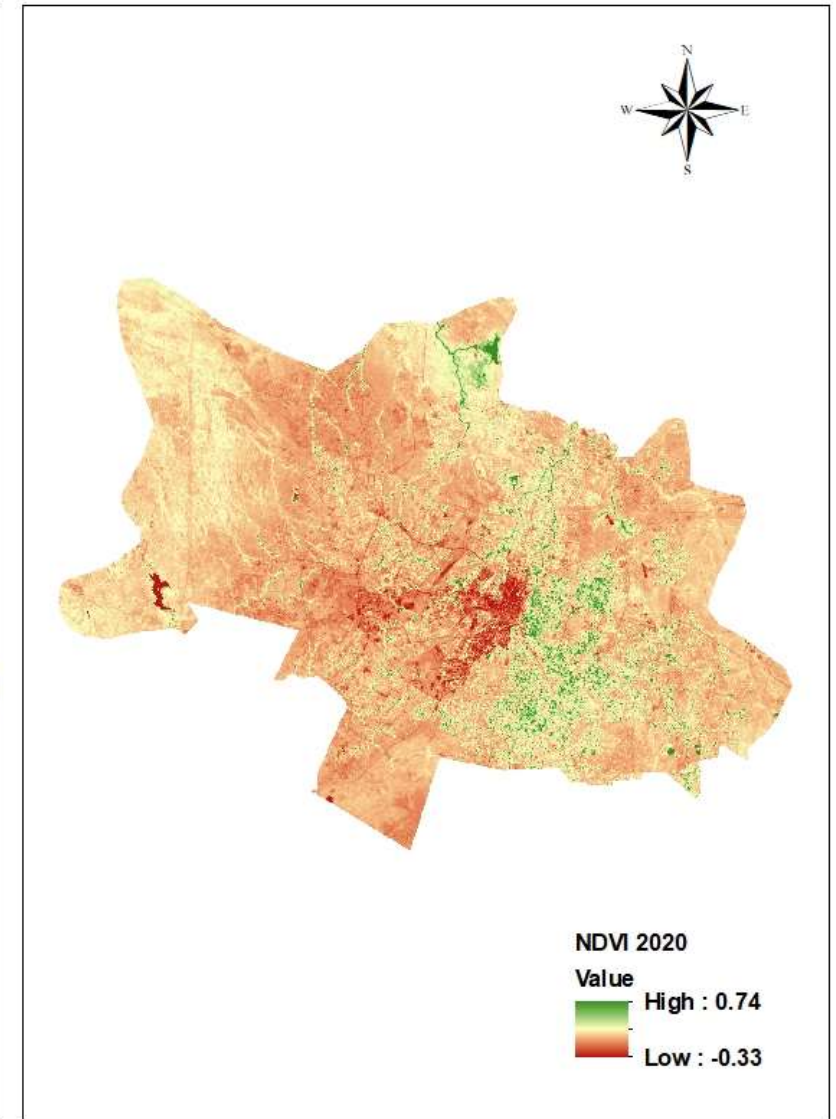
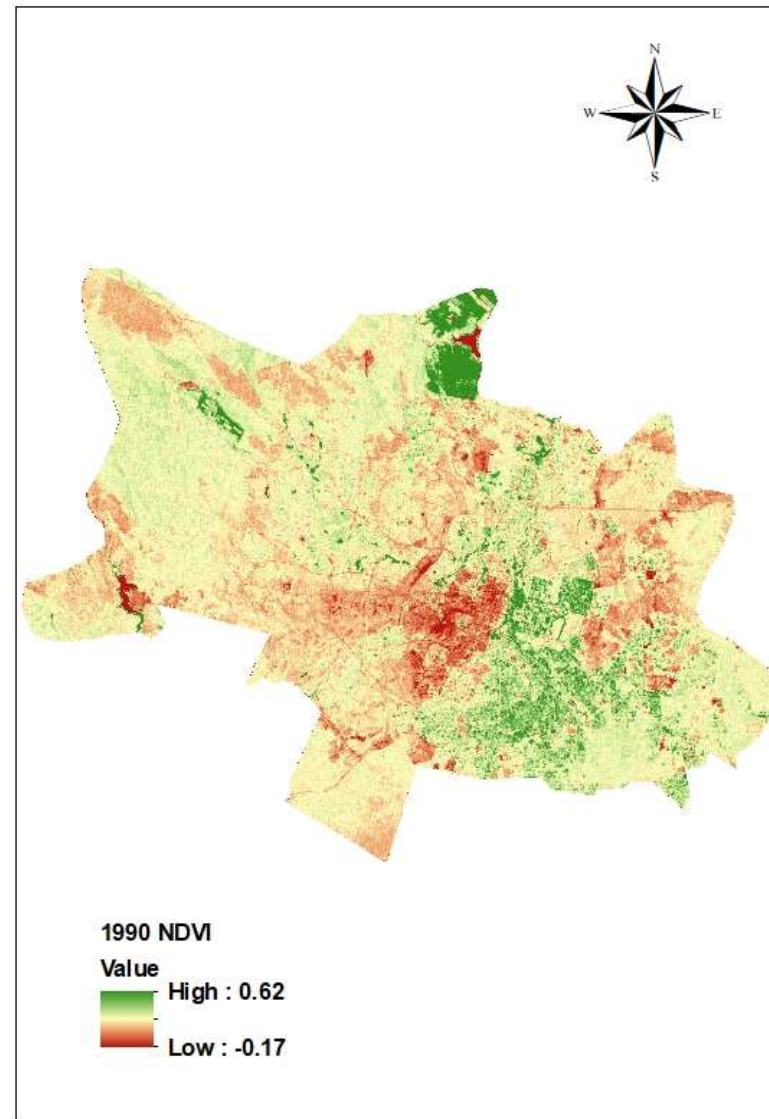
YEAR	1990	1994-2004	2004	2004-2020	2020	1990-2020
Class	Total area composition (ha)	Increase/decrease	Total area composition (ha)	Increase/decrease	Total area composition (ha)	Increase/decrease
Built up	9217	+20 %	17531	+38 %	25525	+53,6%
Water	1121	-2.4%	149	-0.3%	115	-0,2%
Vegetation	14221	-39%	8299	-15,6	7154	-15.9%
Bare lands	21284	-46.4%	20990	-45.8%	14885	-31.2%
Total	45842		46969		47678	



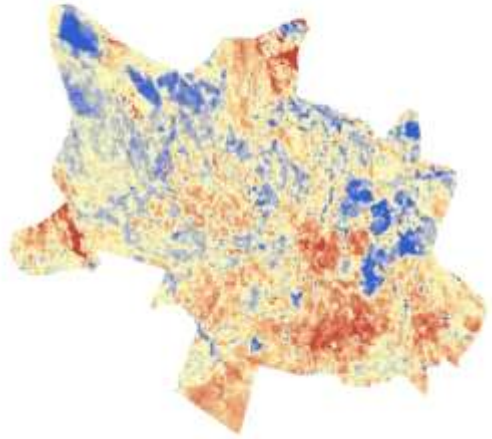
- The results showed a significant decrease in vegetation and barren lands (from 39% to 15.9%) and an increase in built-up areas (from 20% to 53.6%) due to rapid urbanization.



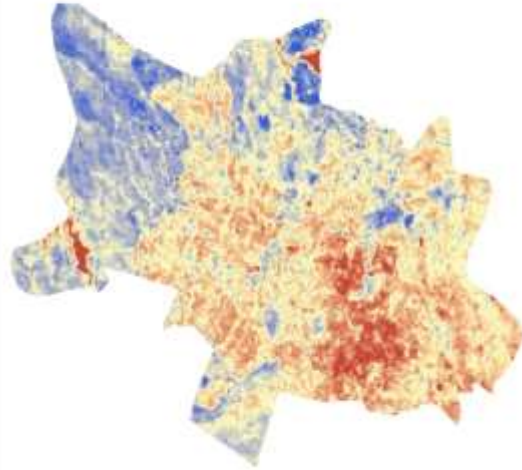
- The Normalized Difference Vegetation Index (NDVI) values also declined, indicating a loss of vegetation



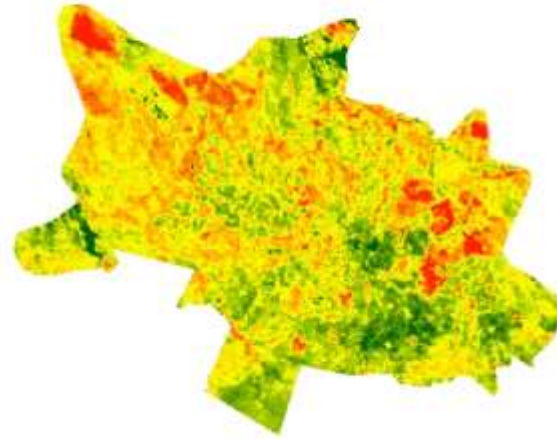
1990 LST



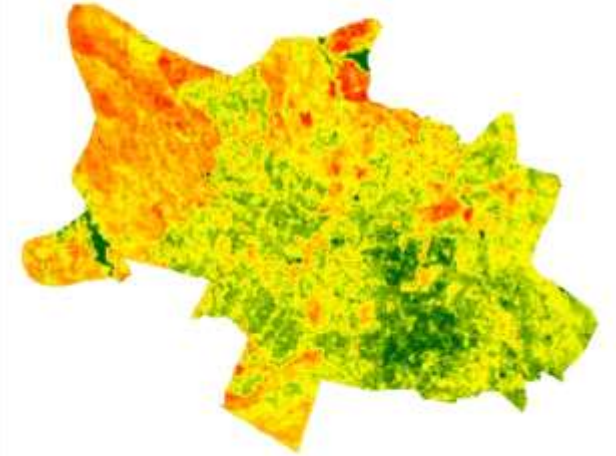
2020 LST

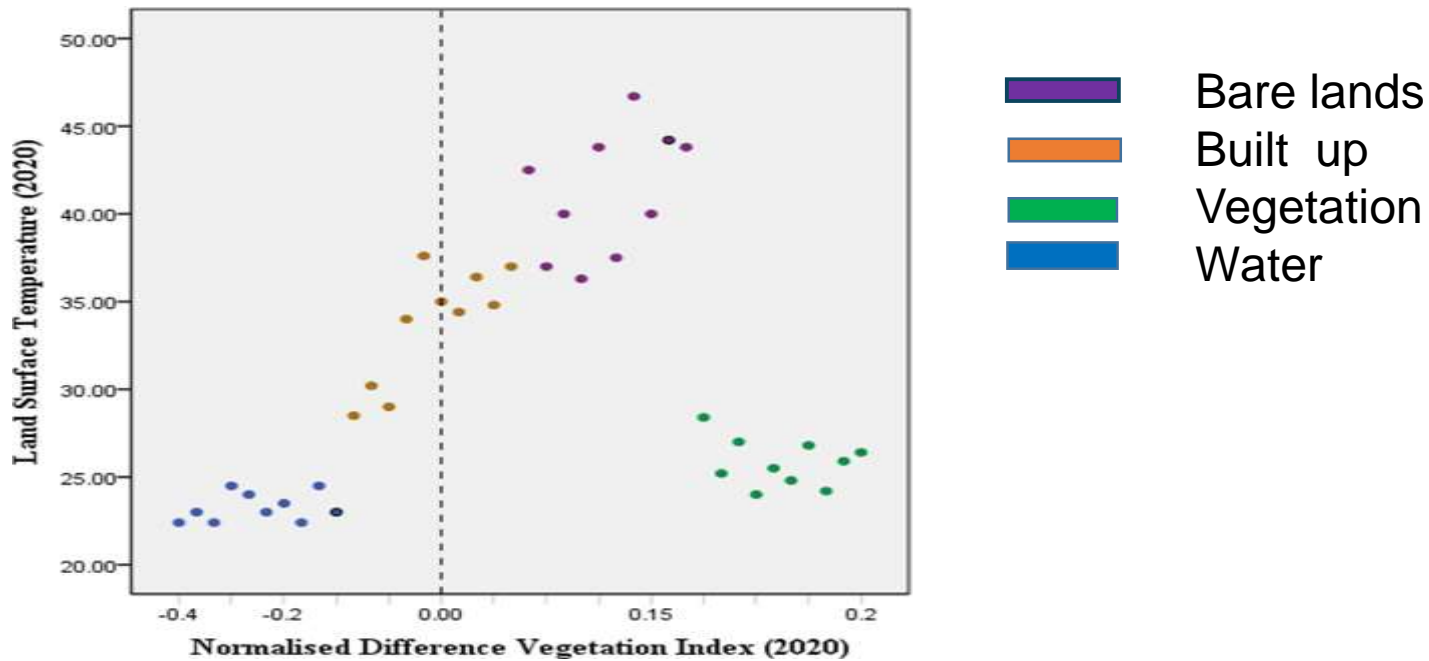


1990 UHI



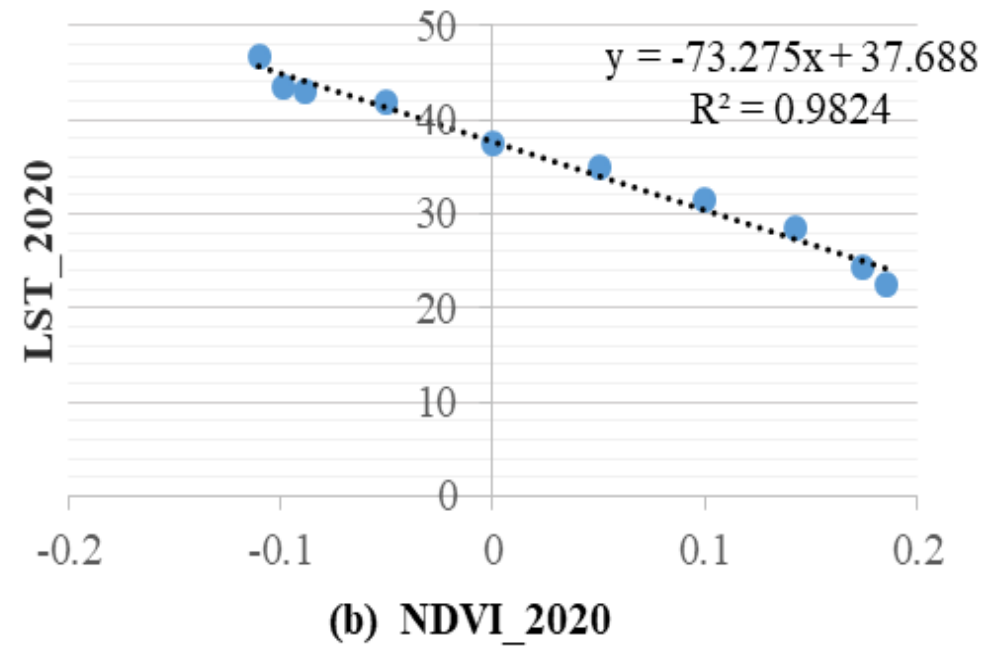
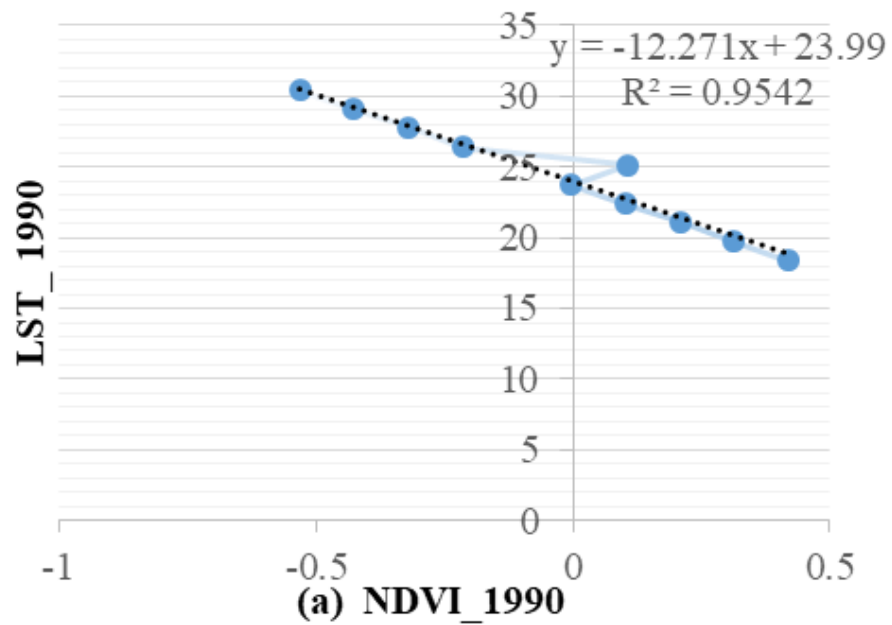
2020 UHI





- The results depict an increase in surface temperatures in Bulawayo from 1990 to 2020.
- Low surface temperature was observed in areas with water and vegetation, while highest surface temperatures were observed on bare land and constructed surfaces





- There was a very strong negative correlation between the LST and the NDVI.
- Thus, greening urban areas can be a solution to UHI effect



Summary of findings

- The results show rapid LULC dynamics. Vegetation cover and bare lands decreased significantly, while built up increased.
- The LST is influenced by LULC types. 2020 recorded highest temperature of 49.2 degrees Celsius
- High temperature surfaces expanded while LST temperatures increased between 1990 and 2020.
- High density areas recorded higher temperatures than the low density eastern counterparts due to higher green spaces like parks and vegetation in the eastern part.
- UHI has increased, showing higher trends within the CBD area and bare lands
- There was a very strong negative correlation between the LST and NDVI.



Recommendations

- The study recommends urban forestry as a strategy to improve the urban heat island effect particularly under the current climate change.
- Expand green infrastructure to reduce the warming effect
- Promotion of urban agriculture on bare lands
- Increase and Investments in green spaces such as green roofs, parks, and botanical gardens across the city through public and private partnerships



Thank You.

