INVESTIGATING THE EFFECTS OF LAND COVER ON THE TEMPERATURE OF NYALI - MOMBASA

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INTRODUCTION

Urbanization significantly impacts local and regional climates by altering surface and air temperatures. In Nyali, a rapidly developing area in Mombasa, increased impervious surfaces like concrete have led to temperature variations, contributing to the urban heat island (UHI) effect. This literature review examines the relationship between land cover and temperature, highlighting the role of vegetation in temperature regulation. Green spaces such as Nyali Beach and golf courses help lower temperatures through evapotranspiration, while commercial areas with extensive concrete surfaces, like City Mall, experience higher heat retention. Studies show that built-up areas in Nyali can be 3-7°C warmer than vegetated zones, increasing energy consumption and public health risks. Understanding these variations is crucial for sustainable urban planning. Implementing green infrastructure, such as urban parks and tree-lined streets, can help mitigate rising temperatures, improve climate resilience, and enhance community well-being.

RESEARCH QUESTIONS

1. How do surface and air temperatures vary between grassy, and concrete land cover areas throughout the day?
2. What is the effect of land cover in regulating surface and air temperatures?
3. How do temperature differences in various land covers contribute to the urban heat island effect?

RESEARCH METHODS

Materials and Equipment

- Digital Air Temperature Sensor/Thermometer
- GLOBE Atmosphere Protocol Thermometer
- Hygrometer
- Mobile GPS App
- Field Notebook & Data Sheets
- GLOBE Observer App
- Weather Station Data
- GLOBE Visualization System
- Maps and Satellite Images (Google Earth Pro)
- Digital Camera and Smartphone

Data Collection Procedures

The study employed GLOBE Atmosphere Protocols; Surface Temperature Protocol and Air Temperature Protocol, to measure and compare temperature variations across different land cover types.

Map of the study site

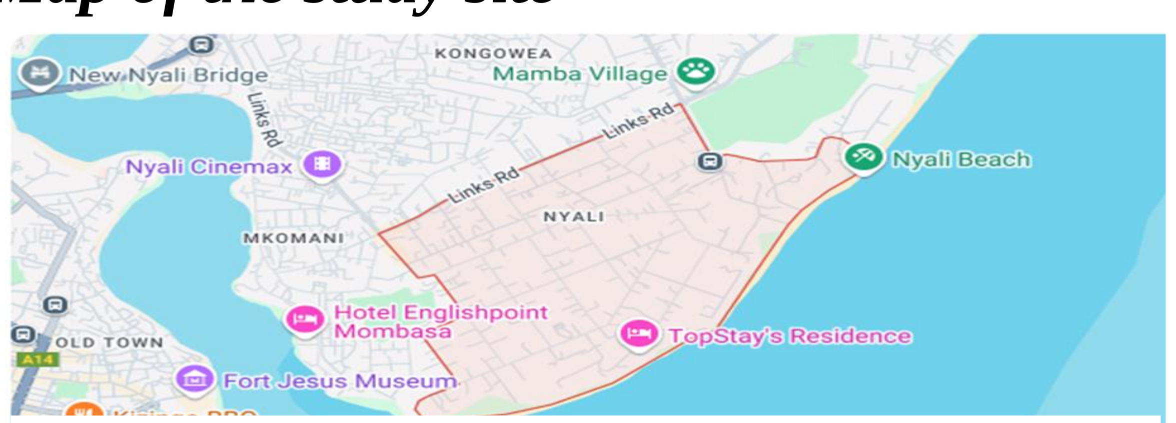

Figure 1: Students at Shree Swaminarayan Academy measuring air temperature.

Study Site and Sampling

The data for this study was collected from two distinct land cover types within the school a grassy area representing vegetated land cover and a concrete surface representing a built-up, impervious surface. To ensure consistency, measurements were taken at fixed points within each land cover type. Data collection was conducted at three different times of the day (morning, midday, and evening) over a period of eight weeks. This approach allowed for the identification of temperature trends and variations between the two surfaces throughout the day.

Measuring Air Temperature

A Digital Hygro-Thermometer was used to measure air temperature at a standard height of 1.5 meters above the ground, in accordance with GLOBE protocols. Readings were recorded regularly to ensure accuracy and consistency. Additionally, humidity levels were measured to analyze their impact on temperature variations, providing a more comprehensive understanding of the microclimatic conditions within the study area.

Figure 2: Students at Shree Swaminarayan Academy measuring air temperature.

Measuring Surface Temperature

Surface temperature was measured using Extech-Mini IR Thermometer to assess the temperatures of different materials (grassy field, a bare soil area, and a concrete-paved surface). To ensure consistency, the device was held at a 90-degree angle to the surface during each measurement.

Figure 3: Students at measuring Surface Temperature

RESULTS

The study examined how different types of land cover (grass and concrete) affect surface and air temperatures throughout the day. The findings highlight significant temperature differences between these surfaces, showing the impact of land use on urban climate and the importance of green spaces in cooling cities.

Figure 4 : Picture showing different Land Covers - Grassy and Concrete surfaces

i) Variation of surface temperatures in different land covers

According to the study, temperatures varied significantly based on land cover. Concrete surfaces heated up the fastest and reached the highest temperatures during midday, often exceeding 40°C. Grass-covered areas remained the coolest throughout the day, with surface temperatures staying lower due to moisture retention and shading effects.

Table 1: Showing changes in Surface Temperature in Grassy and Concrete areas.

Week	Time	Average Weekly Temperature		
		Grassy Area (℃)	Concrete Area (℃)	Difference (℃)
1	Morning	26.1	38.0	11.9
	Midday	28.0	50.2	22.2
	Evening	27.4	35.6	8.2
2	Morning	31.4	48.6	7.2
	Midday	30.2	52.9	22.7
	Evening	30.7	40.1	9.4
3	Morning	30.1	34.2	4.1
	Midday	33.9	51.7	17.8
	Evening	31.9	35.3	3.4
4	Morning	32.3	38.0	5.8
	Midday	33.2	52.5	19.3
	Evening	34.1	38.4	4.3
5	Morning	29.5	32.7	3.2
	Midday	34.0	52.2	18.2
	Evening	32.2	37.5	5.3
6	Morning	28.1	32.9	4.8
	Midday	33.7	53.1	19.4
	Evening	30.3	34.3	3.0
7	Morning	28.0	33.2	5.2
	Midday	34.4	50.6	16.2
	Evening	30.6	34.7	4.1
8	Morning	31.2	34.3	3.1
	Midday	32.7	50.3	17.6
	Evening	33.3	36.9	3.6

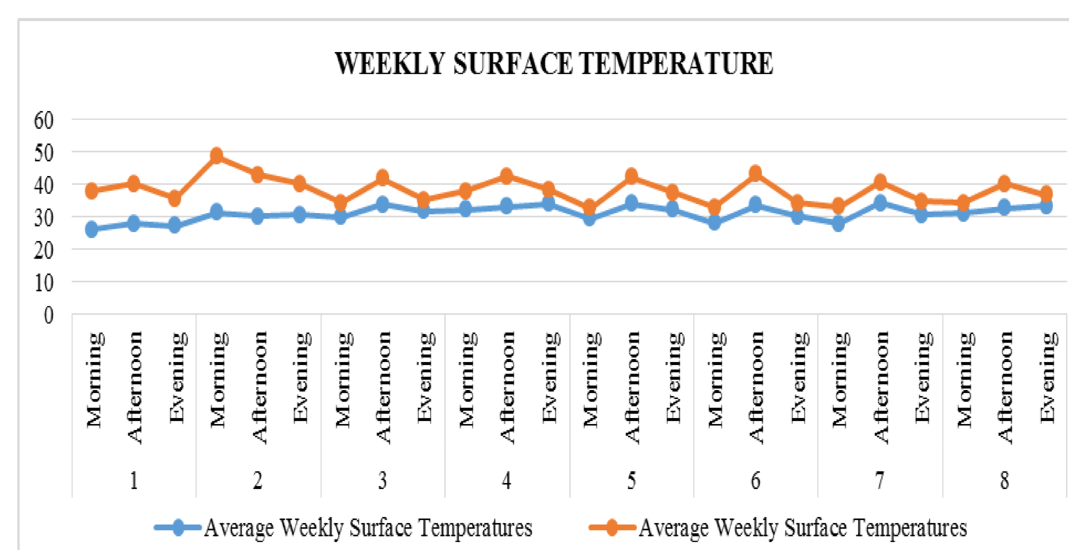

Figure 5: Weekly average temperature for Grassy and Concrete area.

ii) Effect of Land Cover type on temperatures

Concrete absorbed and stored heat, causing temperatures to rise quickly in the morning and remain high even after sunset. Grass-covered areas heated up more slowly because plants provided shade and retained moisture, helping to keep the surroundings cooler. This shows that land cover plays a big role in temperature regulation.

iii) Temperature Differences and the Urban Heat Island Effect

The study confirmed that areas with more concrete had higher temperatures than those with grass and trees. This temperature difference led to the urban heat island (UHI) effect, where cities became significantly hotter than nearby rural areas.

DISCUSSION

Urban areas with extensive hard surfaces, such as concrete, experience higher temperatures than rural surroundings due to the urban heat island (UHI) effect. This occurs because these materials absorb and retain solar heat, leading to elevated temperatures, particularly during the daytime and early evening. A key strategy to mitigate this effect is integrating vegetation into city landscapes. Trees and plants provide cooling through shading, which reduces heat buildup on surfaces, and evapotranspiration, where plants release water vapor to cool the air. These natural processes help lower urban temperatures and improve overall comfort.

However, assessing the impact of urban greenery poses challenges due to variations in shade distribution, weather patterns, human activity, and construction, which can affect temperature measurements. Despite these complexities, research supports the integration of green spaces in urban planning to combat the UHI effect. Expanding vegetation coverage through parks, tree-lined streets, and rooftop gardens can significantly enhance thermal comfort and environmental resilience. As cities continue to grow, sustainable designs prioritizing greenery will be essential in creating healthier and more livable urban environments.

CONCLUSION

The study highlights how land cover influences temperature in Nyali, Mombasa, with concrete surfaces absorbing the most heat while grassy areas remain cooler due to moisture release. Given Nyali's urban nature, the findings emphasize the need for more green spaces to reduce heat and improve comfort. These insights are especially crucial for coastal cities like Mombasa, where rising temperatures impact health, energy use, and the environment. Future research should explore additional factors like humidity and wind, and similar studies can help urban planners worldwide make informed decisions.

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