Flooding vulnerability in informal settlements: Spatial policy implications

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Introduction

- South Africa affected by latest climate change disasters, especially flooding

- Informal settlements mostly affected as they are often located in areas
  - Not suitable for residential development
  - Flood risk areas that are vulnerable to seasonal flooding
  - Health and well-being of informal settlements residents.

Introduction Cont…

- Census 2022 data
  - South Africa experienced a decrease in number of informal dwellings from 2011 to 2022
  - City of Tshwane (COT) an exception among the metros as it had 5.9% increase
- In metro areas
  - Informal dwellings mostly standalone shacks and shacks in backyards
  - Standalone shacks make up informal settlements
- Aim
  - To identify informal settlements that are highly vulnerable to flooding in the City of Tshwane.

Methods

- Data
  - Census 2022 – Stats SA
  - Informal Settlements data - DHS
  - Flood Risk Layer data - SANSA
  - Google Earth Engine time series data (2011-2024)
    I. Global surface water
    II. SRTM - DEM
    III. Landsat 8
- Geospatial analysis
  - Geovisualisation
  - Flood Vulnerability Index.

Flood Vulnerability Index - Flow Model

1. Import and Prepare Data (2011-2024)
Global Surface Water-identify water bodies
SRTM for elevation calculation
Landsat 8 for vegetation and moisture indices.

2. Water Data Processing:
Water Occurrence where water presence is consistent
Calculate distance from permanent water bodies.

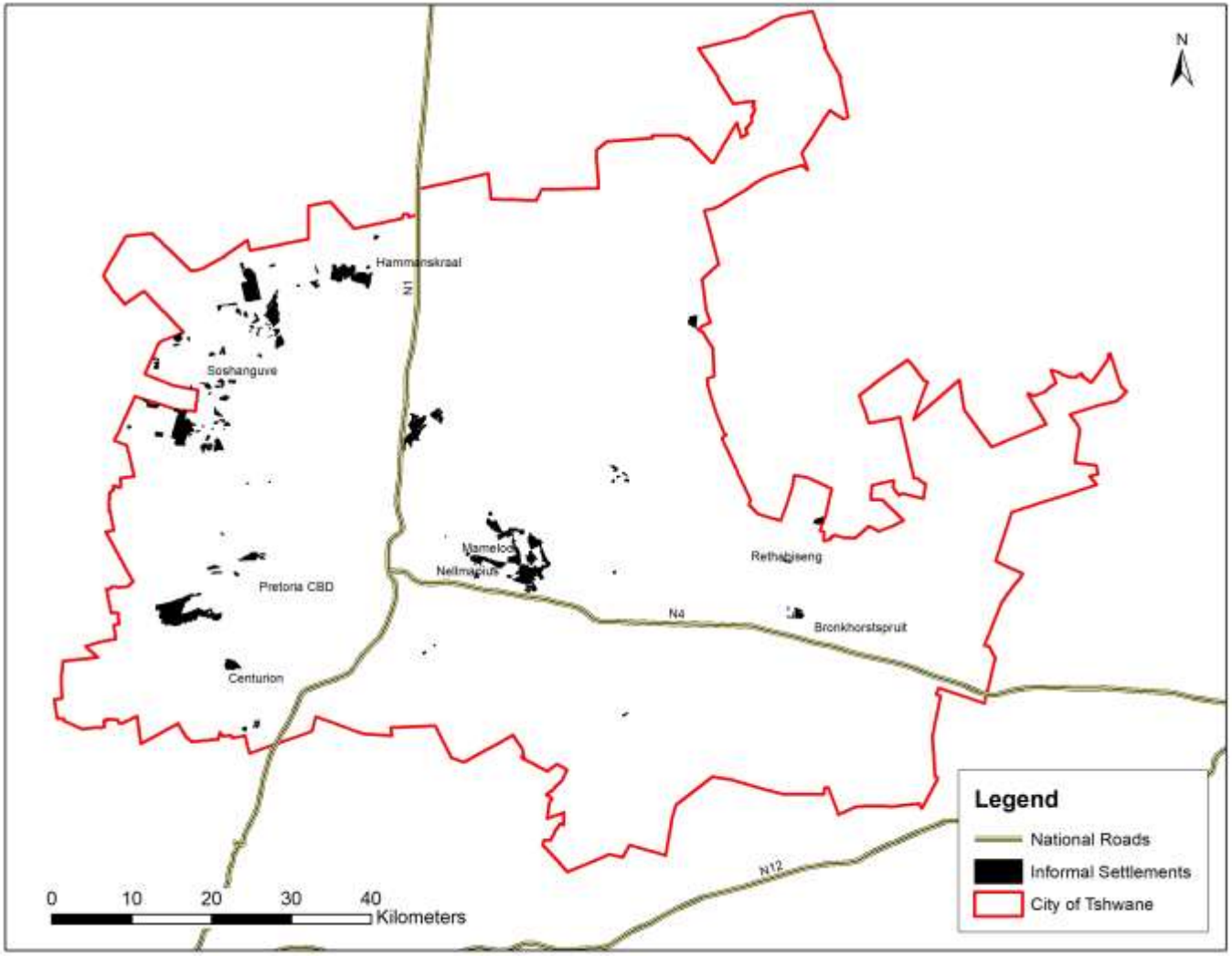
3. Elevation Data Analysis:
Elevation Score: Assigns a score based on elevation, with lower areas being more at risk of flooding.

4.Topographic Position Index (TPI):
Determine how a location's elevation compares to its surroundings
TPI score – low lying areas are more prone to flooding.

5. Vegetation and Water Indices:
NDVI- vegetation density, denser vegetation may reduce risk
Normalized Difference Water Index): Assesses moisture content
Vegetation and Wetness Scores: Scores areas based on NDVI and NDWI, with higher scores indicating higher flood risk.

6. Flood Vulnerability Index:
Combining Scores: Distance, elevation, topographic, vegetation, and wetness.
Final Score: Categorized into risk levels (low to high).

Informal Settlements - COT



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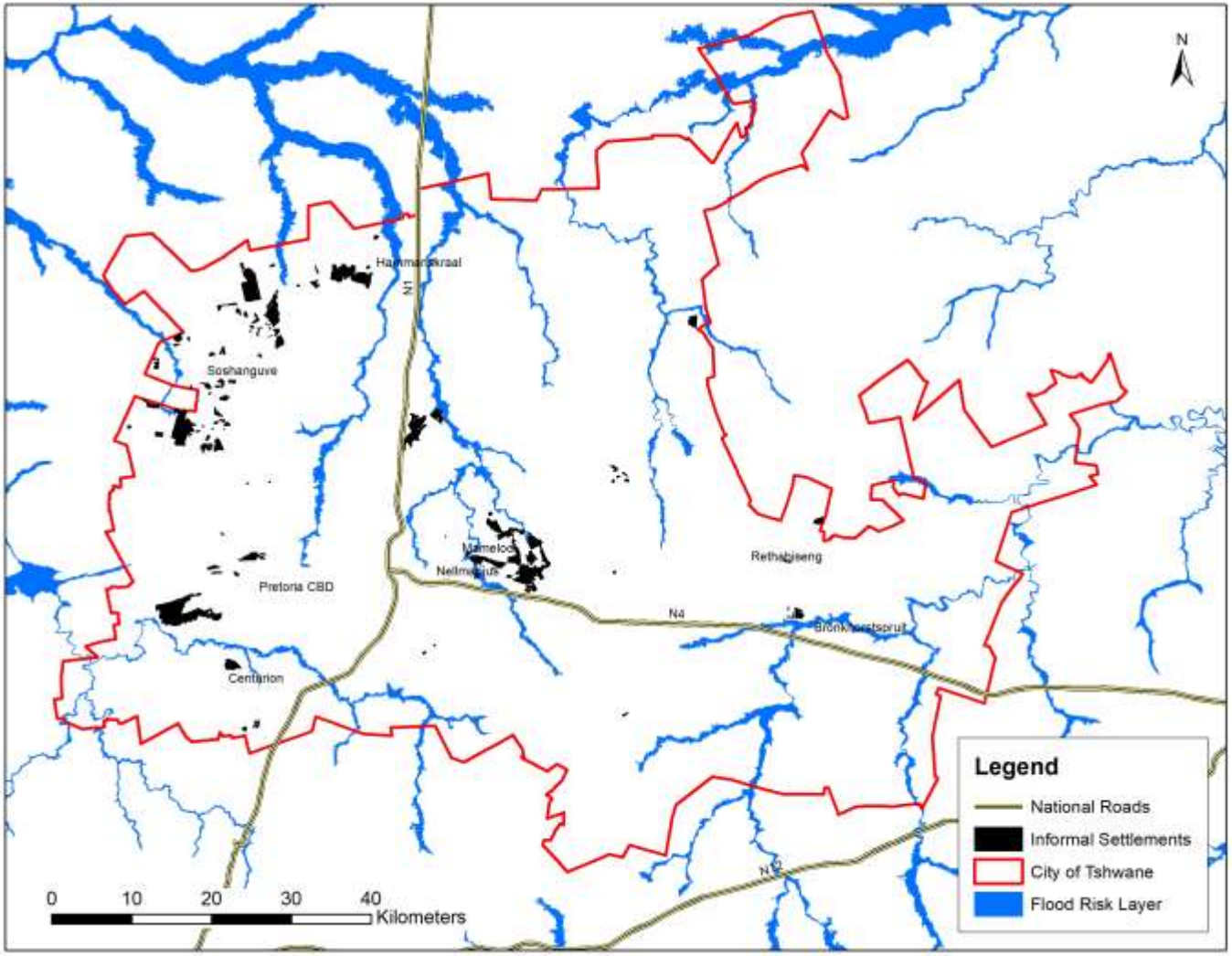
Results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N1
Pretoria CBD
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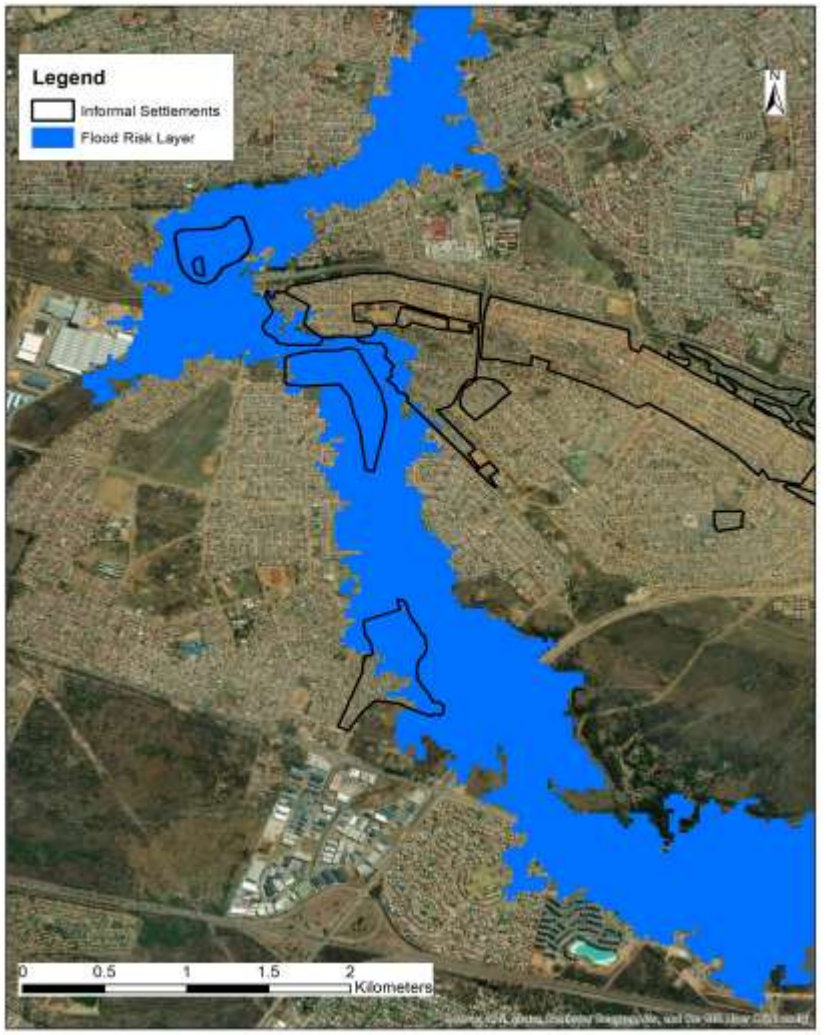
Kilometers
Legend
National Roads
Informal Settlements
City of Tshwane
Flood Risk Layer

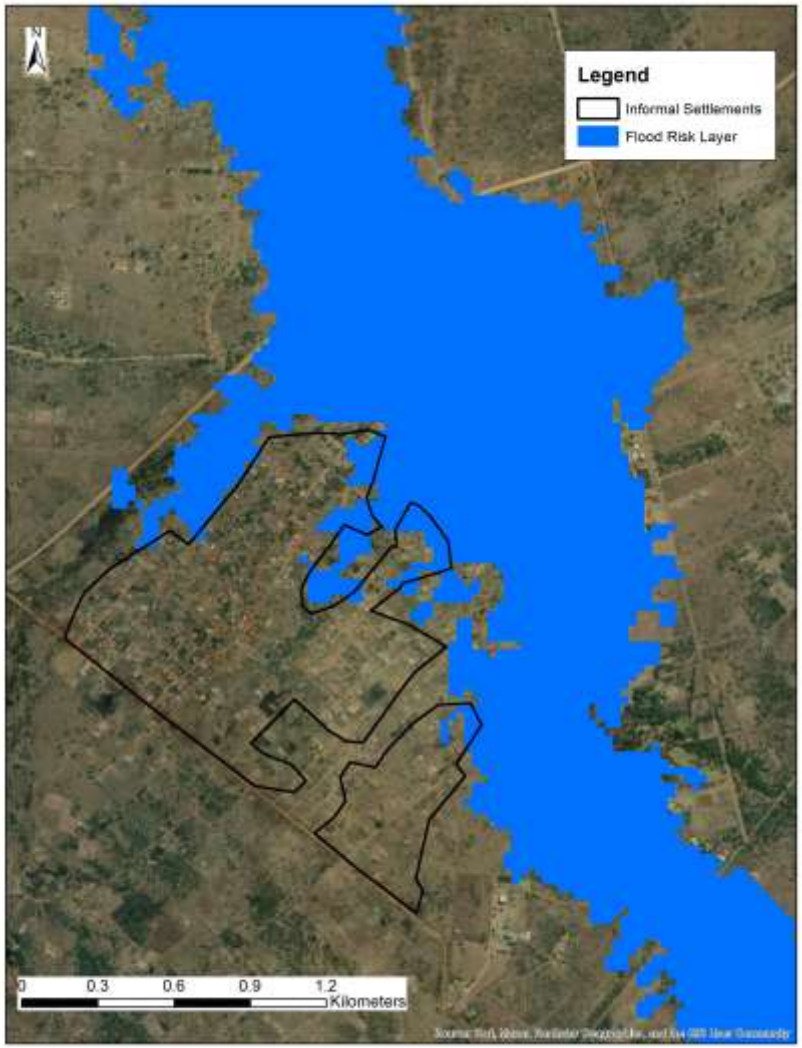
Results Cont…

- Several informal settlements located in flood risk areas in around Mamelodi.
  - Two informal settlements that were completely located with the flood risk area
  - Two other informal settlements had more than half of their area located in the flood risk area
  - i.e. Mavuso informal settlement flooded in December 2022 and December 2023.

Results Cont…



Results Cont…

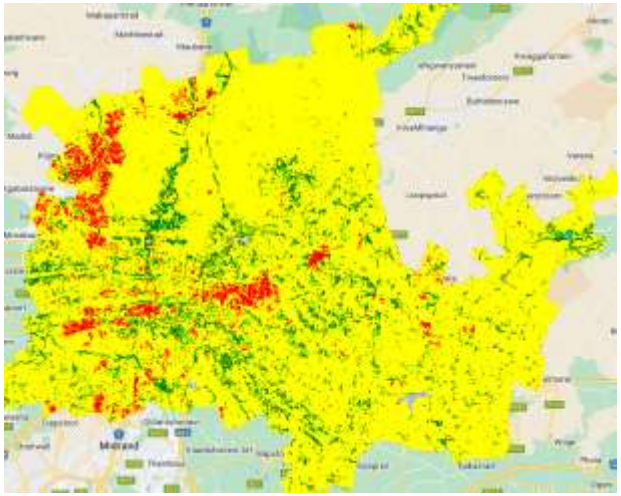


Flood Vulnerability Index - Results

Distance from permanent water

Topography Hazard Score

Vegetation Hazard Score



Wetness hazard Score

Flood Vulnerability Index

Informal settlements around Mamelodi

Discussion

- Informal settlements will be part of COT and other metros for some time in the near future
  - Pull factors
    - Large areas of informality
    - Industrial areas
    - Social amenities
    - Access to services
  - Push factors
    - Irreversible spatial segregation due to Apartheid policies
    - High unemployment rates
    - Climate change
    - Rural-urban migration
    - Immigration.

Discussion Cont…

- Geospatial technologies
  - Risk monitoring
  - Disaster management planning
  - Vulnerability index
  - New informal settlements predictions.

- Location intelligence
  - Spatially targeted interventions and solutions.

Policy Implications

- Proper spatial disaster management planning
- Possible relocation of informal settlements
- Municipal/state land accessible
- Lower rental housing
- Pro-poor SDF.

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