Satellite-based Monitoring of Evapotranspiration, Vegetation and Precipitation Trends of the Shrinking within the Catchment of Lake Kainji, Nigeria

Presented by

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Prince Sultan Bin Abdulaziz International Prize for Water

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INTRODUCTION

- Nigeria has about 14 million hectares of reservoirs, lakes, ponds, and major rivers, which can produce around 980,000 metric tons of fish every year. Lake Kainji is Nigeria's largest man-made lake and the second largest in West Africa after Lake Volta.
- Despite being Nigeria's largest hydroelectric plant, very few studies have been undertaken on environmental assessments of energy output from Kainji Lake. Several reasons, including climate change, increased irrigation, mining extraction, and population growth, have been connected to the lake's decline.
- According to numerous Earth observation data, evapotranspiration losses and reduced vegetation were the main water reduction factors inside the Sudan Savannah ecological zone.

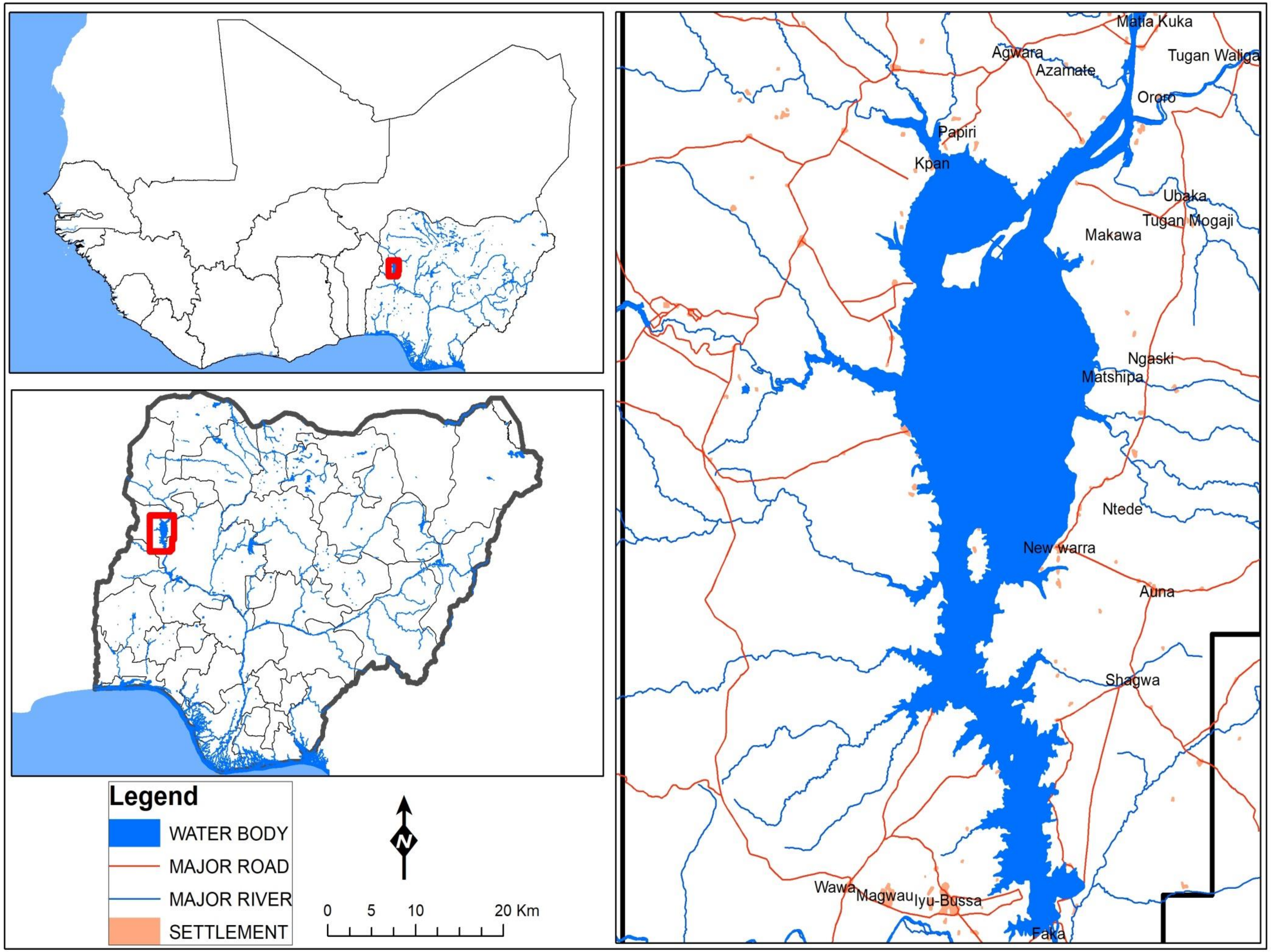


Fig. 1 STUDY AREA MAP SHOWING THE KAINJI LAKE, NIGERIA

Table 1: Data Sources and Description

N	DATA	Required Date(s)	DATA FORMAT	Scale/Resolution	DATA SOURCES	APPLICATIONS
1	Field Survey data	2018-2022 ?	??	??	??	??
2	Topography chart	1950-2000	Digital & Manual	1:50,000	internet	The streams, rivers and lake in the Study Area weill be digitized from it.
3	Landsat	1972-2022	Digital	30m	www.glovis.org	LULC, NDVI, NDWI analysis
4	Sentinel -2 Optical	2015-2022	Digital	10, 20m	www.esa.int	LULC analysis & Vegetation mapping
5	SRTM	2014	Digital	30m	USGS Explorer	DEM, Topography & Stream Network
6	CRU, CHIRPS, ERA5	1970-2021	Numerical	≤ 50 km	www.badc.ac.uk	Climatic trends analysis & Anomaly plots
7	Population	2006	Numerical		FGN Censors	Population density & dynamics

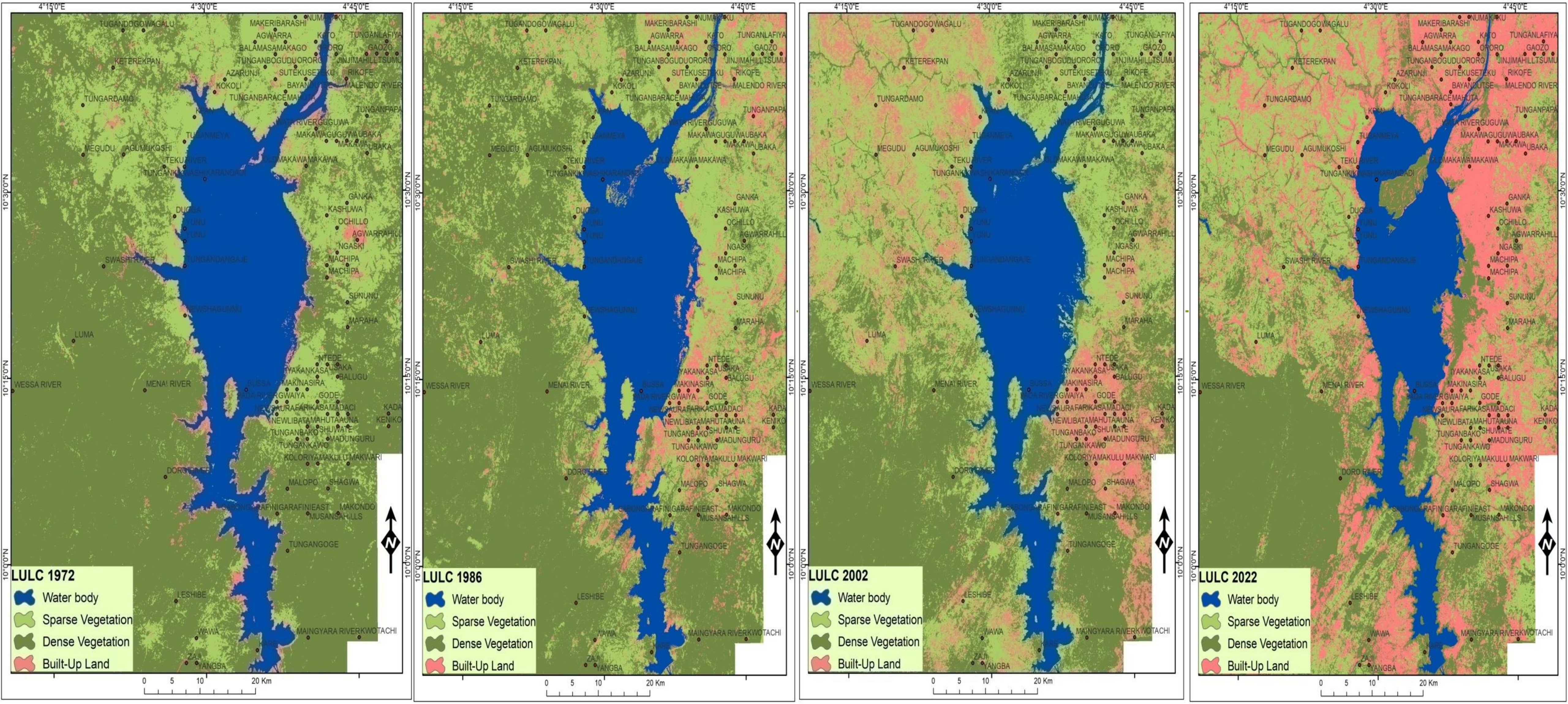


Fig. 2 TIME SERIES ANALYSES OF LULC (1972 - 2022)

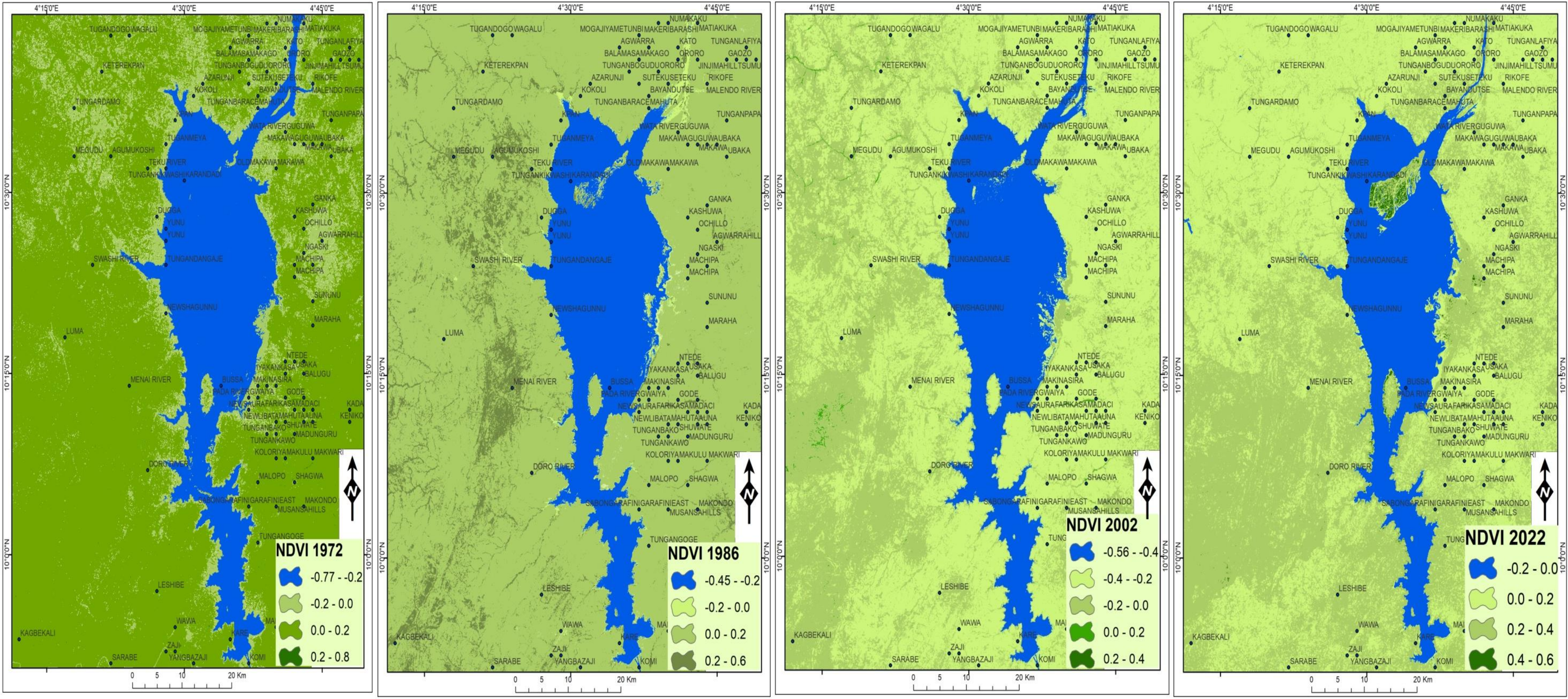


Fig.3 SPATIAL TRENDS OF POTENTIAL EVAPOTRANSPIRATION (1960 - 1980)

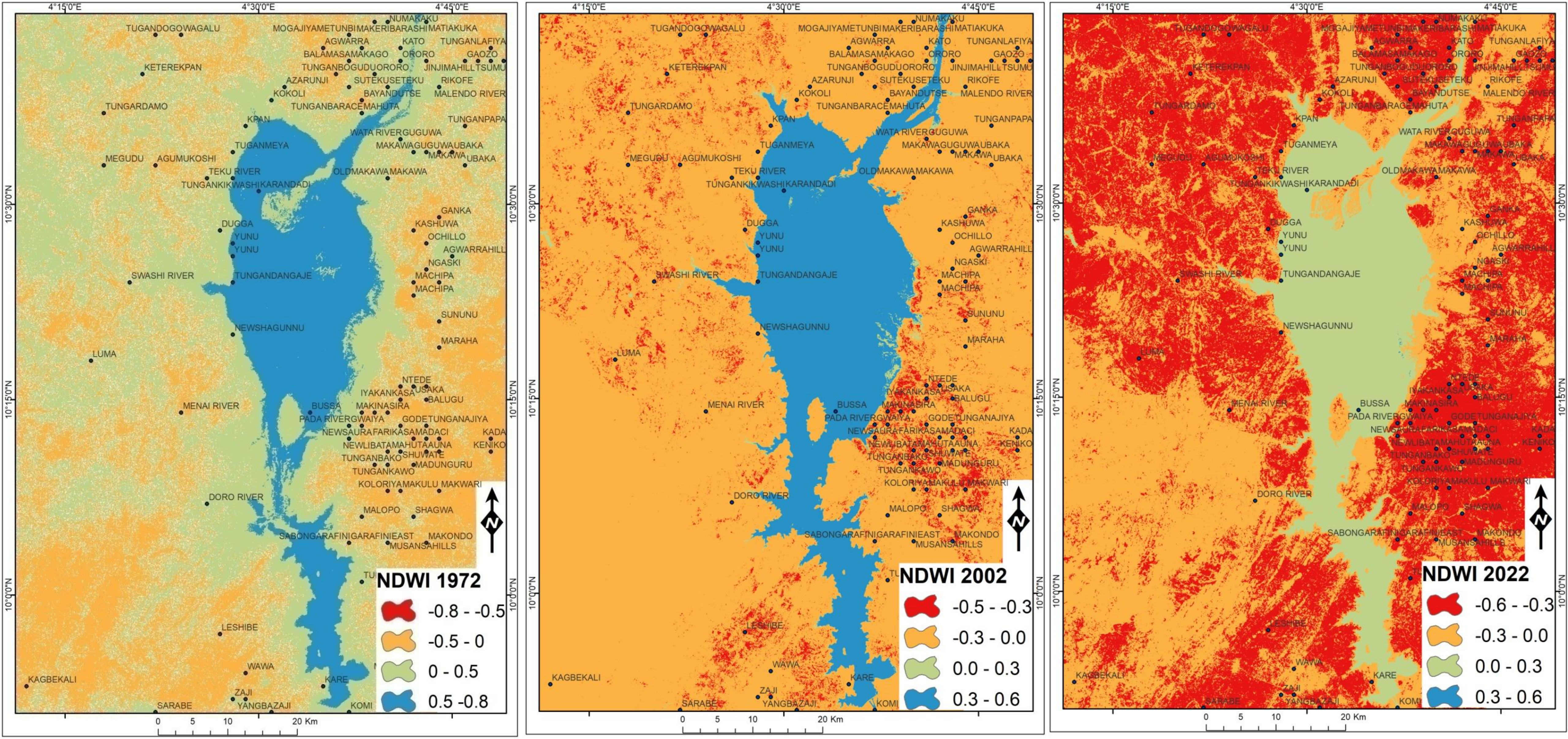
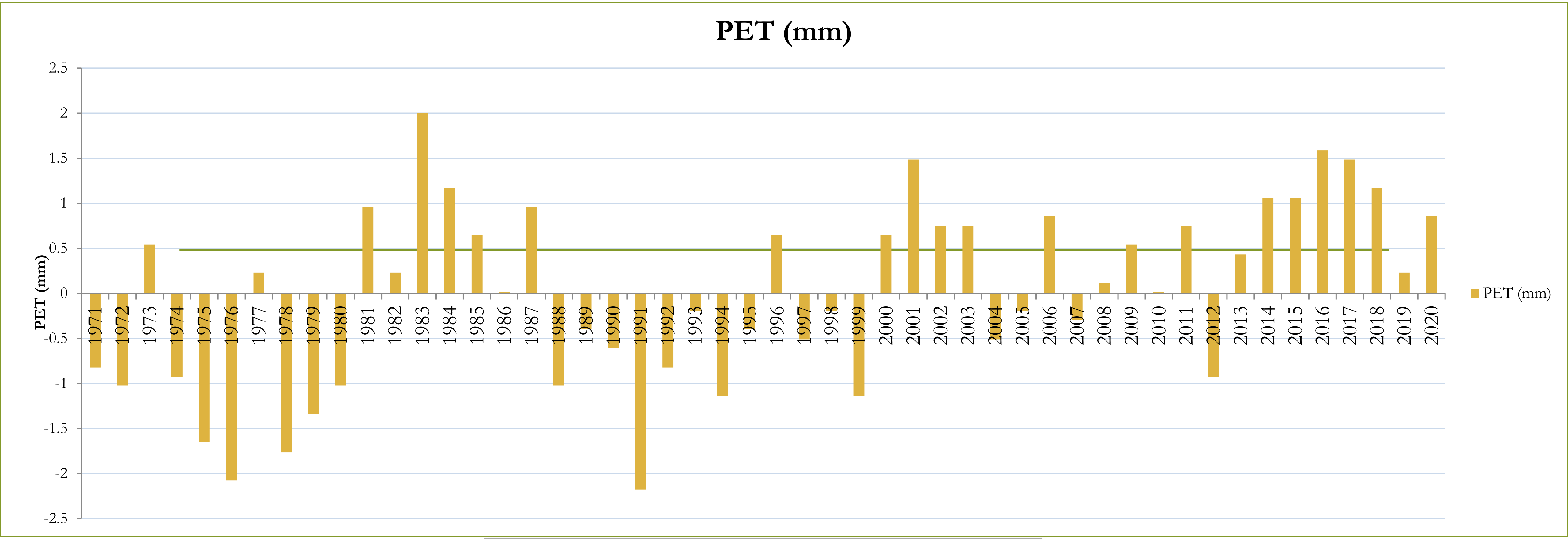


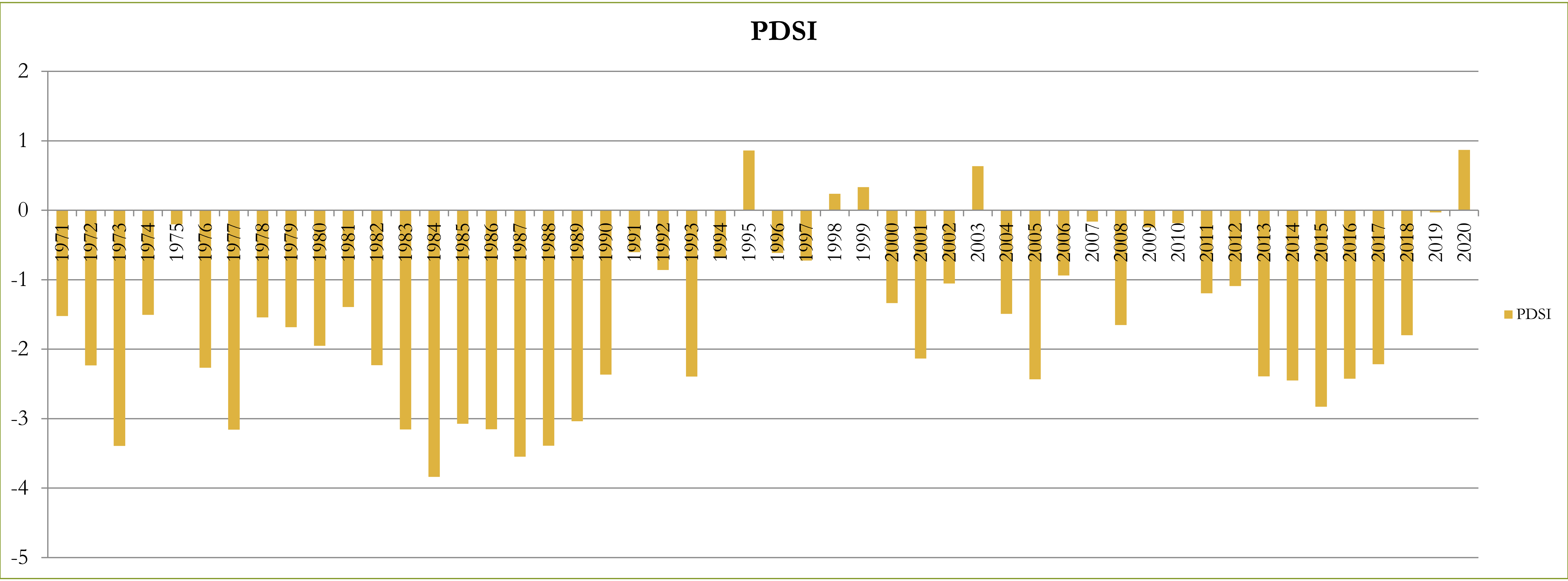
Fig. 4 SPATIAL MAPS OF NDWI (1972 - 2022)

Potential Evapotranspiration (PET)



Drought/Wet severity	SPEI
Extremely wet	≥2.00
Severely wet	1.50–1.99
Moderately wet	1.00–1.49
Near normal	−0.99–0.99
Moderate drought	−1.00–(−1.49)
Severe drought	−1.50–(−1.99)
Extreme drought	≤−2.00

Palmer Drought Severity Index (PDSI)



Index value	*Drought class*
–1.00 to –1.99	Mild drought
–2.00 to –2.99	Moderate drought
–3.00 to –3.99	Severe drought
< –4.00	Extreme drought

CONCLUSION AND RECOMMENDATION

- Space technology with the use of satellite images were shown to be valuable tools for surface water monitoring and management, according to the findings.
- To promote sustainable control and resource management of the drying Lake, mitigation pushes for more cooperation and the strengthening of decision-makers.
- The Kaniji Lake's satellite-based monitoring has improved water resource management, drought effect monitoring, shrinkage extent extraction, and has promising future capabilities.
- Some of the technologies and methods presented are well established, while others hold promise but require **extensive field testing, validation**, and **scaling**.
- Therefore, considering future climate change adaptation plans, further **extensive field experiments** over the Study Area is highly recommended.

THANK YOU