5 SPECTRAL INDICES OF BOLUWADURO LGA, OSUN STATES

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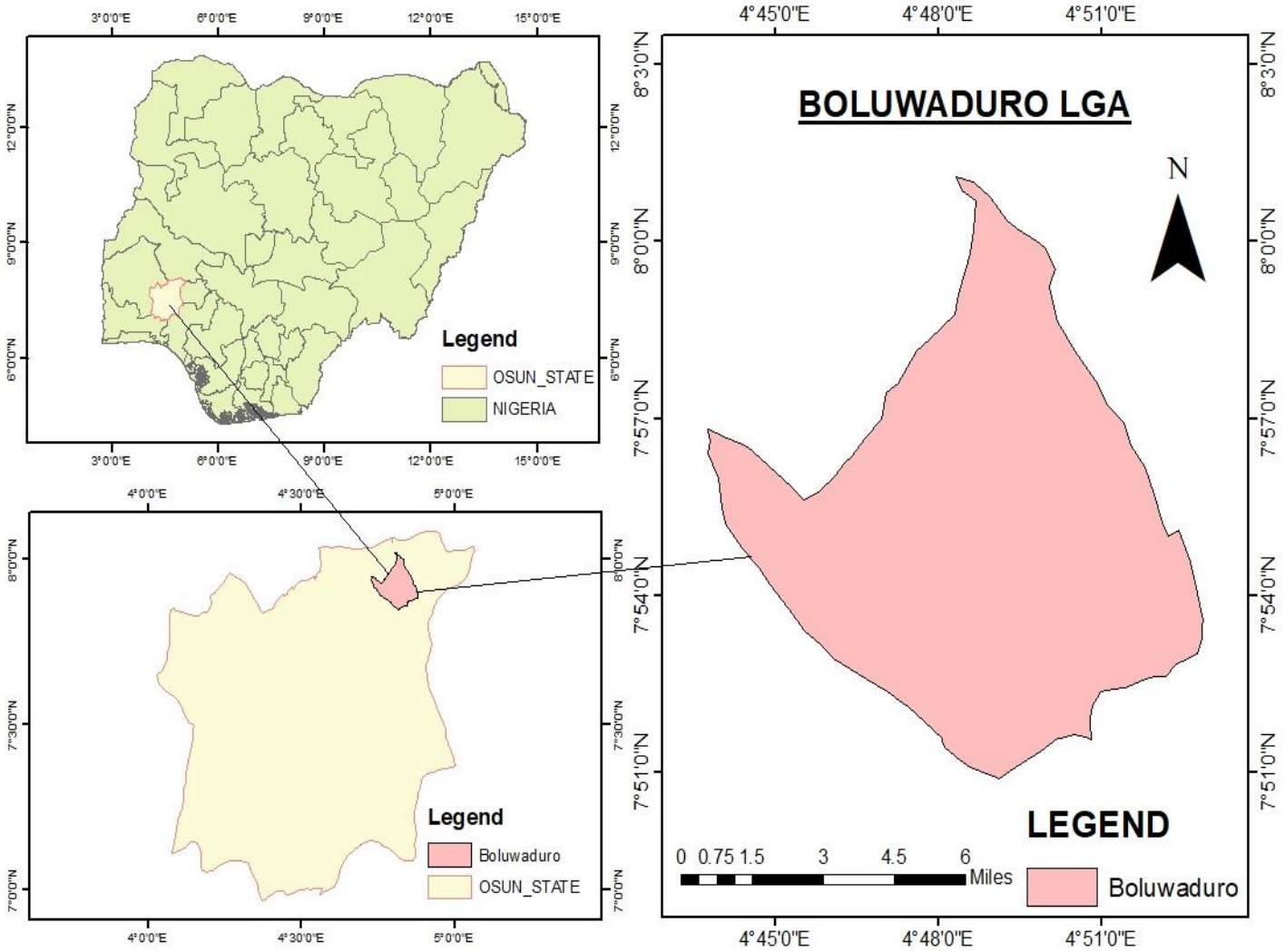
LIST OF SPECTRIAL INDICES

- Normalized Difference Vegetation Index (NDVI)
- Normalized Difference Moisture Index (NDMI)
- Soil Adjusted Vegetation Index (SAVI)
- Normalized Difference Water Index (NDWI)
- Green Normalized Difference Vegetation Index (GNDVI)

STUDY AREA



DATA USED

- Landsat 7 of year 1999
- Landsat 8 of year 2021

Normalized Difference Moisture Index (NDMI)

NDMI detects moisture level in vegetation

NDMI is calculated using the near-infrared (NIR) and the short-wave infrared (SWIR) reflectance

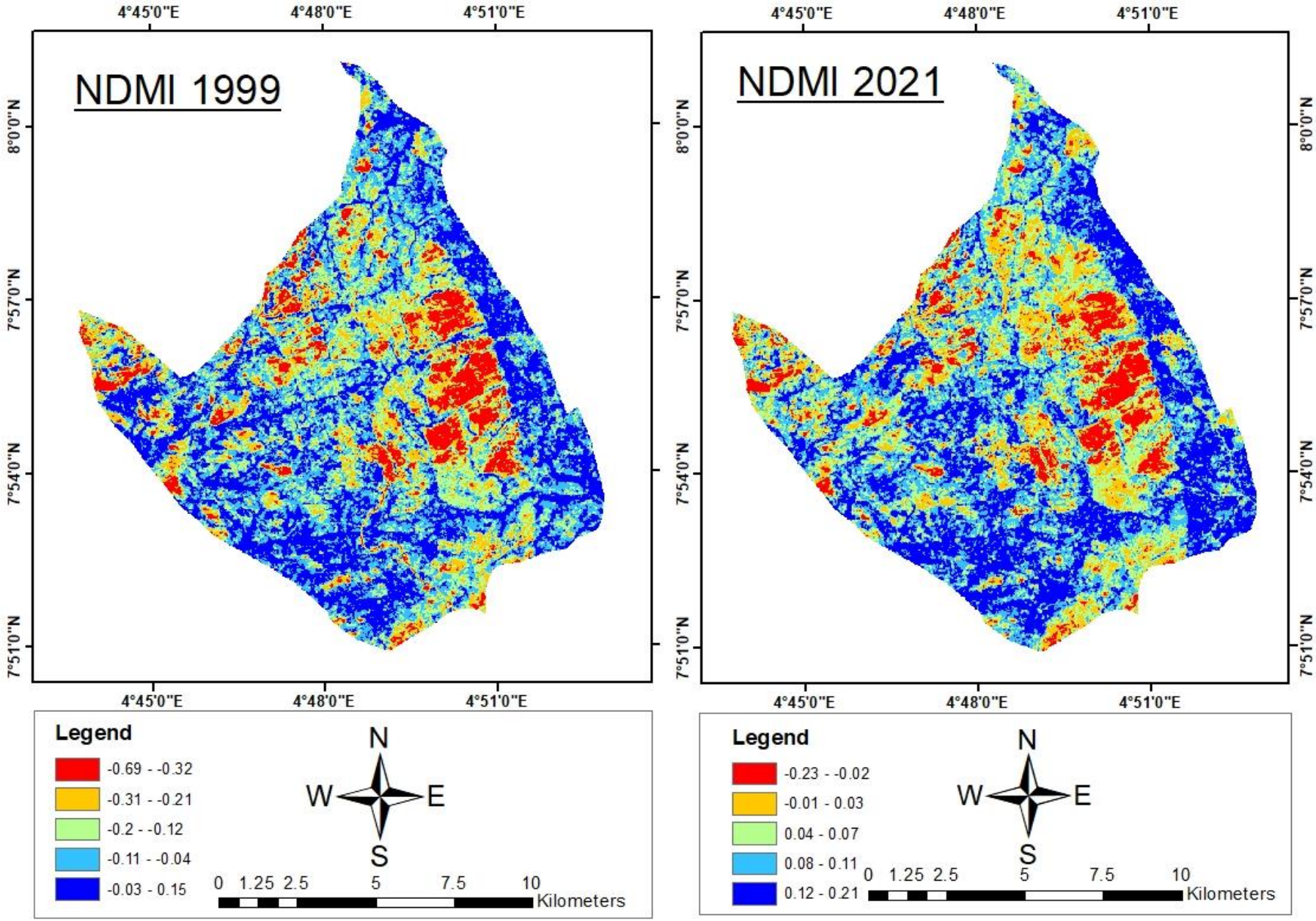
$$NDMI = (NIR - SWIR)/(NIR + SWIR)$$

For year 1999 (Landsat 7)

$$NDMI = (Band4 - Band5)/(Band4 + Band5)$$

For year 2021 (Landsat 8)

$$NDMI = (Band5 - Band6)/(Band5 + Band6)$$


NDMI 1999
NDMI 2021
4°45'0"E
4°48'0"E
4°51'0"E
8°0'0"N
7°57'0"N
7°54'0"N
7°51'0"N
Legend
-0.69 - -0.32
-0.31 - -0.21
-0.2 - -0.12
-0.11 - -0.04
-0.03 - 0.15
-0.23 - -0.02
-0.01 - 0.03
0.04 - 0.07
0.08 - 0.11
0.12 - 0.21
N
W
E
S
0 1.25 2.5 5 7.5 10
Kilometers

Normalized Difference Water Index (NDWI)

NDWI is used to highlight open water features in a satellite image , allowing a water body to stand out against the soil and vegetation.

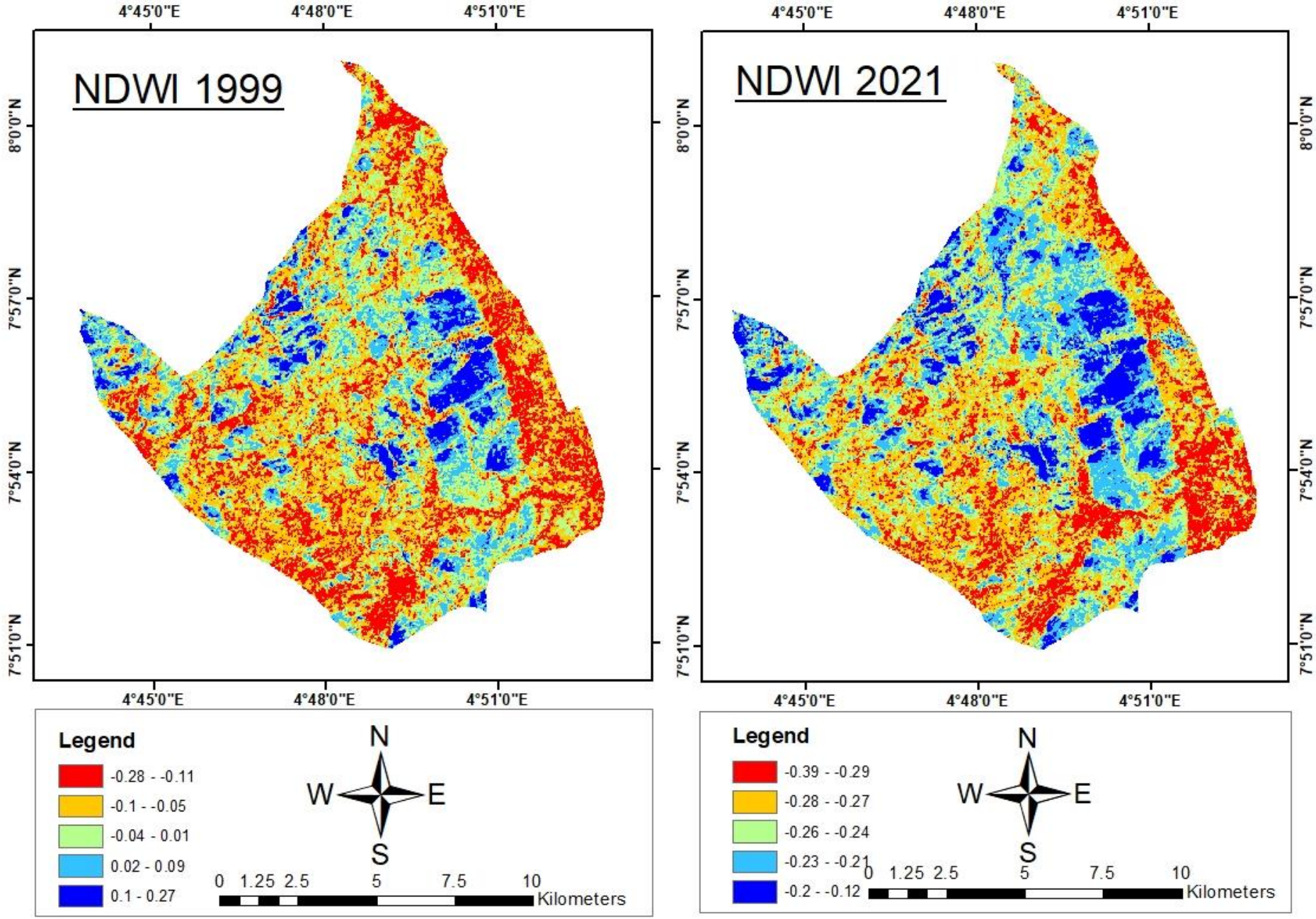
NDWI= (Green – NIR)/(Green + NIR)

For year 1999 (Landsat 7)

NDWI =(Band2 – Band4)/(Band2 + Band4)

For year 2021 (Landsat 8)

NDWI =(Band3 – Band5)/(Band3 + Band5)


NDWI 1999
NDWI 2021
4°45'0"E
4°48'0"E
4°51'0"E
8°0'0"N
7°57'0"N
7°54'0"N
7°51'0"N
Legend
-0.28 - -0.11
-0.1 - -0.05
-0.04 - 0.01
0.02 - 0.09
0.1 - 0.27
-0.39 - -0.29
-0.28 - -0.27
-0.26 - -0.24
-0.23 - -0.21
-0.2 - -0.12
N
W
E
S
0 1.25 2.5 5 7.5 10
Kilometers

Soil Adjusted Vegetation Index (SAVI)

SAVI is used to correct Normalized Difference Vegetation Index (NDVI) for influence of soil brightness in an areas where vegetative cover is low.

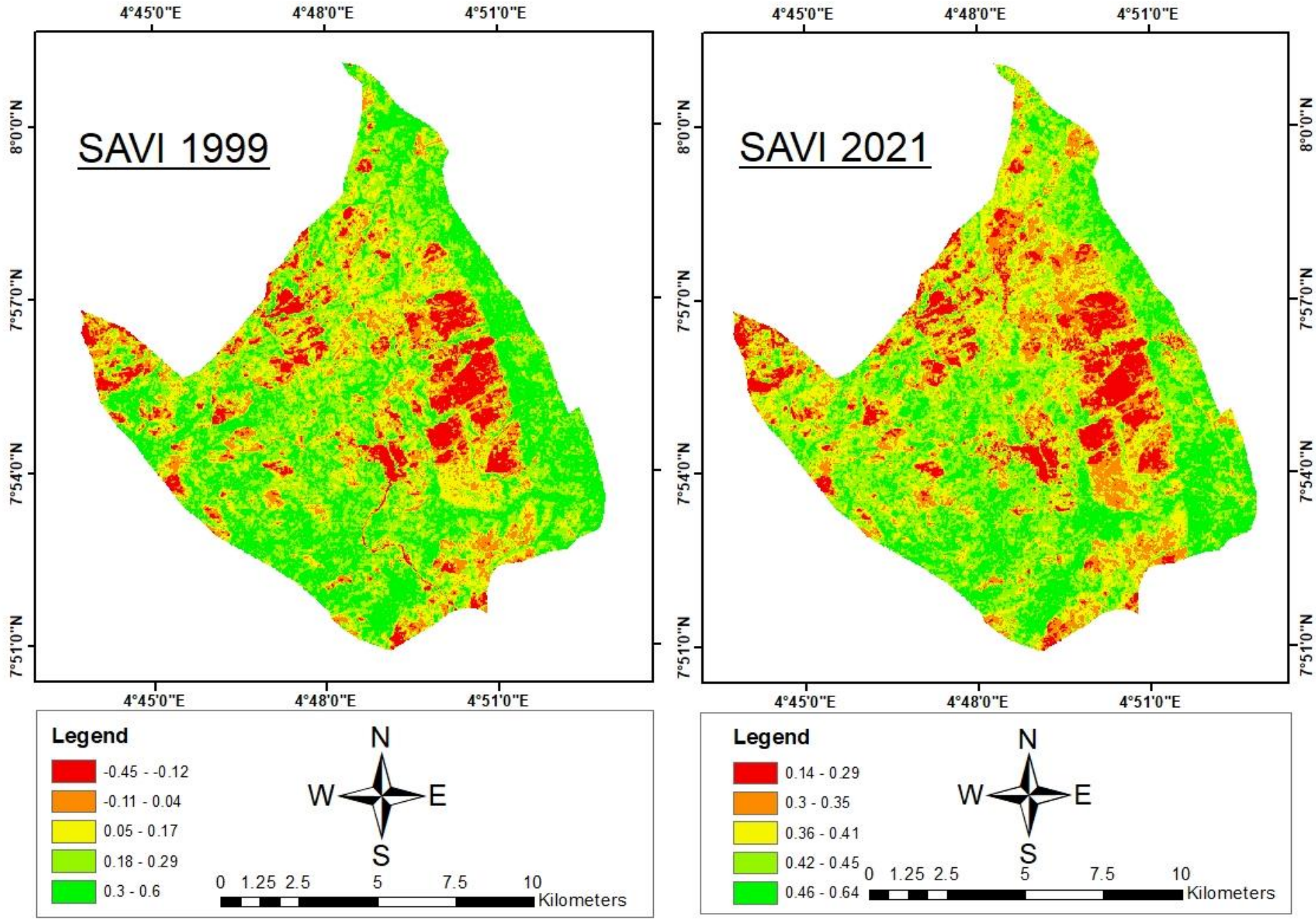
$$SAVI = (NIR - R)/(NIR + R + L))*(1+L)$$

For year 1999 (Landsat 7)

$$SAVI = (Band4 - Band\ 3)/(Band4 + Band3 + 0.5))*(1.5)$$

For year 2021 (Landsat 8)

$$SAVI = (Band5 - Band4)/(Band5 + Band4 + 0.5))*(1.5)$$


SAVI 1999
SAVI 2021
4°45'0"E
4°48'0"E
4°51'0"E
8°0'0"N
7°57'0"N
7°54'0"N
7°51'0"N
Legend
-0.45 - -0.12
-0.11 - 0.04
0.05 - 0.17
0.18 - 0.29
0.3 - 0.6
0.14 - 0.29
0.3 - 0.35
0.36 - 0.41
0.42 - 0.45
0.46 - 0.64
N
W
E
S
0 1.25 2.5 5 7.5 10
Kilometers

Normalized Difference Vegetation Index (NDVI)

The NDVI is calculated by determining the ratio of red and near infrared bands from a remotely sensed image on a per- pixel basis to use as the normalized difference between red and near infrared bands in an image

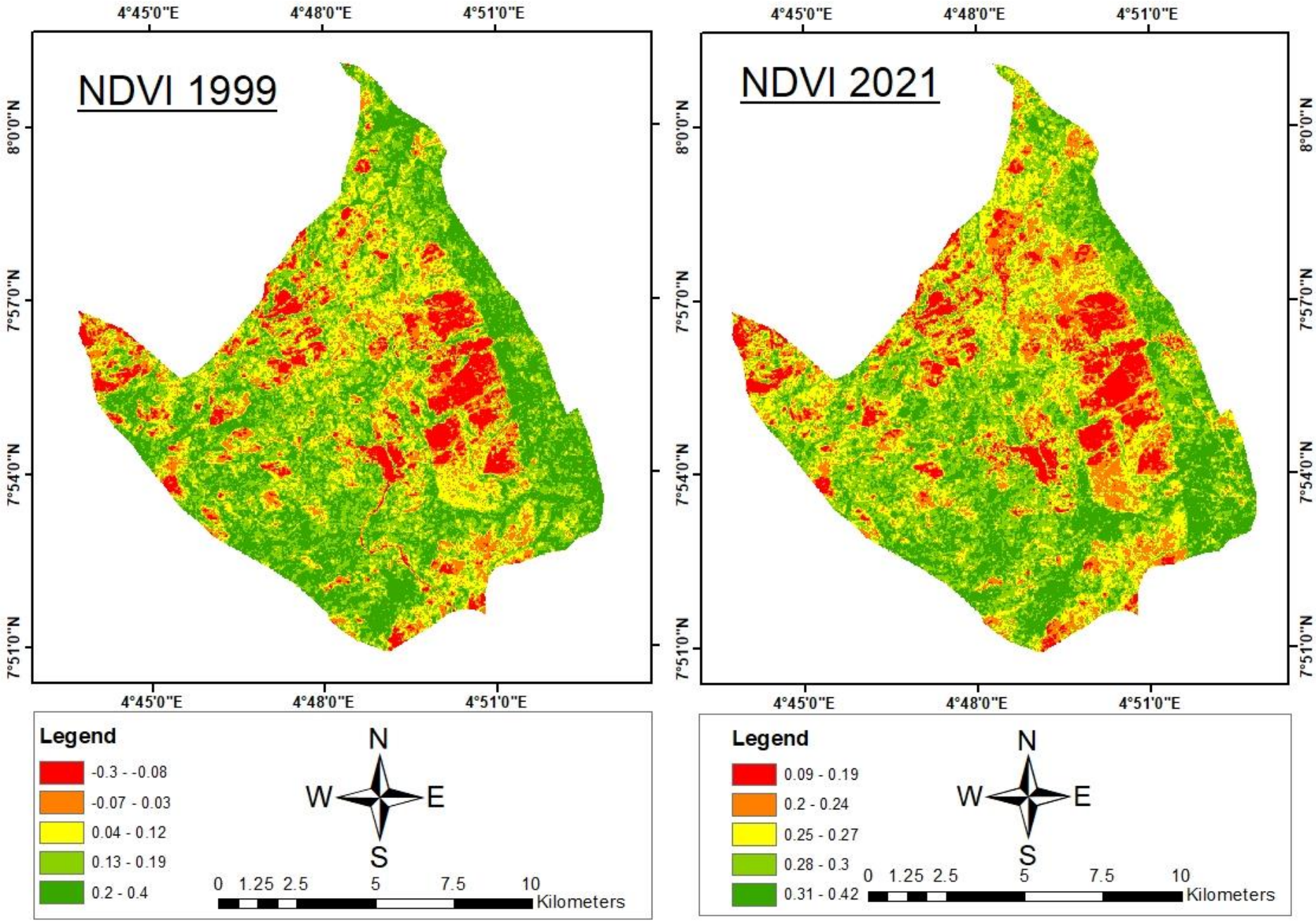
NDVI = NIR – RED/ NIR + RED

For year 1999 (Landsat 7)

NDVI = (Band4 – Band3)/(Band4 + Band3)

For year 2021(Landsat 8)

NDVI = (Band5 – Band4)/(Band5 + Band4)


NDVI 1999
NDVI 2021
4°45'0"E
4°48'0"E
4°51'0"E
8°0'0"N
7°57'0"N
7°54'0"N
7°51'0"N
Legend
-0.3 - -0.08
-0.07 - 0.03
0.04 - 0.12
0.13 - 0.19
0.2 - 0.4
0.09 - 0.19
0.2 - 0.24
0.25 - 0.27
0.28 - 0.3
0.31 - 0.42
N
W
E
S
0 1.25 2.5 5 7.5 10
Kilometers

Green Normalized Difference Vegetation Index (GNDVI)

- Green Normalized Difference Vegetation Index (GNDVI) is a modified version NDVI to be more sensitive to variation of chlorophyll content in the crop.

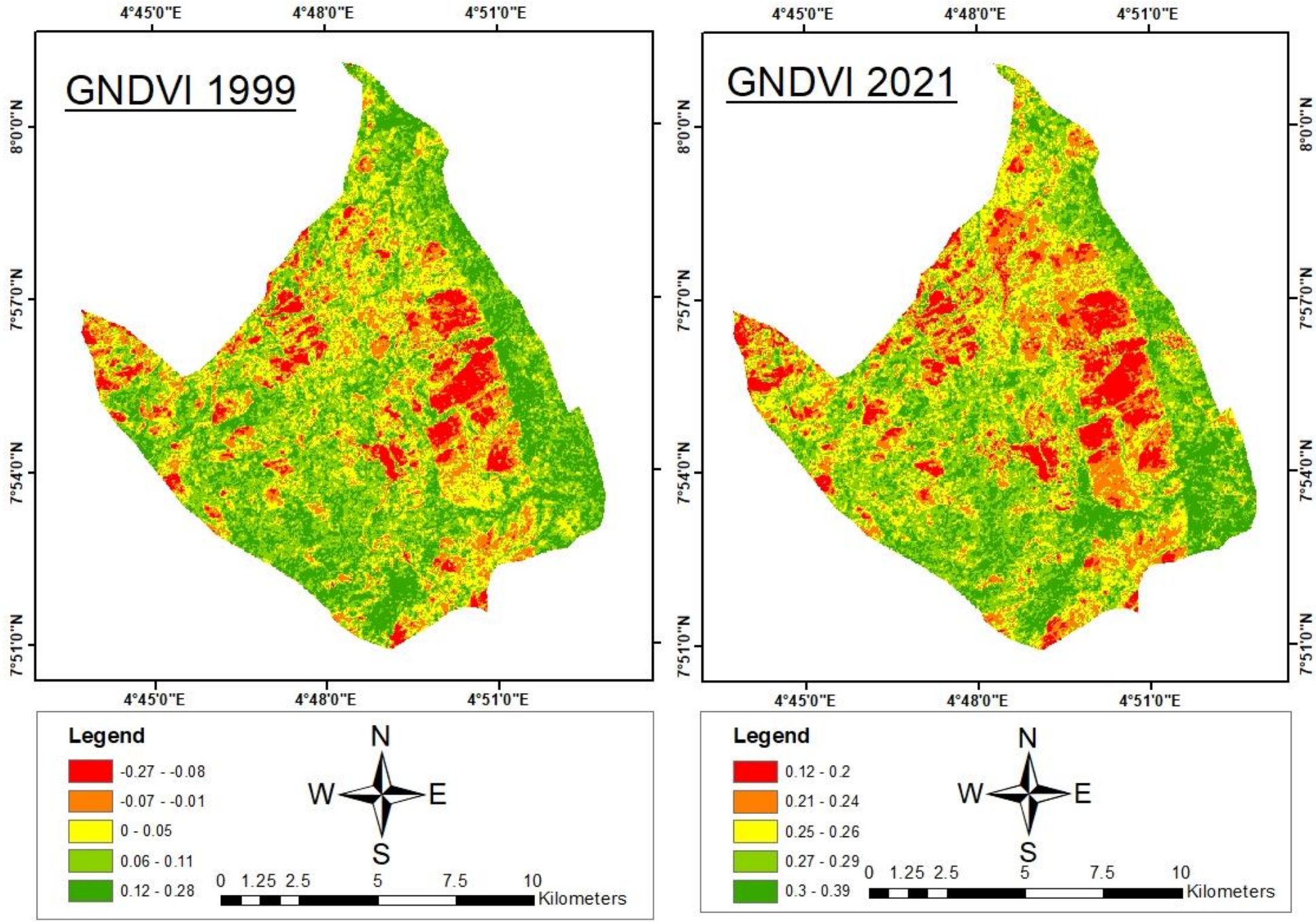
GNDVI = NIR – GREEN/ NIR + RED

For year 1999 (Landsat 7)

GNDVI = (Band4 – Band2)/(Band4 + Band2)

For year 2021(Landsat 8)

NDVI = (Band5 – Band3)/(Band5 + Band3)


GNDVI 1999
GNDVI 2021
4°45'0"E
4°48'0"E
4°51'0"E
8°0'0"N
7°57'0"N
7°54'0"N
7°51'0"N
Legend
-0.27 - -0.08
-0.07 - -0.01
0 - 0.05
0.06 - 0.11
0.12 - 0.28
0.12 - 0.2
0.21 - 0.24
0.25 - 0.26
0.27 - 0.29
0.3 - 0.39
N
W
E
S
0 1.25 2.5 5 7.5 10
Kilometers

LAND SURFACE TEMPERATURE

Land surface temperature (LST) is a critical spatial data layer that provides information about the temperature distribution across a geographic area. GIS allows you to analyze, visualize, and manipulate LST data in conjunction with other geospatial information.

DATA USED

- Landsat 7 of year 1999
- Landsat 8 of year 2021

METHODOLOGY

- Convert the data from digital number to spectral Radiance using the equation below:

For Landsat 7:

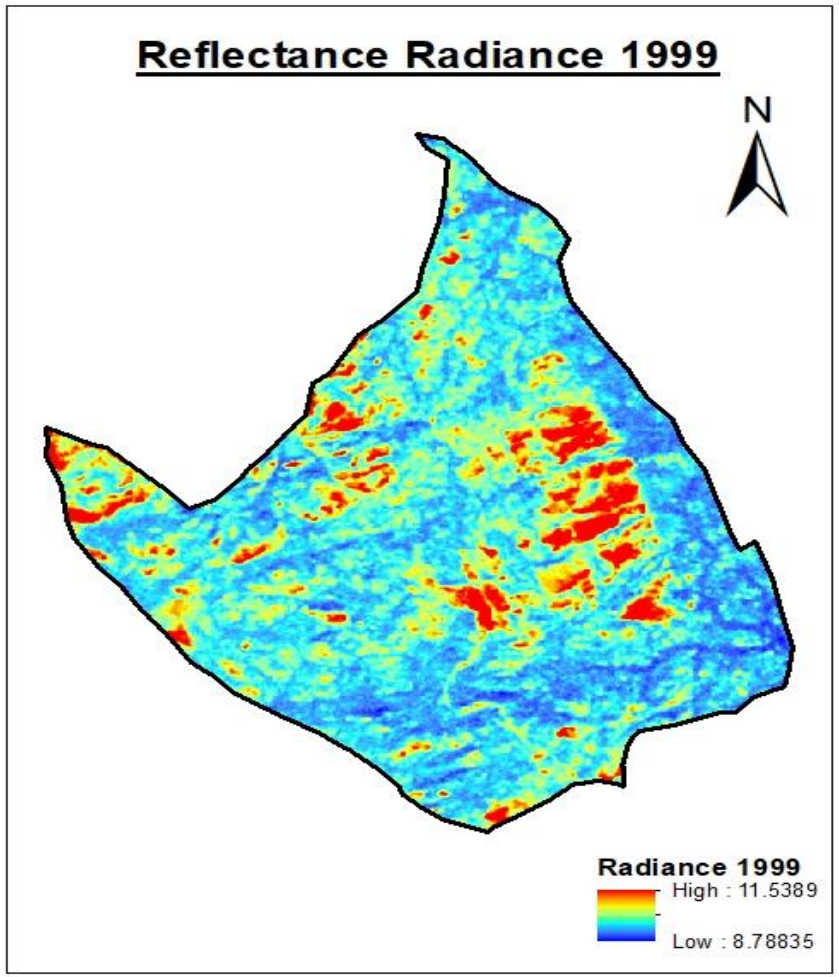
$$L_\lambda = ((LMAX\lambda - LMIN\lambda)/ (Q_{CAL}MAX-Q_{CAL}MIN)) * (Q_{CAL}-Q_{CAL}MIN) + LMIN\lambda$$

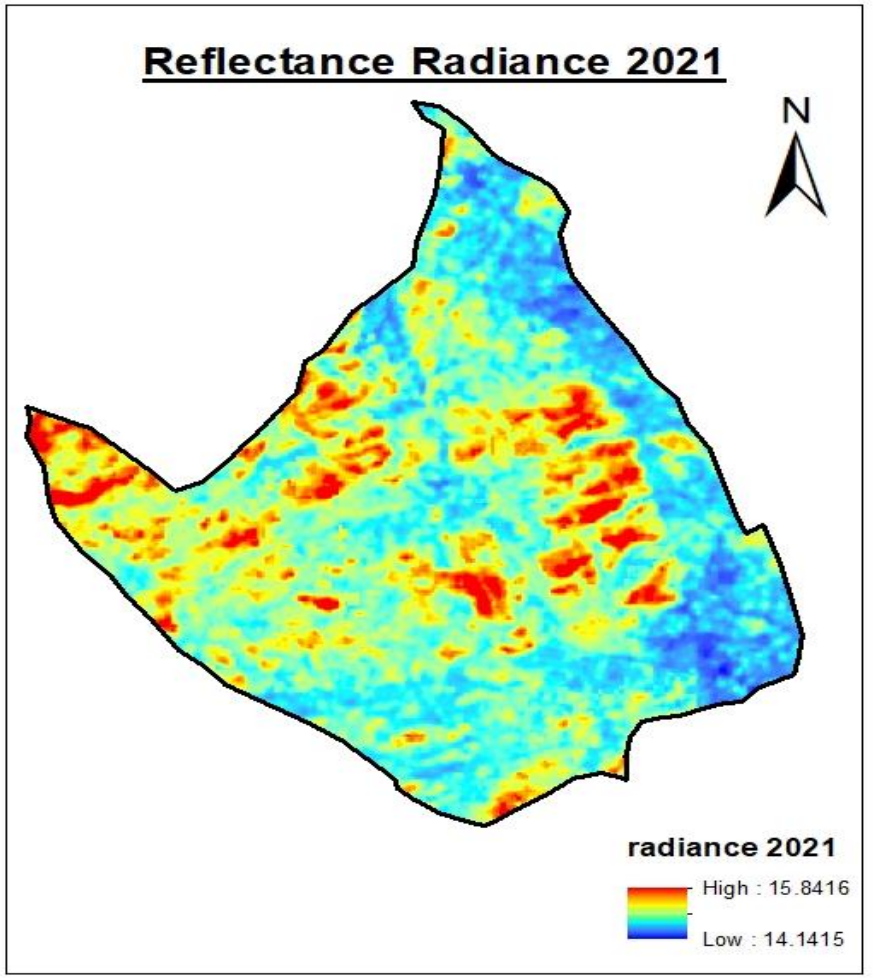
For Landsat 8:

$$L_\lambda = M_L Q_{CAL} + A_L$$

where L_λ = Spectral Radiance at the sensor's aperture in watts

Output


Reflectance Radiance 1999
N
Radiance 1999
High : 11.5389
Low : 8.78835


Reflectance Radiance 2021
N
radiance 2021
High : 15.8416
Low : 14.1415

- CONVERSION TO AT SATELLITE TEMPERATURE BRIGHTNESS

$$T_B = \frac{K2}{In(1+\frac{K1}{L\lambda})} \quad \text{(unit: Kelvin)}$$

Where: T_B = Temperature Brightness

- **DERIVING THE LAND SURFACE EMISSIVITY**

step 1 $P_v = (NDVI - NDVI_{MIN} / NDVI_{MAX} - NDVI_{MIN})^2$

step 2 $\varepsilon = 0.004P_v + 0.986$

Where:

P = proportion of vegetation

ε = Land Surface Emissivity

- CALCULATION OF THE LAND SURFACE TEMPERATURE

Where:

$LST = T/1 + W * (T/P) * In(\varepsilon)$

T = at satellite temperature

W = wavelength of emitted radiance

P = (h*c)/s

h = Planck's constant (6.626×10^{-34} Js)

s = Boltzman's constant (1.38×10^{-23} Jk^{-1})

c = Speed of light (3×10^{8} ms^{-1})

Output of Land Surface Temperature