Land Suitability Mapping of the Most Illegally Harvested Plant Species using a GIS-based Model in Uganda

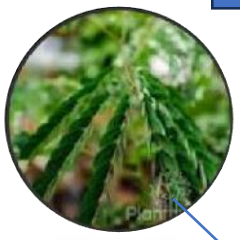
CONSERVATION CONFERENCE

Omwiha

Muhanga

Mugavu

Engote



Albizia gummifera

Mugano

Musisa

WORLD WILDLIFE DAY 3 MARCH

MINISTRY OF TOURISM, WILDLIFE AND ANTIQUITIES
THE REPUBLIC OF UGANDA

Land Suitability Mapping of the Most Illegally Harvested Plant Species using a GIS based Model in Uganda

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First Author

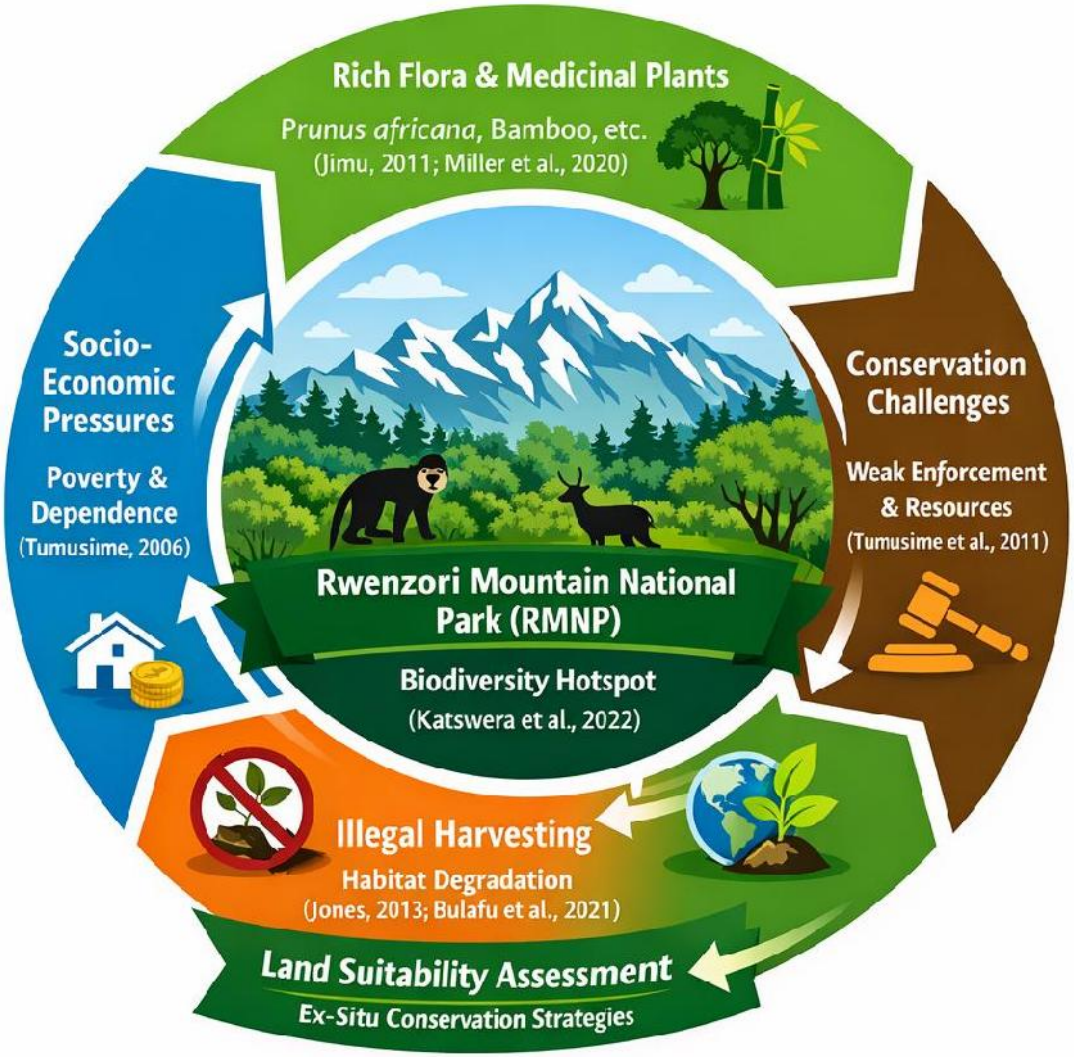
Corresponding Author

World Wildlife Day
CONSERVATION CONFERENCE

Third Author

Fourth Author

INTRODUCTION



PROBLEM STATEMENT

Field-taken photos

SOCIO-ECONOMIC PRESSURES
- Poverty
- Lack of Livelihood Options
- Dependence on Traditional Resource Use

(Tumusiime, 2006)

(Tumusiime, 2006, Muhumuza et al., 2022)

CONSERVATION CHALLENGES
- Weak Enforcement & Resources
- Escalating Biodiversity Loss

(Jones, 2013; Tumusiime et al., 2011; Bulafu et al.;

Illegally Harvested Medicinal Plant Species in the Rwenzori Mountain National Park
(Regional Biodiversity Hotspot in the Albertine Rift, Uganda)

ILLEGAL HARVESTING
- Habitat Degradation
- Declining Plant Populations
- Disrupted Ecosystem Services

(Jones, 2013, Bulafu et al., 2021)

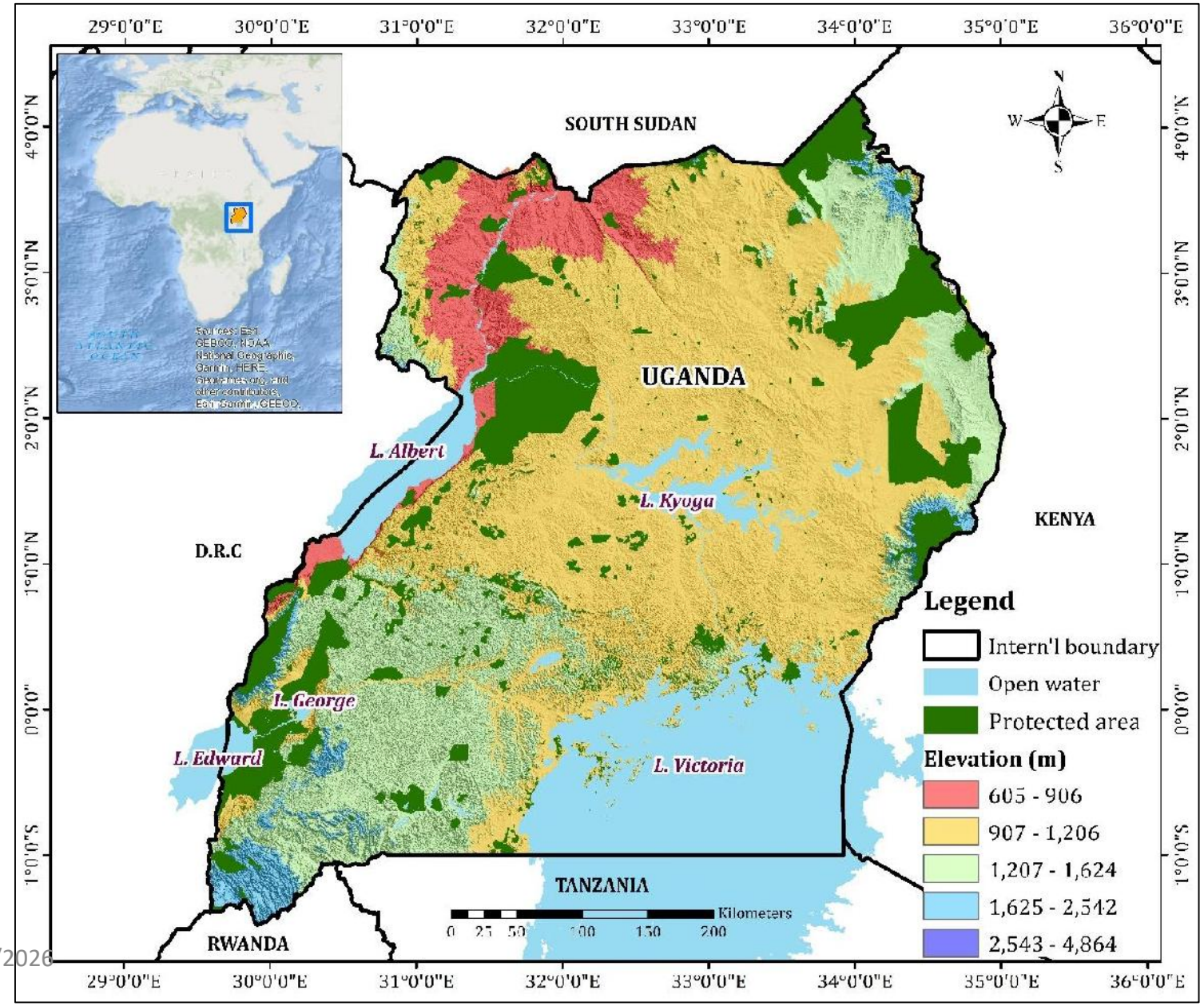
KNOWLEDGE GAP
- No Land Suitability Assessment
- Ex-Situ Conservation Deficiency

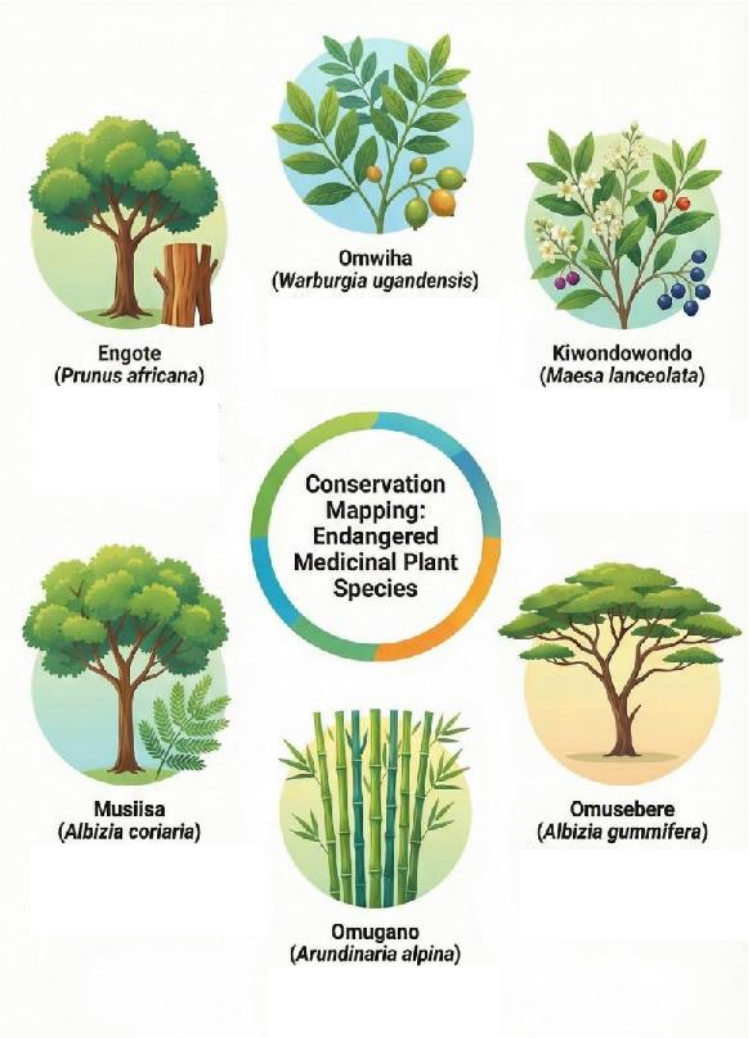
(Jimu, 2011, Miller et al, 2020)

Critical Need:
Assess the spatial suitability of the illegally harvested plant species in Uganda for ex-situ conservation & sustainable cultivation
(Oliver et al., 2015; Brandon, 2014)

METHODOLOGY

STUDY AREA


29°0'0"E
30°0'0"E
31°0'0"E
32°0'0"E
33°0'0"E
34°0'0"E
35°0'0"E
36°0'0"E
4°0'0"N
3°0'0"N
2°0'0"N
1°0'0"N
0°0'0"
1°0'0"S
SOUTH SUDAN
UGANDA
KENYA
D.R.C
TANZANIA
RWANDA
L. Albert
L. Kyoga
L. George
L. Edward
L. Victoria
N
W
E
S
Legend
Intern'l boundary
Open water
Protected area
Elevation (m)
605 - 906
907 - 1,206
1,207 - 1,624
1,625 - 2,542
2,543 - 4,864
Kilometers
0 25 50 100 150 200



Criterion of plant selection

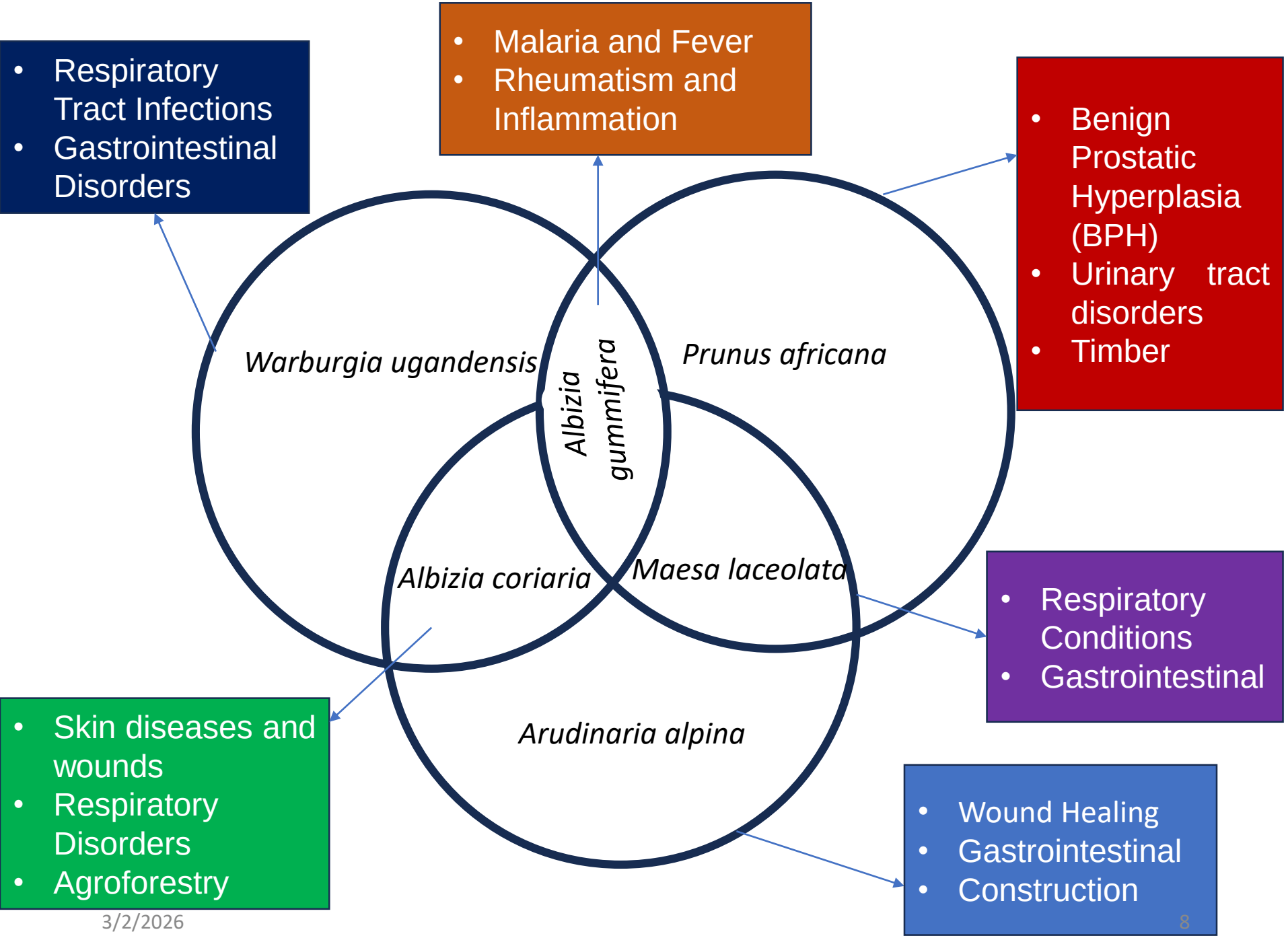
Ethnobotanical survey in RMNP

- General Illegally Harvested Plants
  - Omuhanga (Senna occidentalis)
  - Ekinyamuriro (Crassocephalum montuosum)
  - Omukohwa (Crassocephalum multicorymbosum)
  - Omukoku (Momordica foetida)
  - Omunimba (Tetradenia riparia)
  - Omukaka (Bersama abyssinica)
  - Enderema (Baselia alba)
  - Omurondo (Mondia whitei)
  - Omukole (Dombeya goetzenii)
  - Omutoma (Ficus natalensis)
  - Akatembatembe (Oxalis latifolia)
  - Omusenene (Podocarpus usambarensis)
- Illegal Harvesting of Selected Plant Species
- Most Illegally Harvested Species
  - Engote (Prunus africana) Medicinal & Timber
  - Omwiha (Warburgia ugandensis) Medicinal & Poles
  - Kiwondowondo (Maesa lanceolata) Medicinal & Hedge
  - Musiisa (Albizia coriaria) Shade & Timber
  - Omugano (Arundinaria alpina) Construction & Crafts
  - Omusebere (Albizia gummifera) Shade & Medicine

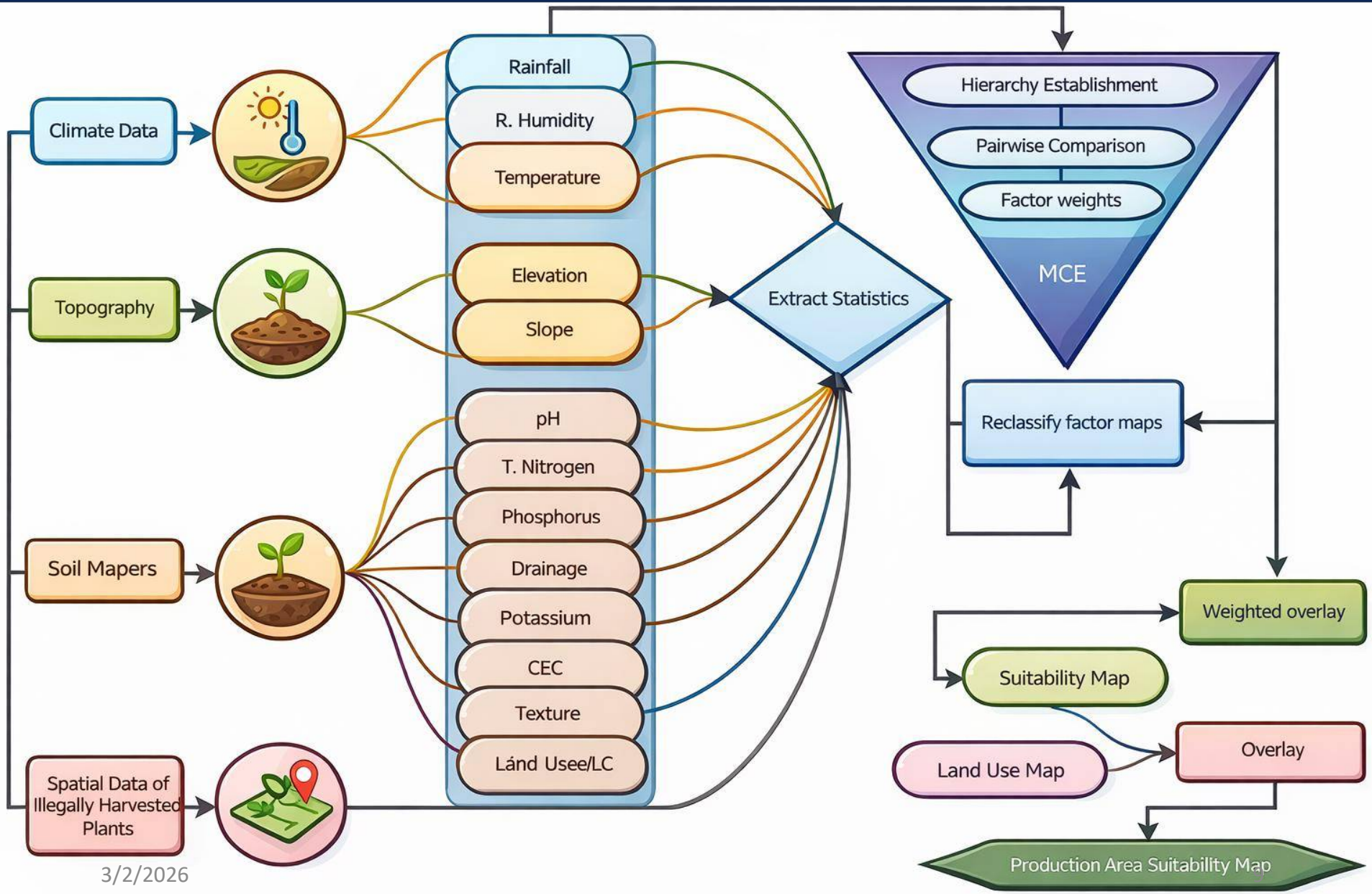
Literature review

(Tolo et al., 2023)

(Nuwagira, Yasin, & Ikiriza, 2022)

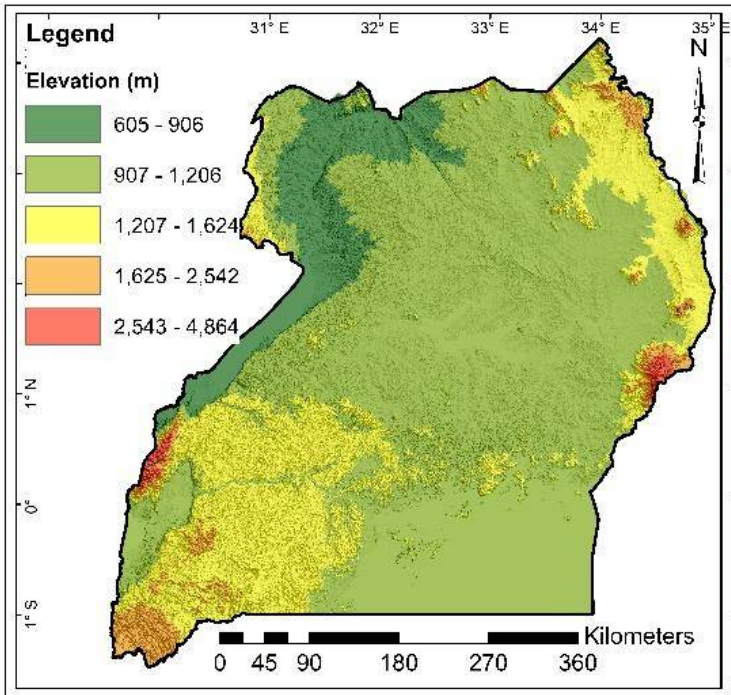

• Respiratory Tract Infections
• Gastrointestinal Disorders
• Malaria and Fever
• Rheumatism and Inflammation
• Benign Prostatic Hyperplasia (BPH)
• Urinary tract disorders
• Timber
Warburgia ugandensis
Albizia gummifera
Prunus africana
Albizia coriaria
Maesa laceolata
Arudinaria alpina
• Respiratory Conditions
• Gastrointestinal
• Skin diseases and wounds
• Respiratory Disorders
• Agroforestry
• Wound Healing
• Gastrointestinal
• Construction

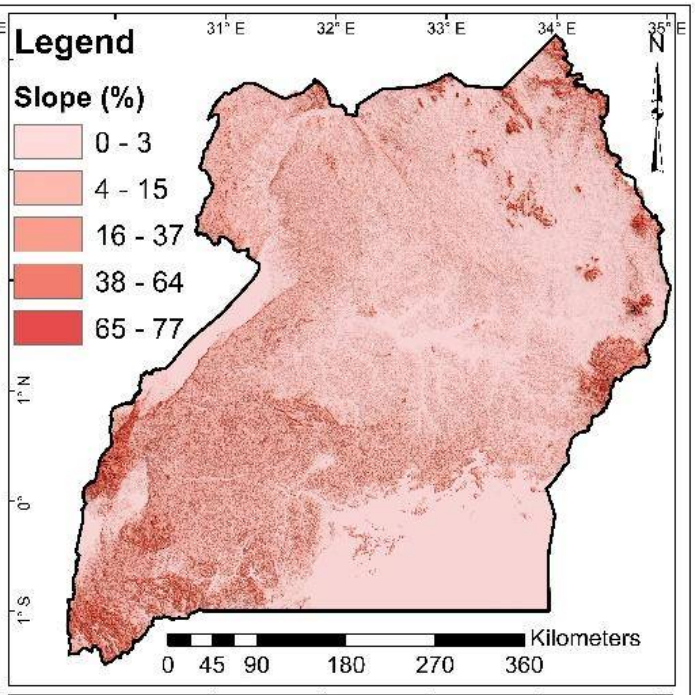
GIS-BASED LAND SUITABILITY MODELLING



MODEL VARIABLE MAPS

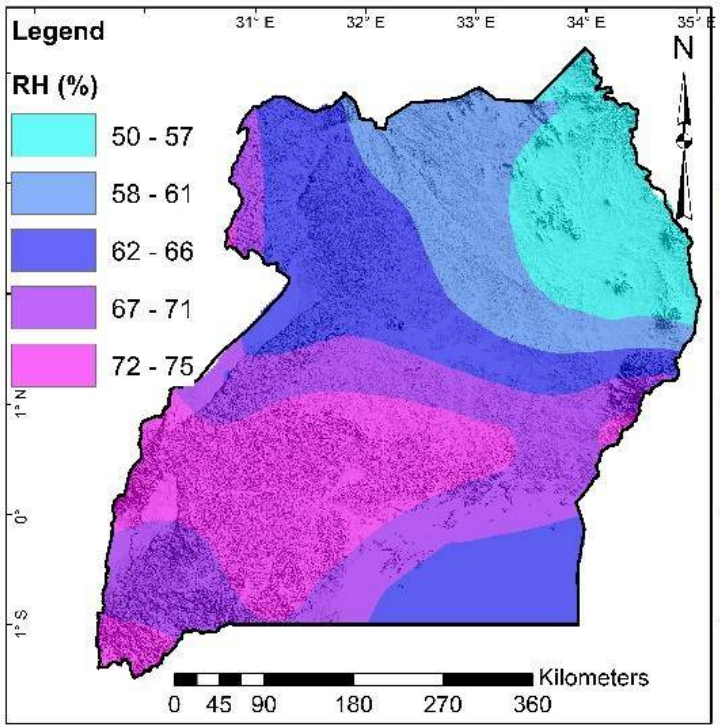
Elevation

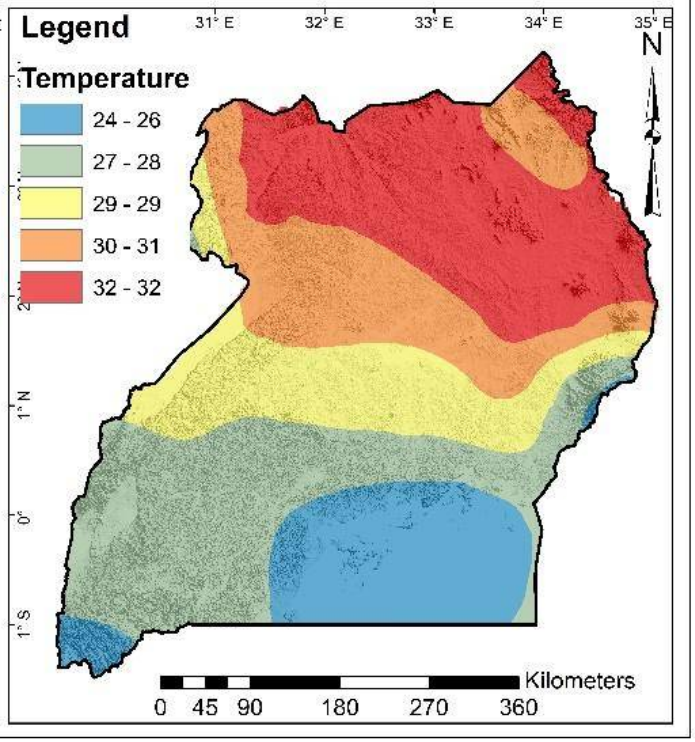




Slope

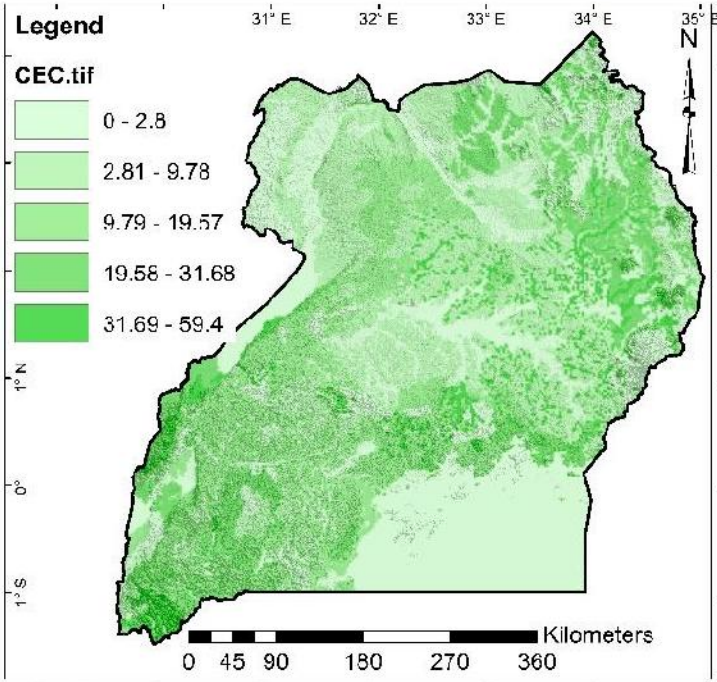
RH



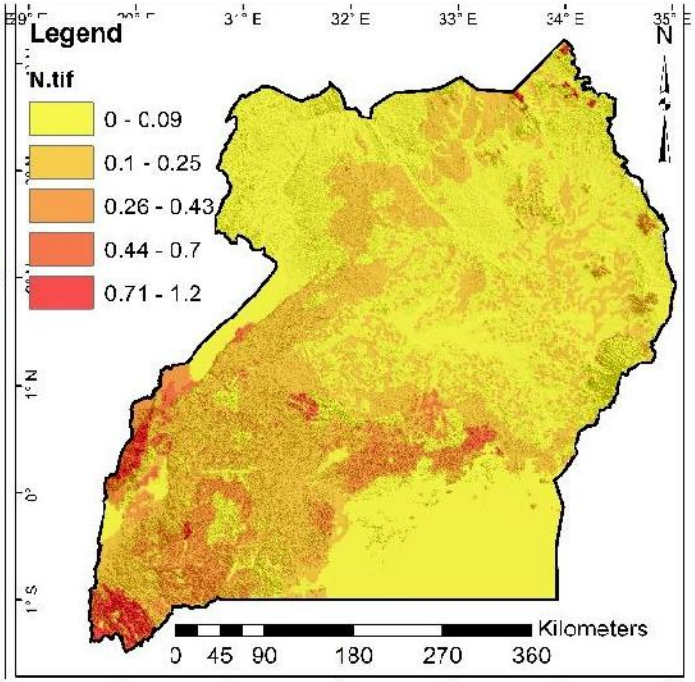


Temp

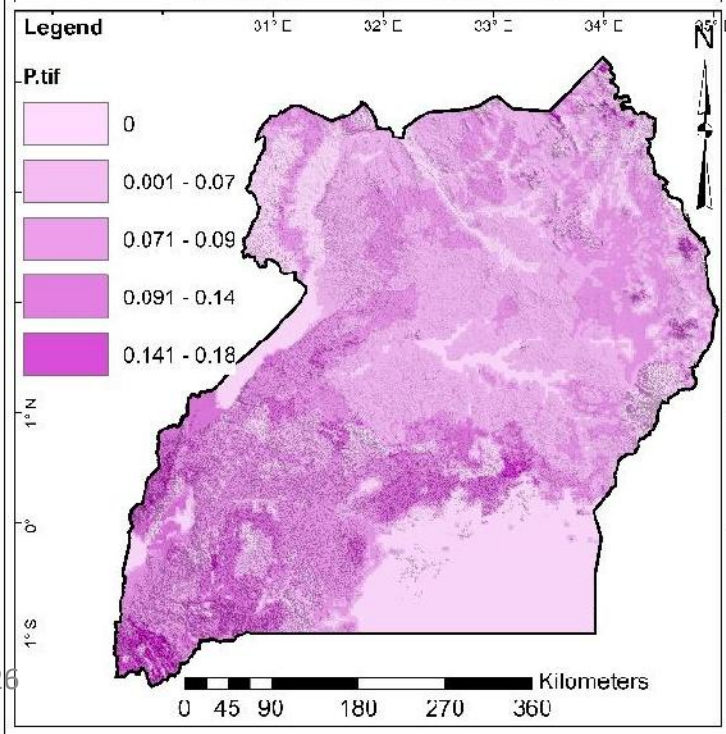
CEC



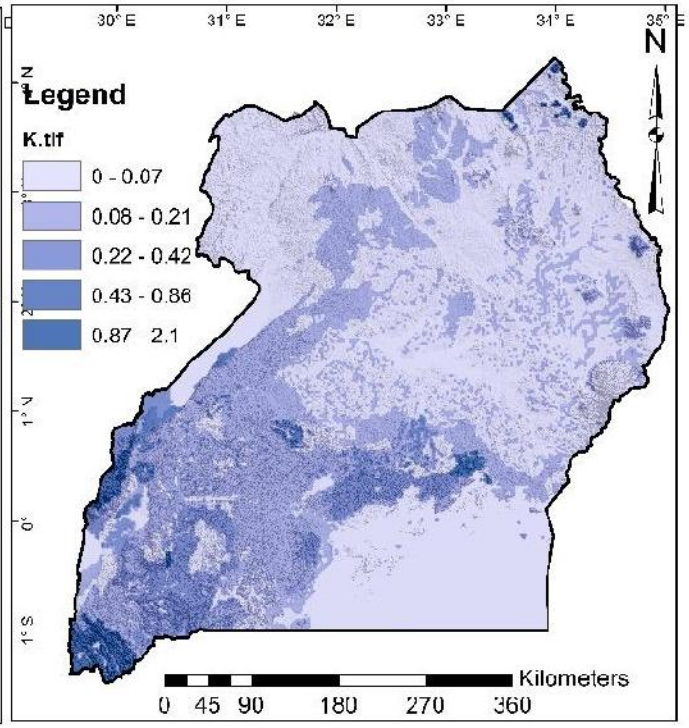
Nitrogen



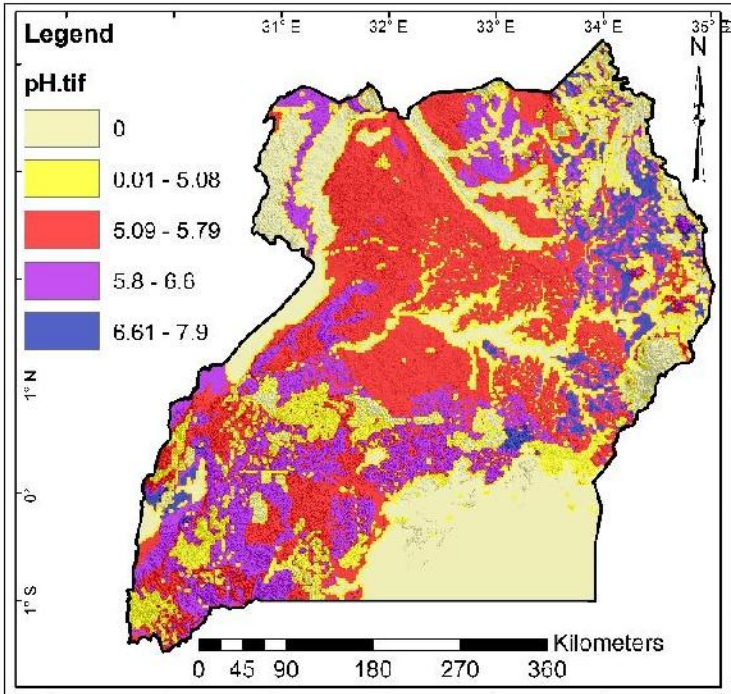
Phosphorus



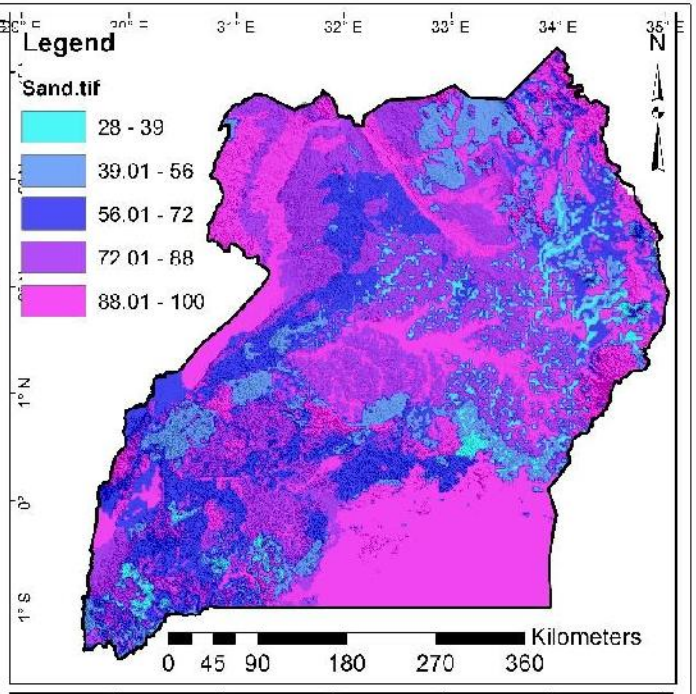
Potassium



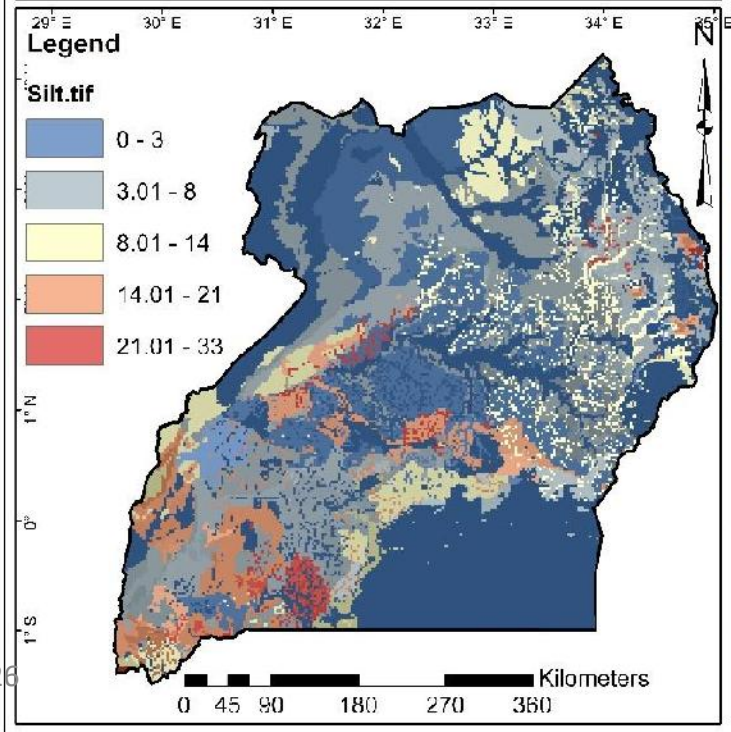
pH



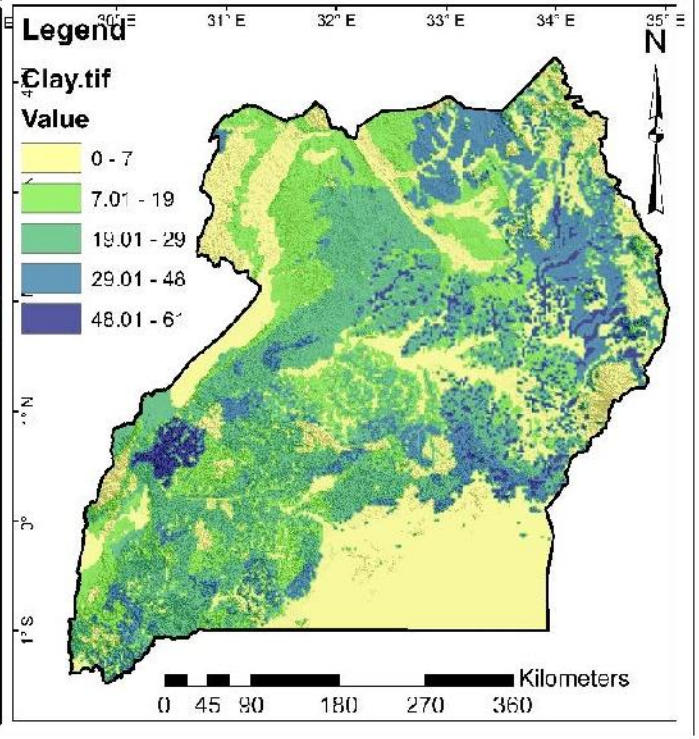
Sand

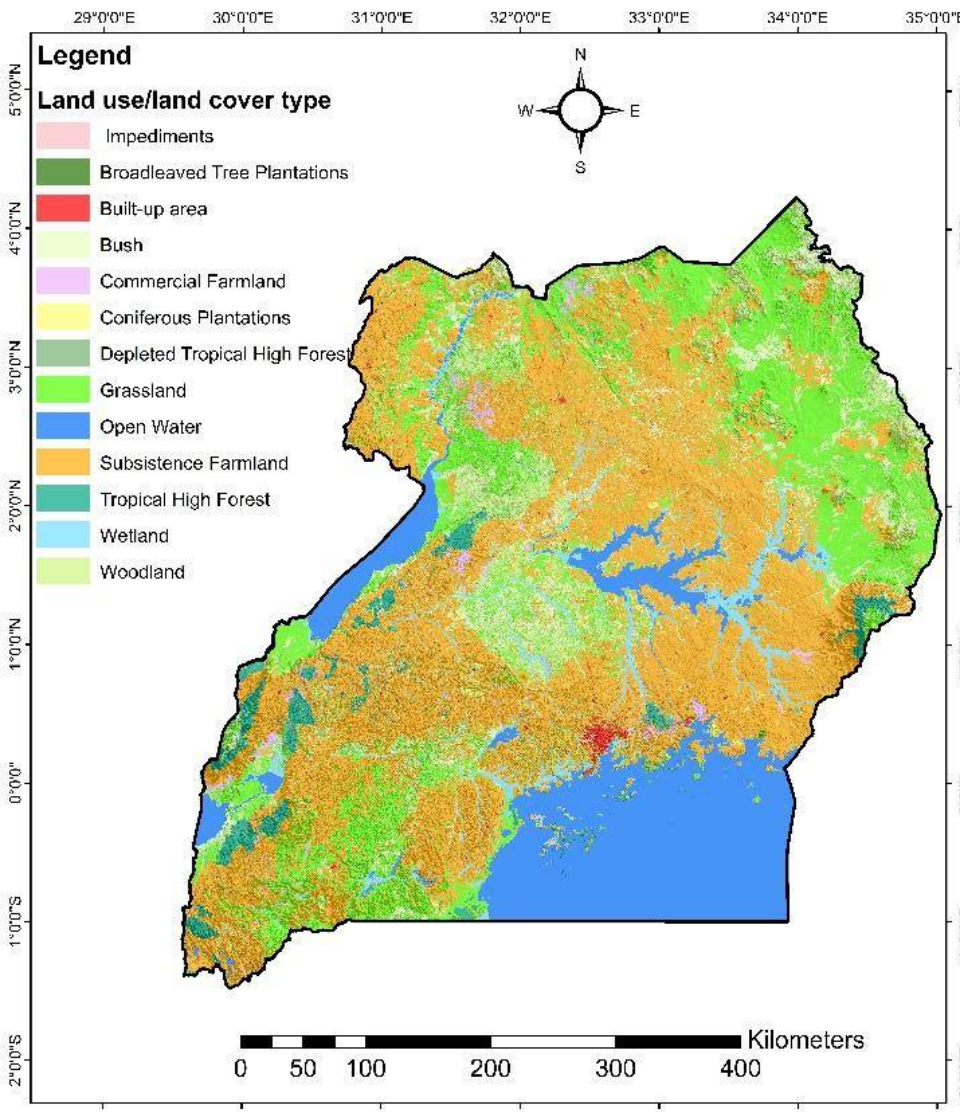


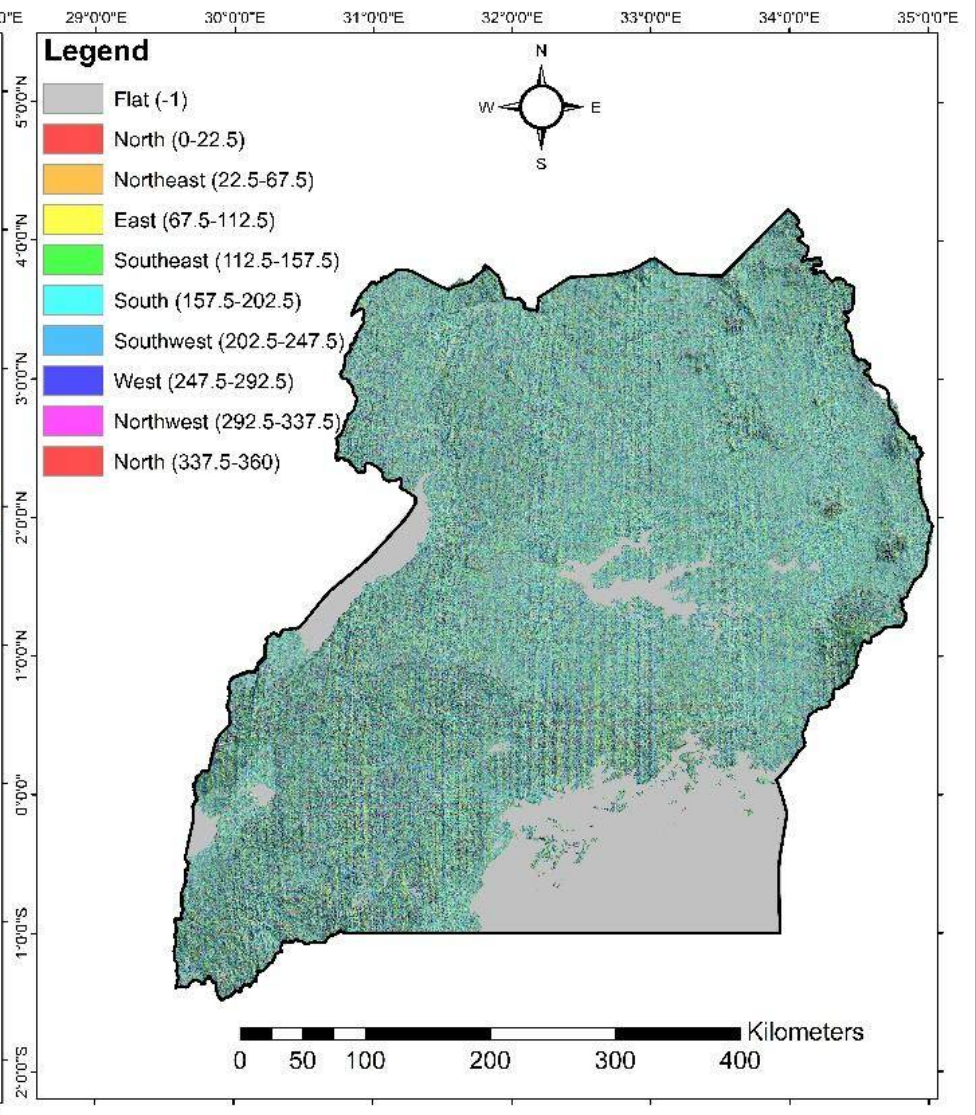
Silt



Clay





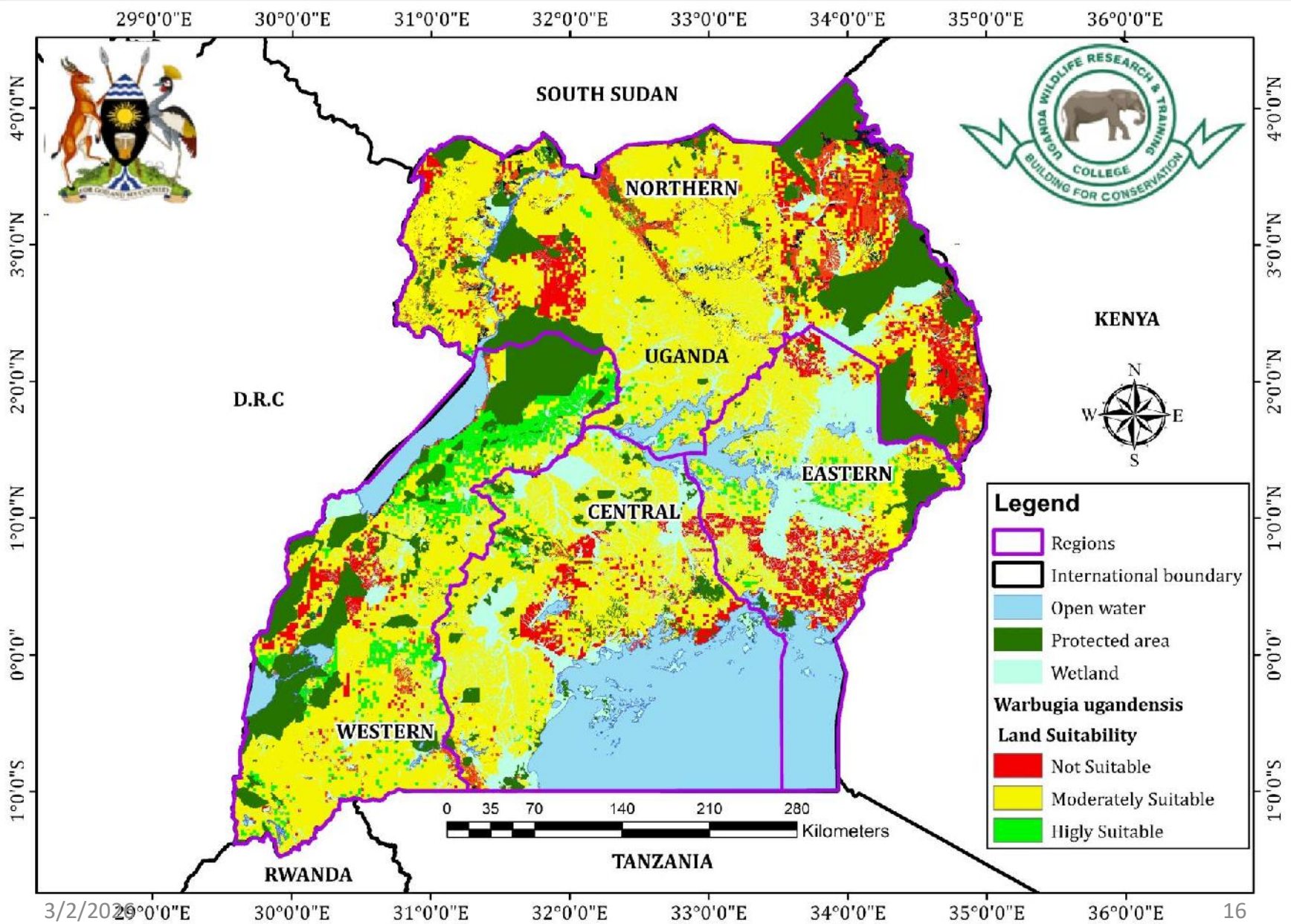


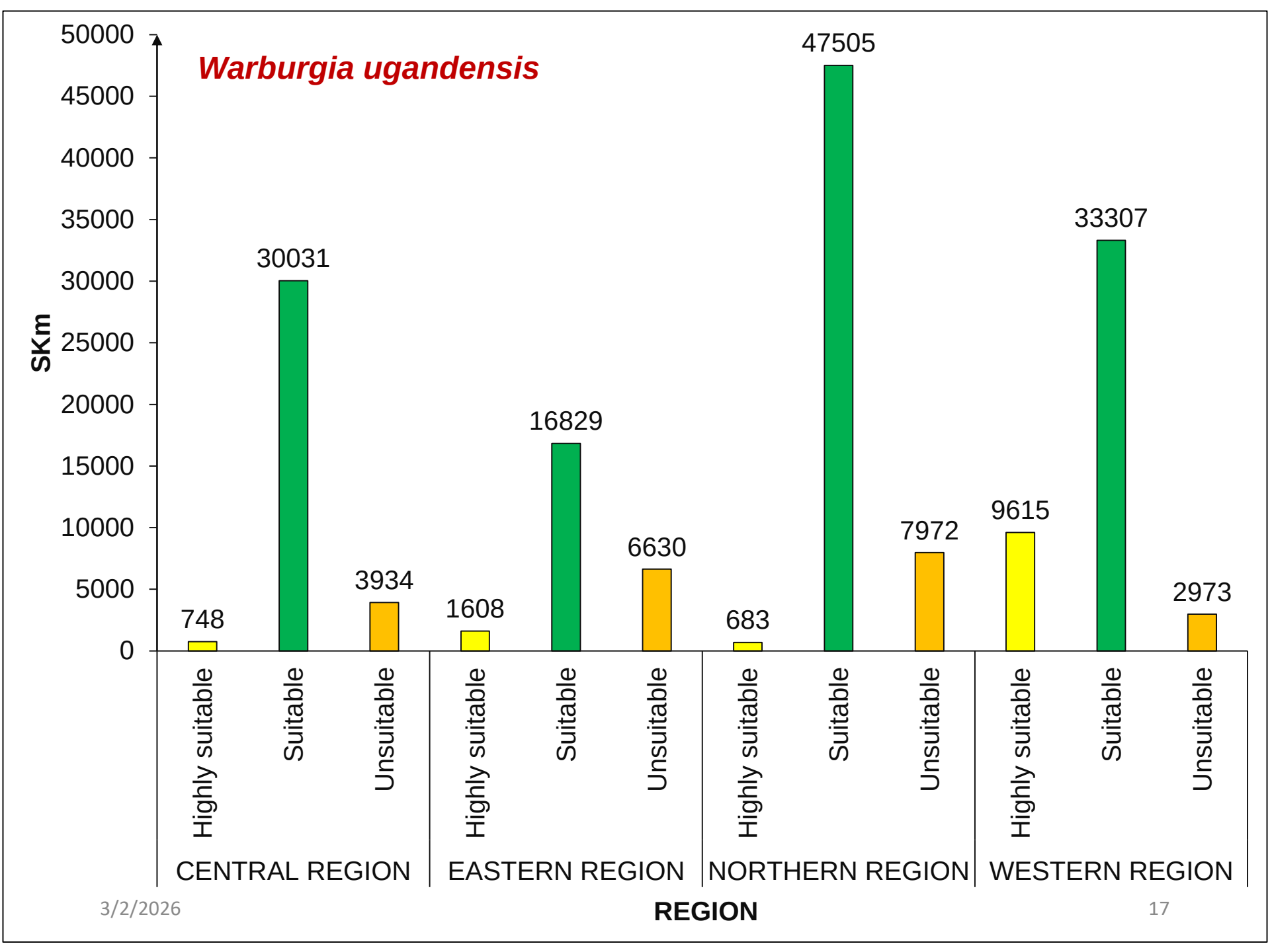
Land use/land cover type

Aspect

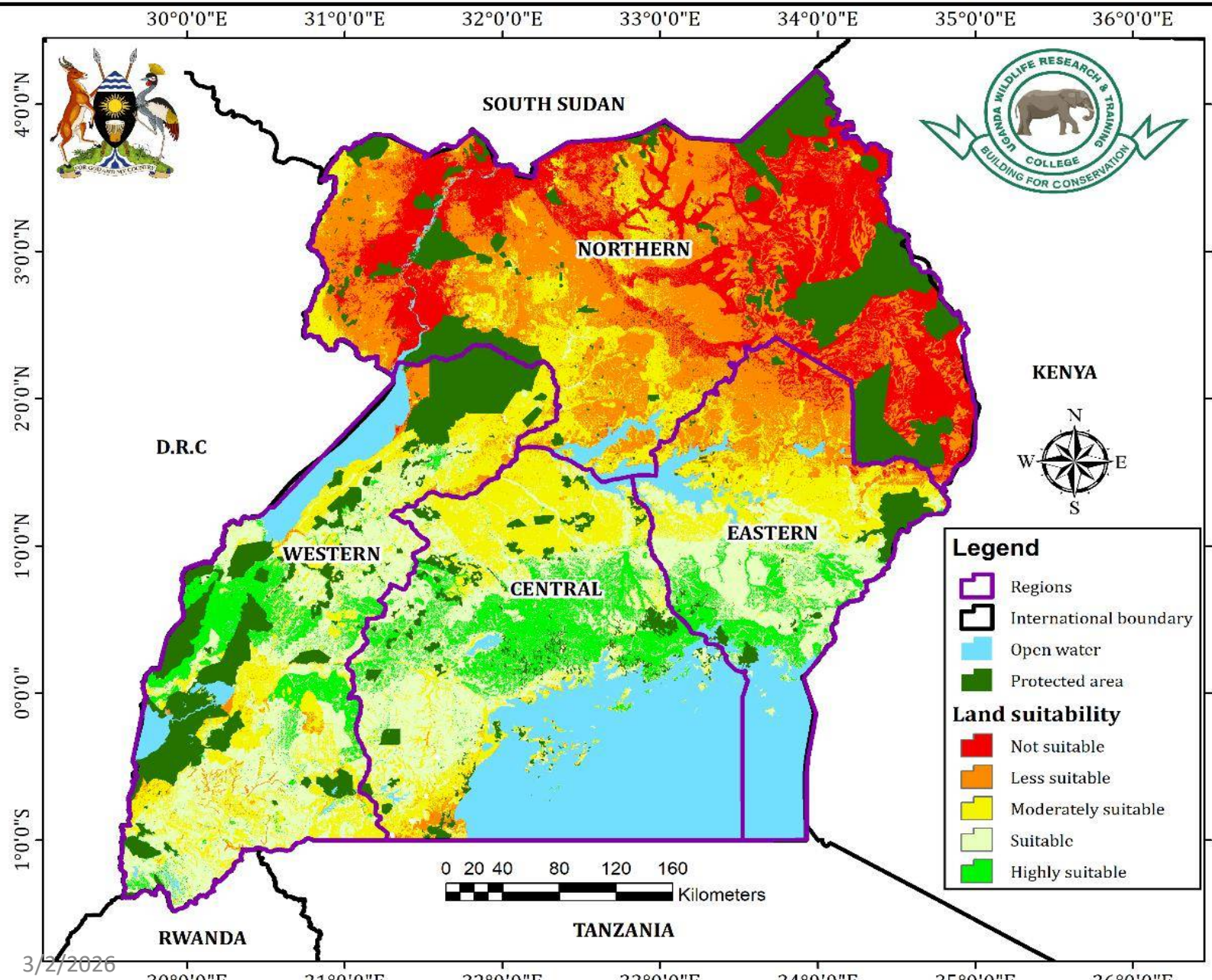
LAND SUITABILITY RESULTS

LAND SUITABILITY MAPPING OF WARBURGIA UGANDENSIS: A THREATENED SPECIES IN RWENZORI MOUNTAINS NATIONAL PARK

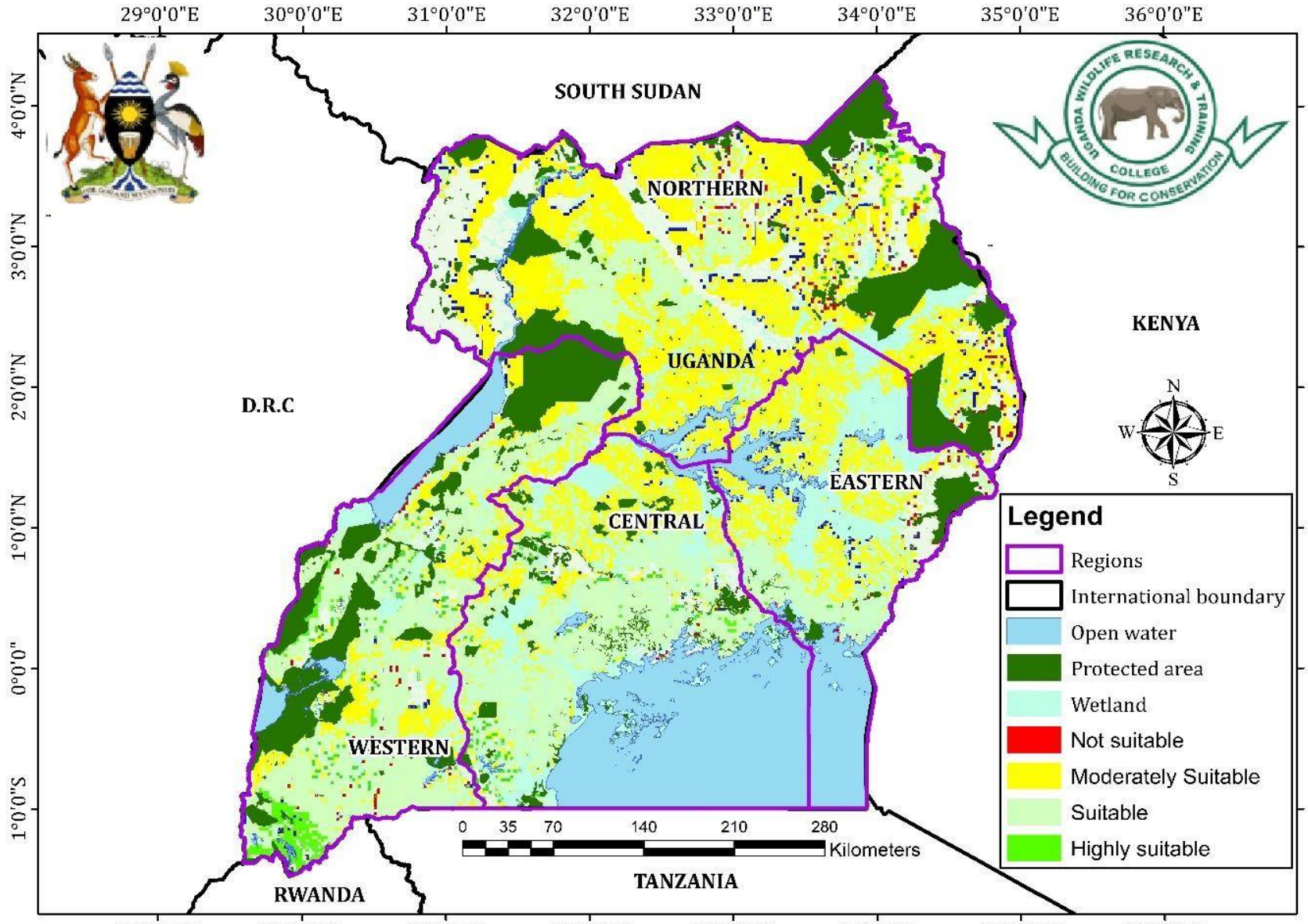


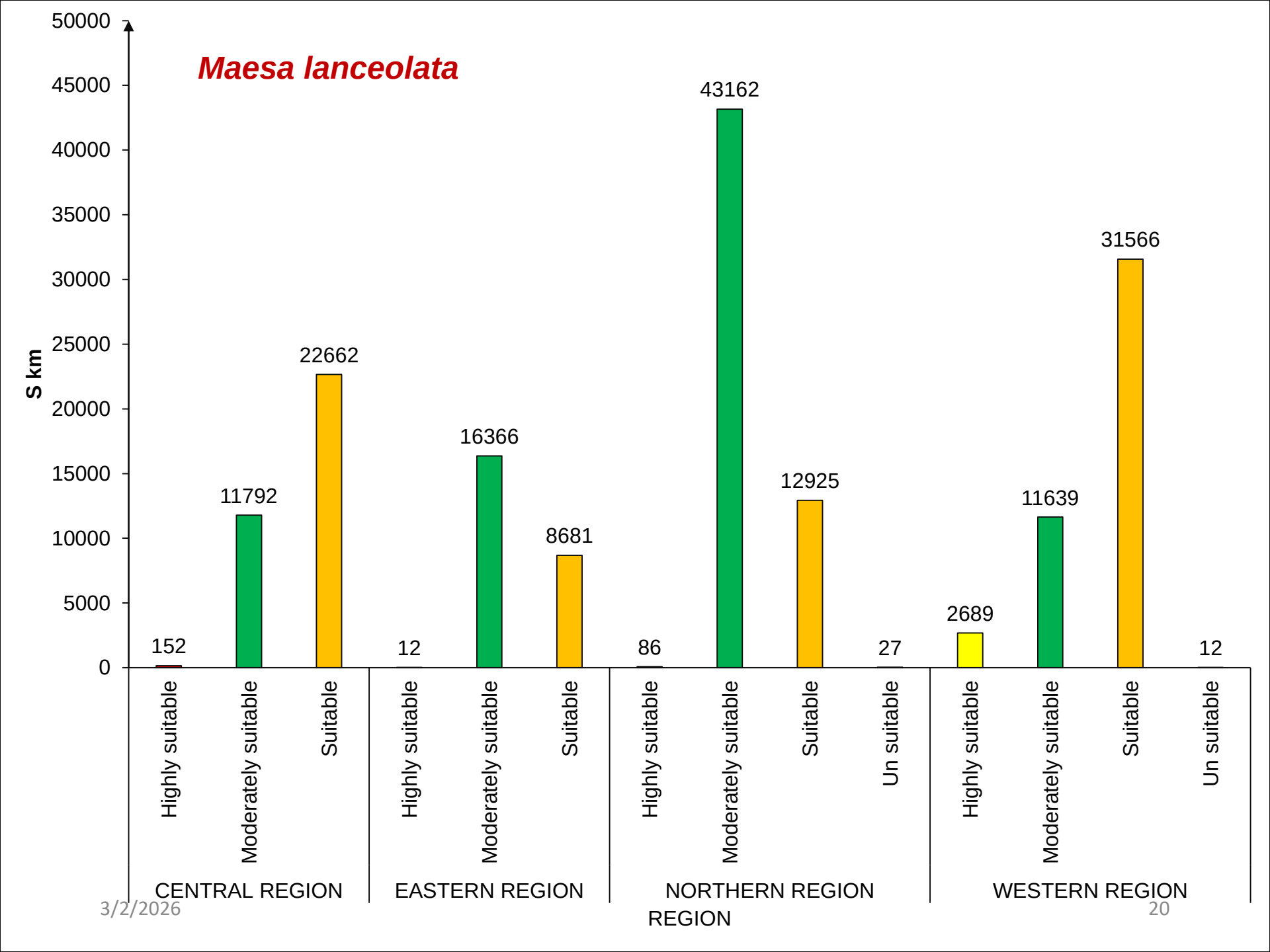

Warburgia ugandensis
SKm
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
748
30031
3934
1608
16829
6630
683
47505
7972
9615
33307
2973
Highly suitable
Suitable
Unsuitable
CENTRAL REGION
EASTERN REGION
NORTHERN REGION
WESTERN REGION
REGION

LAND SUITABILITY MAPPING OF PRUNUS AFRICANA: A THREATENED PLANT SPECIES IN RWENZORI MOUNTAINS NATIONAL PARK

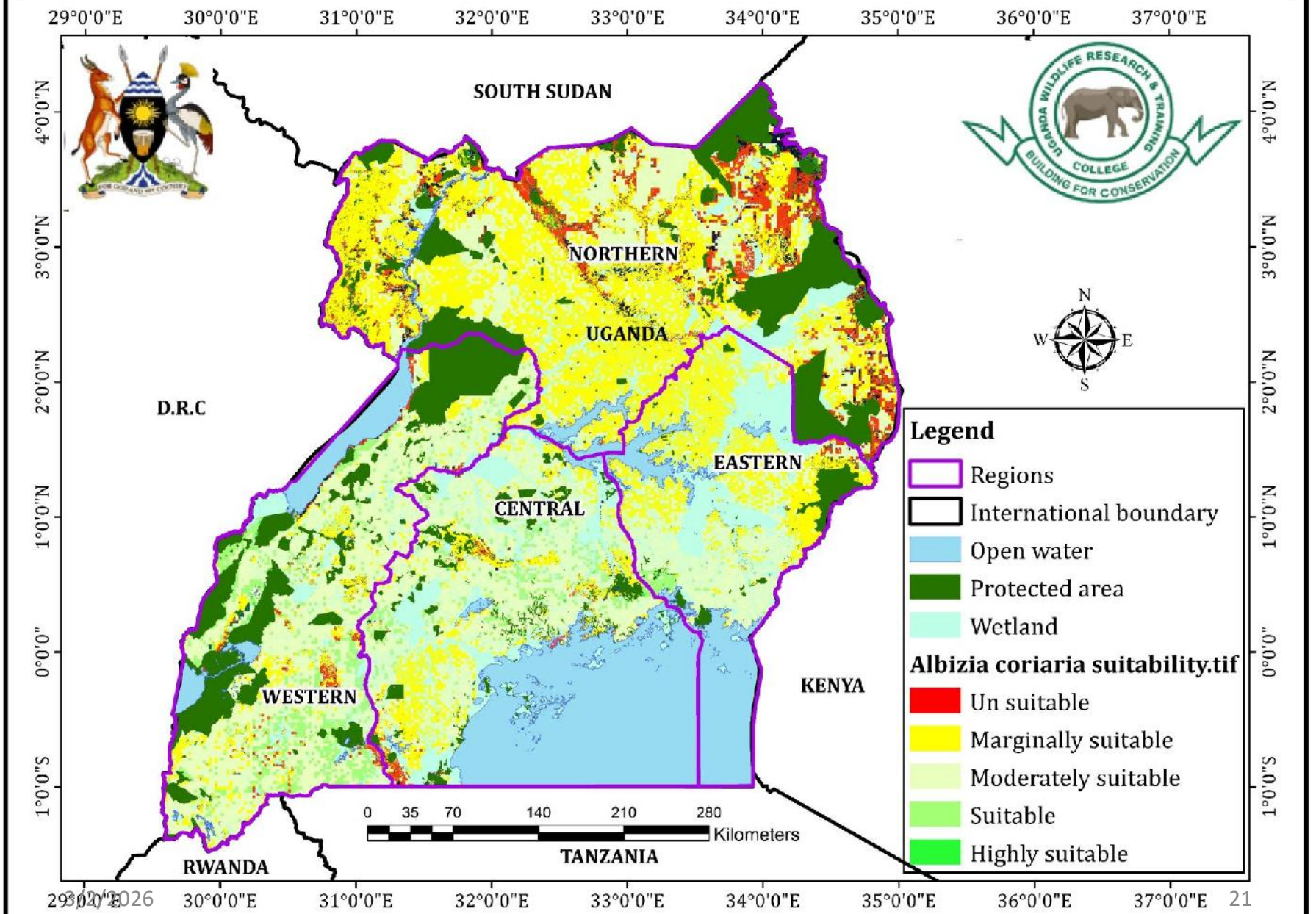


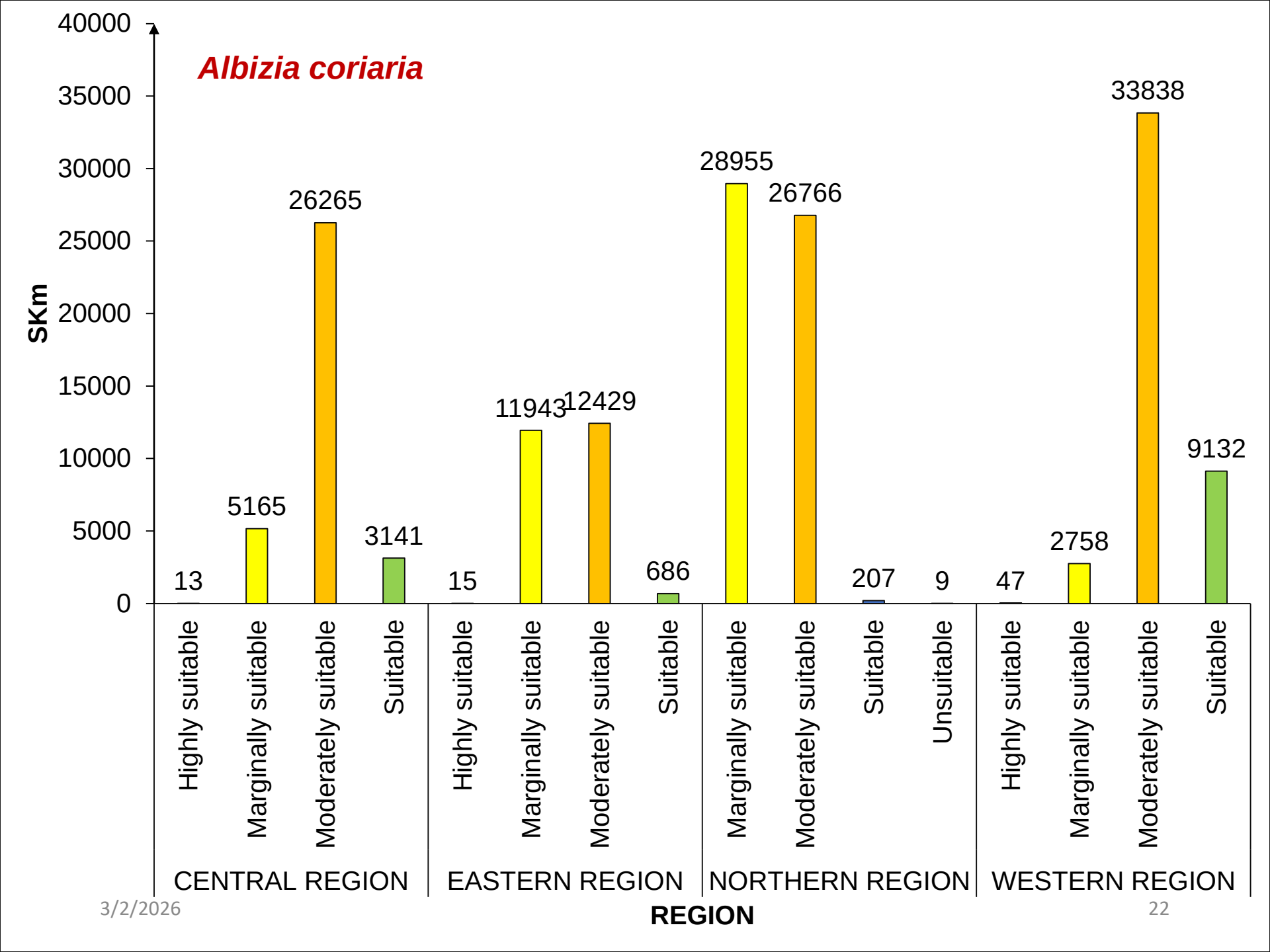
LAND SUITABILITY MAPPING OF MAESA LANCEOLATA: A THREATENED SPECIES IN RWENZORI MOUNTAINS NATIONAL PARK



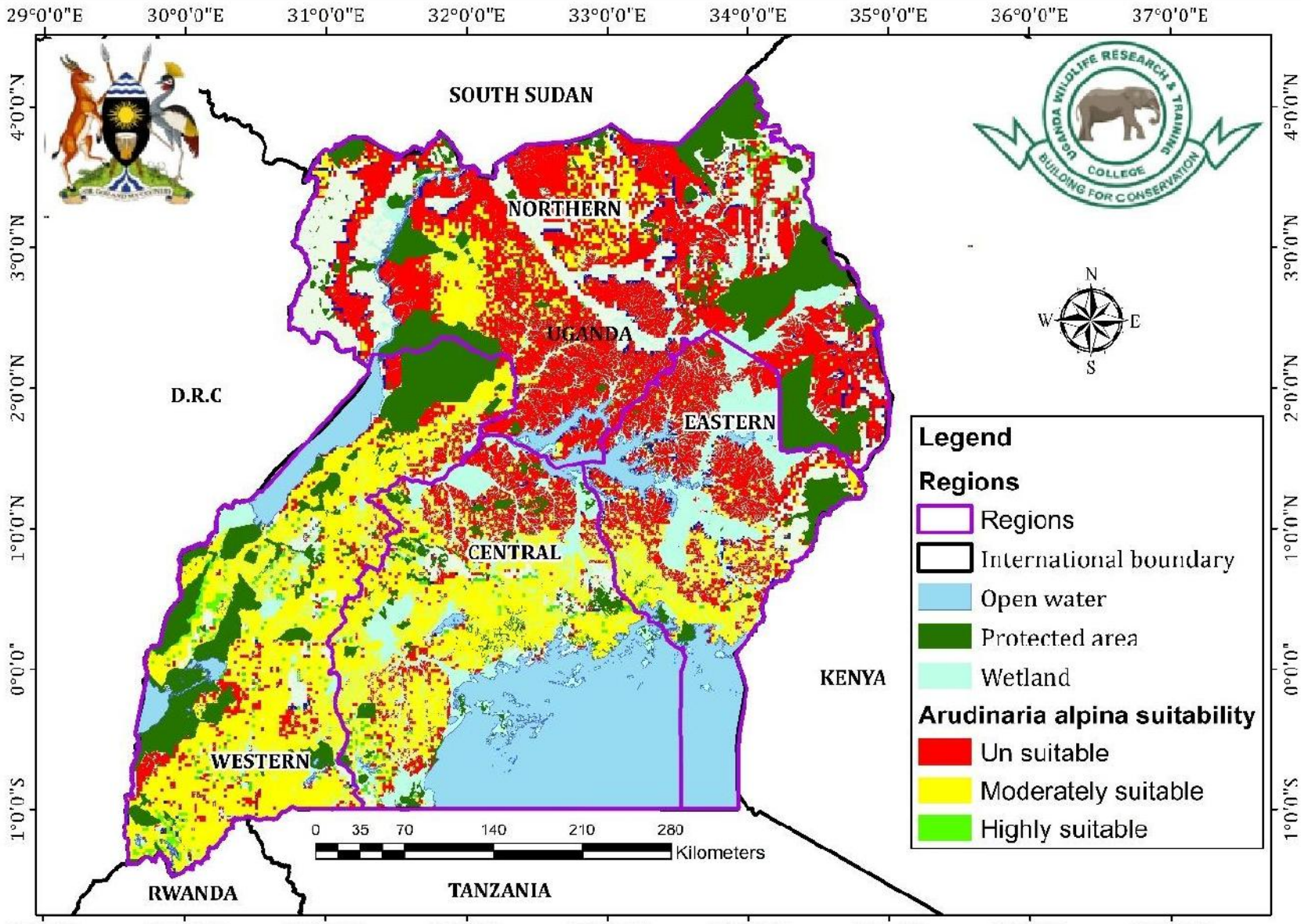

Maesa lanceolata
S km
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
152
11792
22662
12
16366
8681
86
43162
12925
27
2689
11639
31566
12
Highly suitable
Moderately suitable
Suitable
Highly suitable
Moderately suitable
Suitable
Highly suitable
Moderately suitable
Suitable
Un suitable
Highly suitable
Moderately suitable
Suitable
Un suitable
CENTRAL REGION
EASTERN REGION
NORTHERN REGION
WESTERN REGION
REGION

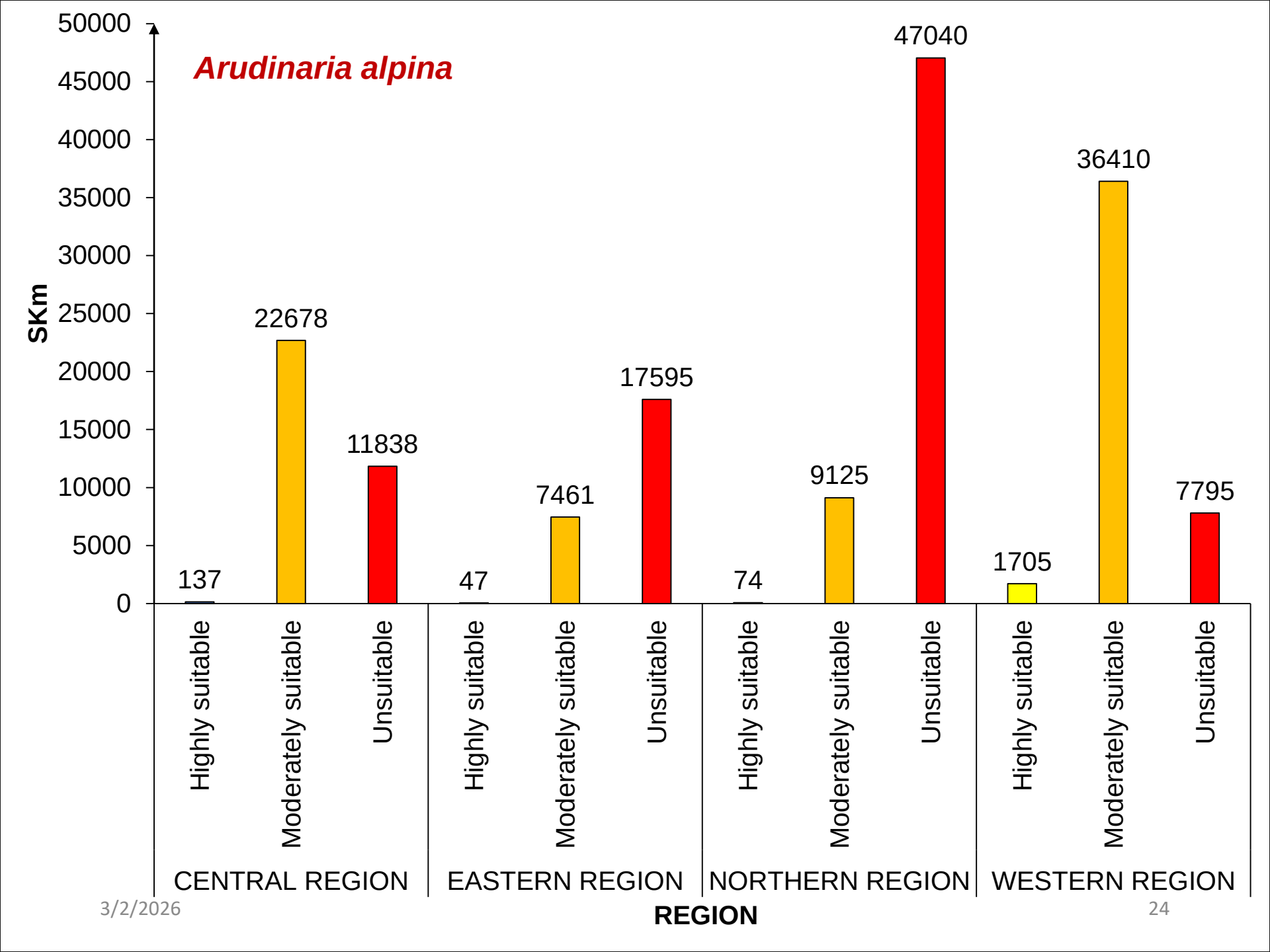
LAND SUITABILITY MAPPING OF ALBIZIA CORIARIA: A THREATENED SPECIES IN RWENZORI MOUNTAINS NATIONAL PARK



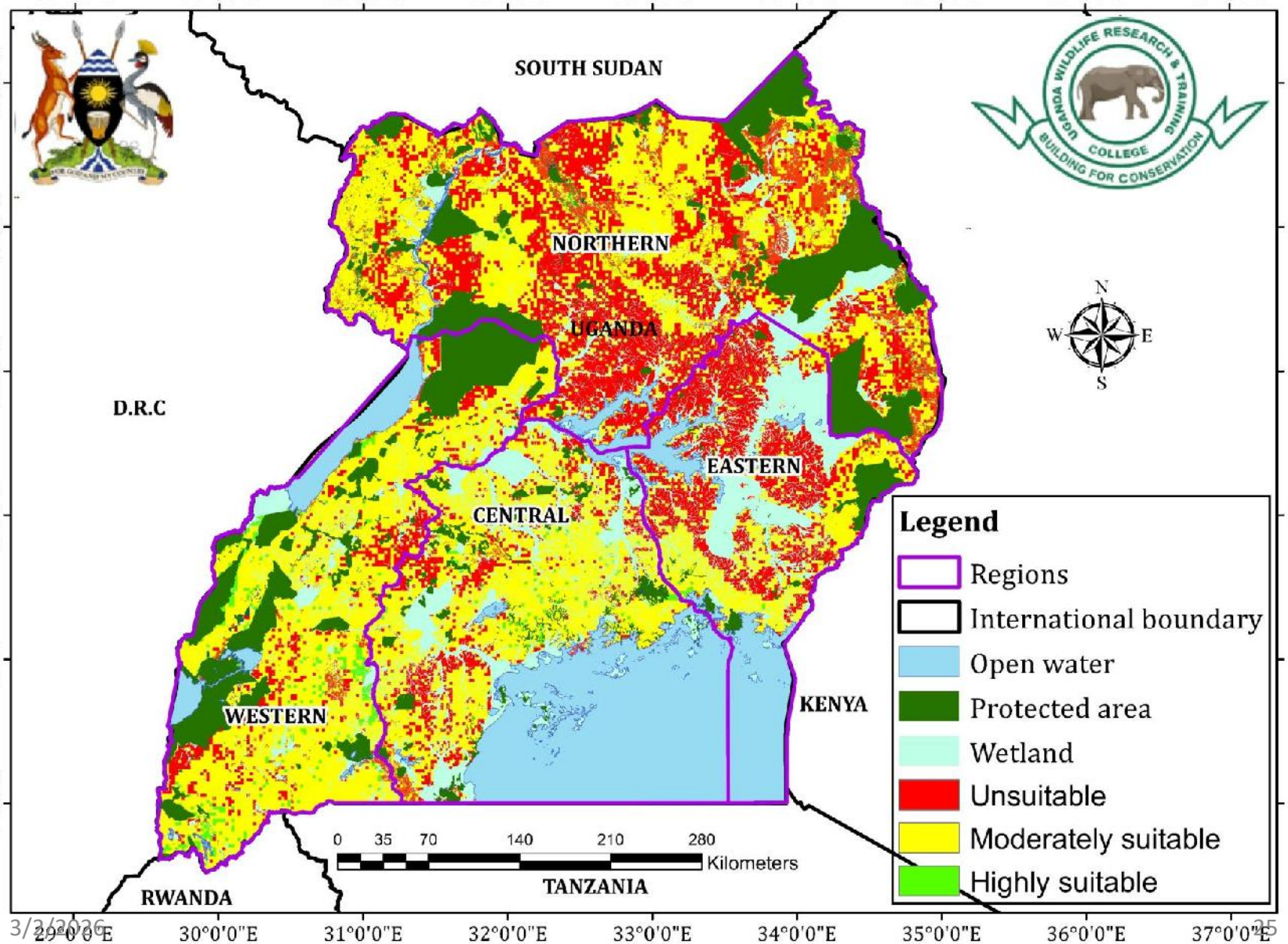

Albizia coriaria
SKm
40000
35000
30000
25000
20000
15000
10000
5000
0
13
5165
26265
3141
15
11943
12429
686
28955
26766
207
9
47
2758
33838
9132
Highly suitable
Marginally suitable
Moderately suitable
Suitable
Highly suitable
Marginally suitable
Moderately suitable
Suitable
Marginally suitable
Moderately suitable
Suitable
Unsuitable
Highly suitable
Marginally suitable
Moderately suitable
Suitable
CENTRAL REGION
EASTERN REGION
NORTHERN REGION
WESTERN REGION
REGION

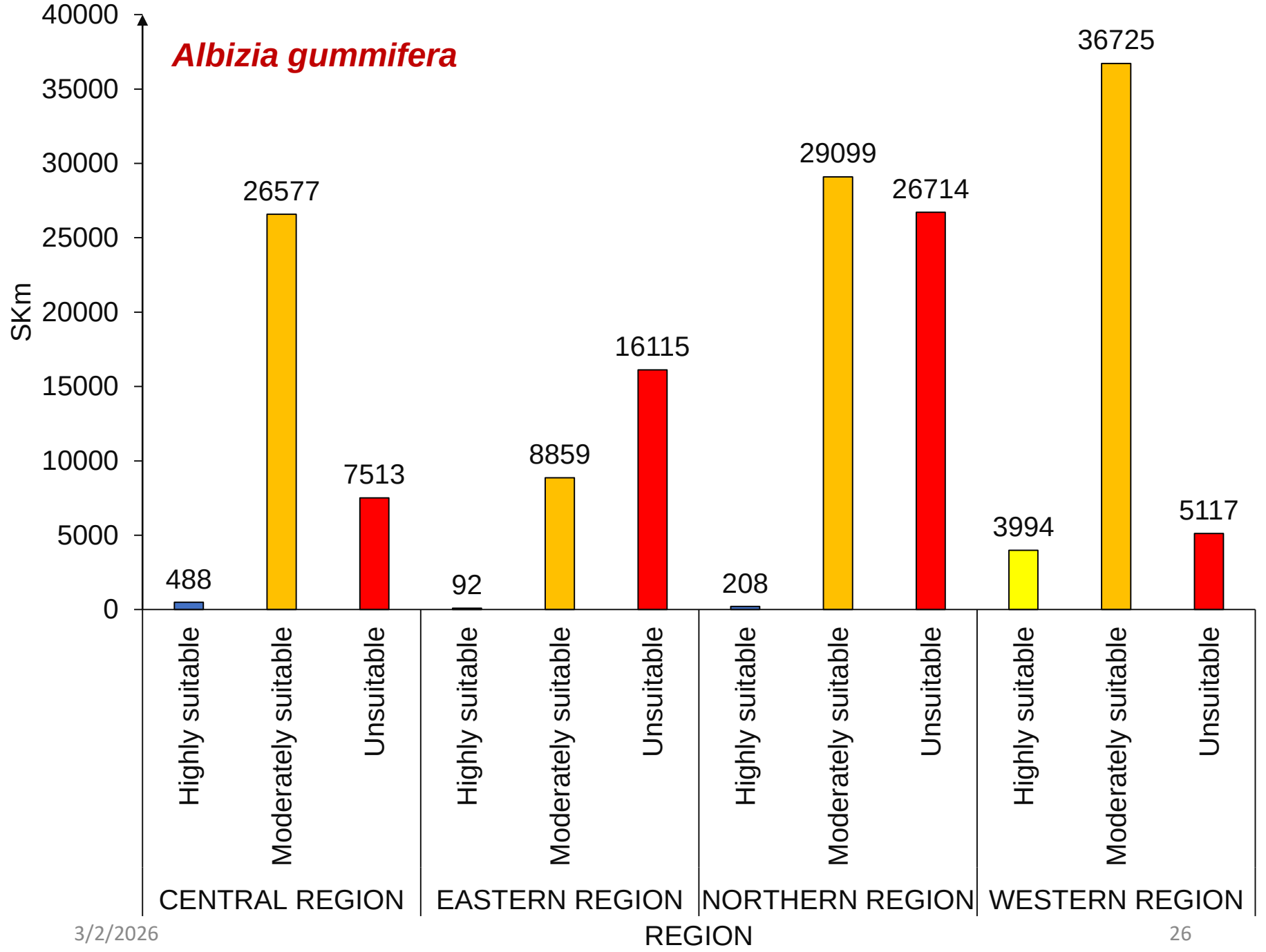
LAND SUITABILITY MAPPING OF ARUDINARIA ALPINA: A THREATENED SPECIES IN RWENZORI MOUNTAINS NATIONAL PARK




Arudinaria alpina
SKm
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
137
22678
11838
47
7461
17595
74
9125
47040
1705
36410
7795
Highly suitable
Moderately suitable
Unsuitable
CENTRAL REGION
EASTERN REGION
NORTHERN REGION
WESTERN REGION
REGION

LAND SUITABILITY MAPPING OF ALBIZIA GUMMIFERA: A THREATENED SPECIES IN RWENZORI MOUNTAINS NATIONAL PARK




Albizia gummifera
SKm
40000
35000
30000
25000
20000
15000
10000
5000
0
488
26577
7513
92
8859
16115
208
29099
26714
3994
36725
5117
Highly suitable
Moderately suitable
Unsuitable
CENTRAL REGION
EASTERN REGION
NORTHERN REGION
WESTERN REGION
REGION

DISCUSSION

- Western Uganda, especially the Rwenzori Mountains, emerged as the core high-suitability zon**e** across all species. Recognized as a major African center of plant endemism and elevational microclimatic diversity (Burgess et al., 2007).
- *Warburgia ugandensis & Prunus africana*: High suitability concentrated in humid, high-altitude forests.
- *Maesa lanceolata*: Broader moderate suitability across central, eastern, and parts of northern Uganda; persistence in secondary forests and forest edges reflects ecological flexibility (Friis et al., 2010).
- *Albizia coriaria & Albizia gummifera*: Wider suitability including agroforestry and disturbed landscapes; optimal conditions remain in wetter western and central Uganda (Orwa et al., 2009).
- *Arundinaria alpina*: Strong confinement to western highlands (>2,000 m a.s.l.); sharp decline toward lowlands highlights vulnerability to climate warming and land-use change (Kigomo, 1988).

CONCLUSION

- The results revealed clear spatial variation in habitat suitability across Uganda, with highly suitable areas mainly concentrated in the western and south-western highlands, particularly within and around RMNP.

- Findings show that altitude, climate, soil characteristics, and land use strongly influence species distribution.

- The study also identified suitable areas outside the park that could support ex-situ conservation, helping to reduce pressure on in-situ populations while maintaining community access to plant resources.

- Generally, the research demonstrates that land suitability mapping is an effective decision-support tool for conservation planning, restoration, and sustainable plant resource management in the Albertine Rift region.

RECOMMENDATIONS

- Promote ex-situ conservation: Uganda Wildlife Authority and National Forestry Authority should establish botanical gardens, community nurseries, and enrichment planting programs targeting highly exploited species such as *Prunus africana and Warburgia ugandensis.*

- Integrate suitability maps into planning: Incorporate generated land suitability maps into Rwenzori Mountains National Park management plans to guide restoration, buffer zone management, and species-specific conservation actions.

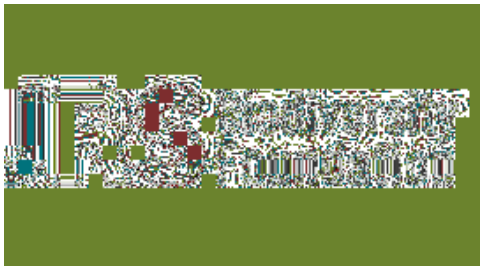
- Support community cultivation: Provide seedlings, technical training, and market linkages to communities around RMNP to reduce illegal harvesting and enhance household incomes.

- Strengthen enforcement & monitoring: Use identified suitability hotspots within RMNP to prioritize patrols, monitoring, and ecological restoration efforts.

- Enhance adaptive management: Regularly update land suitability models to reflect climate change and land-use dynamics; expand future research to include more threatened species and socio-economic drivers.

ACKNOWLEDGEMENT

MINISTRY OF TOURISM, WILDLIFE AND ANTIQUITIES
THE REPUBLIC OF UGANDA



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TOURISM BOARD

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UGANDA
THE PEARL OF AFRICA

THANK YOU