

Understanding the seasonal dynamics of invasive water hyacinth (*Eichhornia crassipes*) in the Greater Letaba river system using Sentinel-2 satellite data

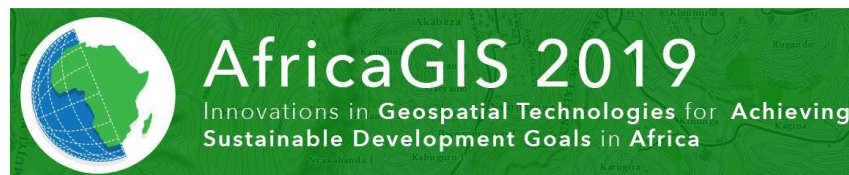
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Introduction

- Water resource plays a critical role globally.
- Providing numerous socio-economic and ecological benefits.
- Freshwater is on a steady decline due to increased pressure resulting from anthropogenic activities e.g. poor domestic waste disposal, agriculture and industrial intensification,
- Causing eutrophication not only in lakes, but also in streams, rivers and reservoirs.
- Climate change – raising temperatures.
- Consequently causing massive spread of aquatic weeds.



Why care about water hyacinth?

- It deteriorate freshwater ecosystem
- Its presence and distribution dominates causes:
 - Low oxygen beneath the mats-like results in hypoxia,
 - Excessive growth of water hyacinth threatens water quality, changes species richness, breeding grounds for water related diseases,
 - Dramatic negative impacts on fisheries and boat traffic
 - Chokes rivers/dams results in promotion of water loss through evapotranspiration,
 - Clog navigation,
- Period of eight months, ten water hyacinth plants can reproduce **655,360 plants** that can cover approximately half a hectare of the surface area (Gunnarsson and Petersen, 2007).



- Lack of regional efforts to ensure the collaboration and interaction to harmonize the efforts to control water hyacinth at catchment scale.
- Financial problems emanating from controlling and managing water hyacinth are poorly funded.

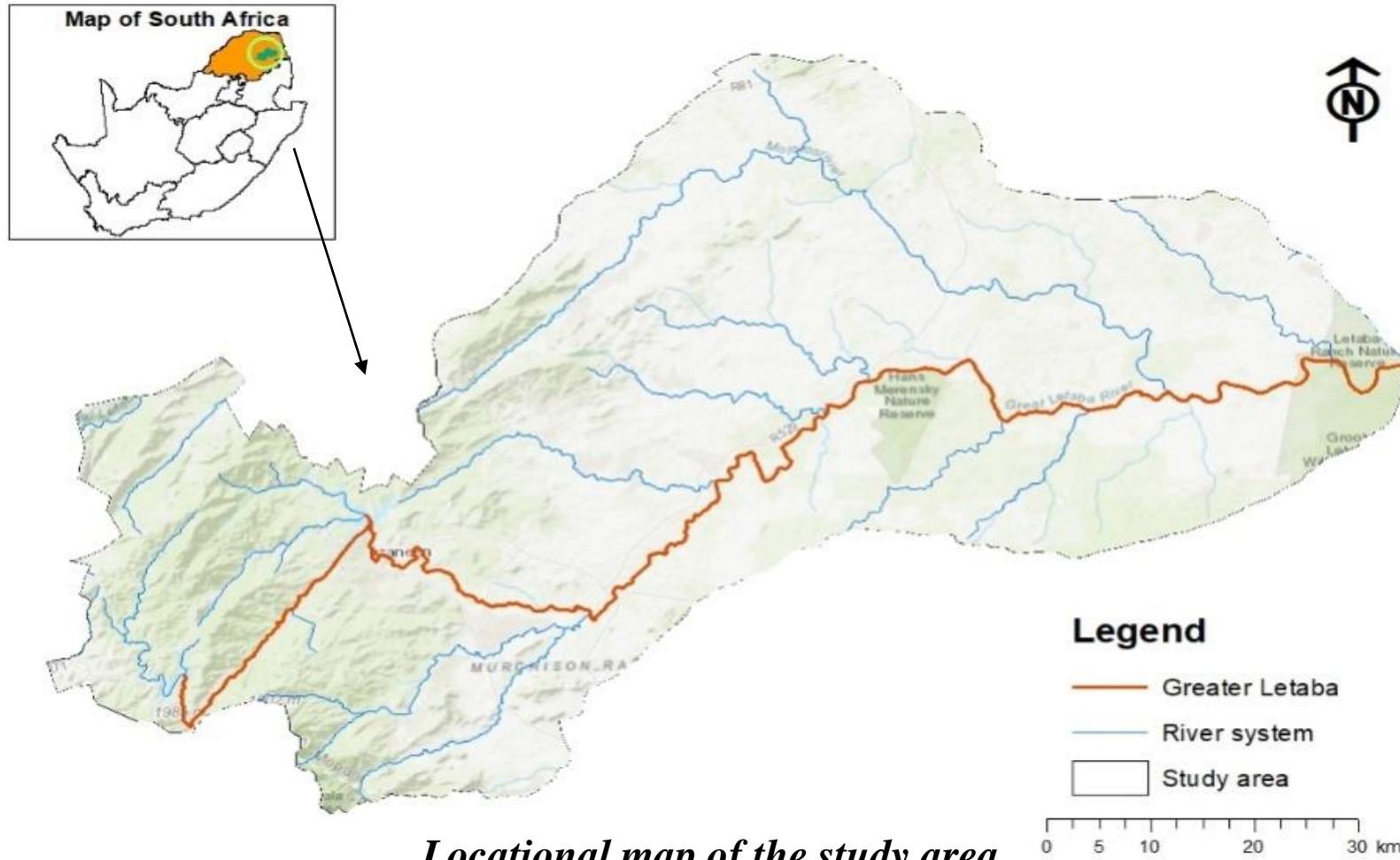
What need to be done?

- Remote sensing data - provides opportunities for detection, mapping, monitoring and understanding the proliferation of water hyacinth.
- Use accurate, cheap, up-to-date, satellites imagery,
- Spatio temporal information is required for management,
- Need to test the applicability of new crop of freely and readily available EO data
- Need for comprehensive knowledge on the spatio temporal distribution of water hyacinth is critical for management purposes.

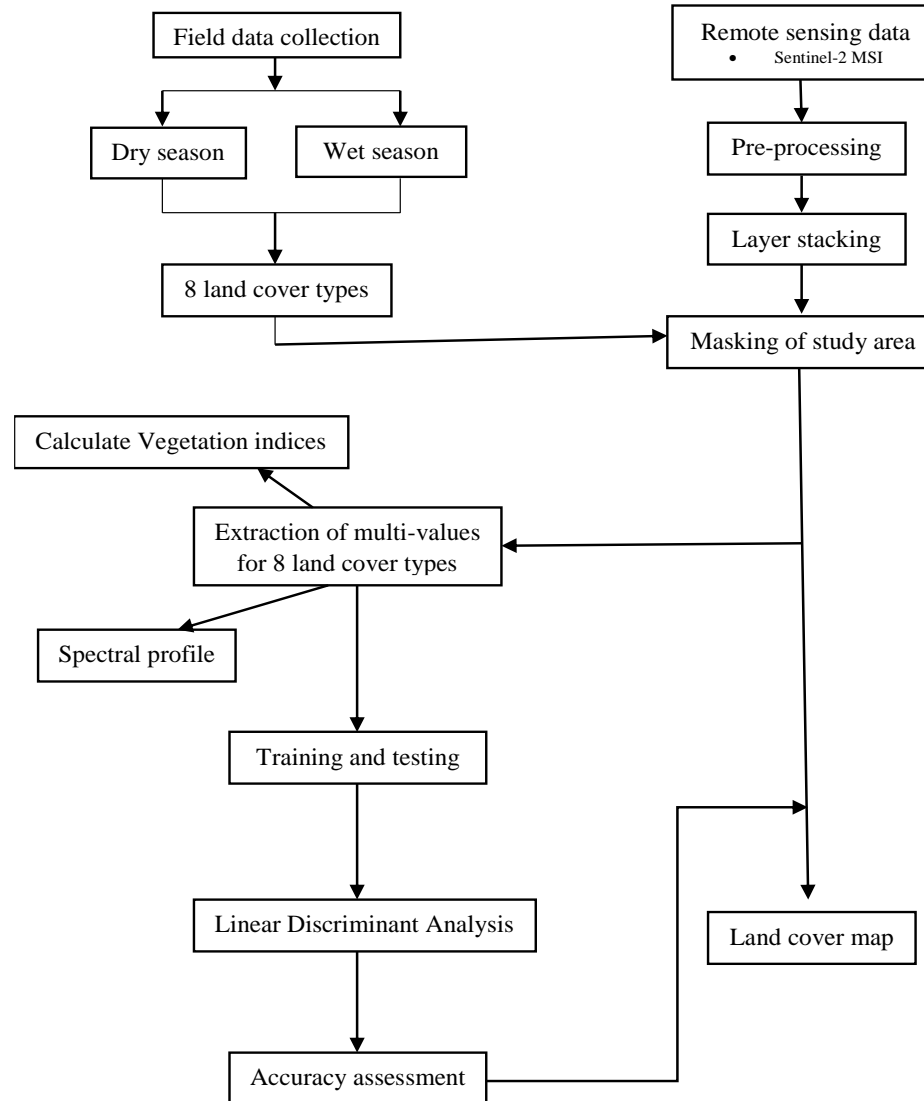
Challenges and gaps in mapping water hyacinth

- Extensive mapping of water hyacinth in large reservoirs.
- Limitations: mixed pixels problems.
- Less focus on small rivers.
- Lack of high resolution spatial data.
- Snapshot image analysis.
- Single date species information limit the understanding of the temporal variability and some important information is likely to be masked out.

Study area

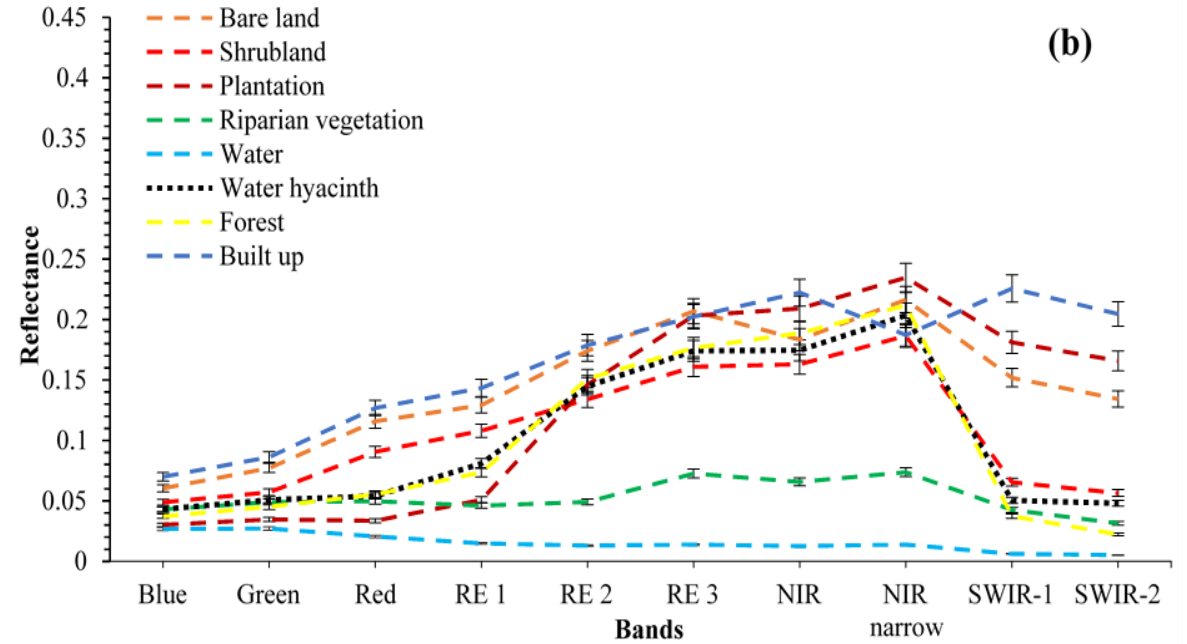
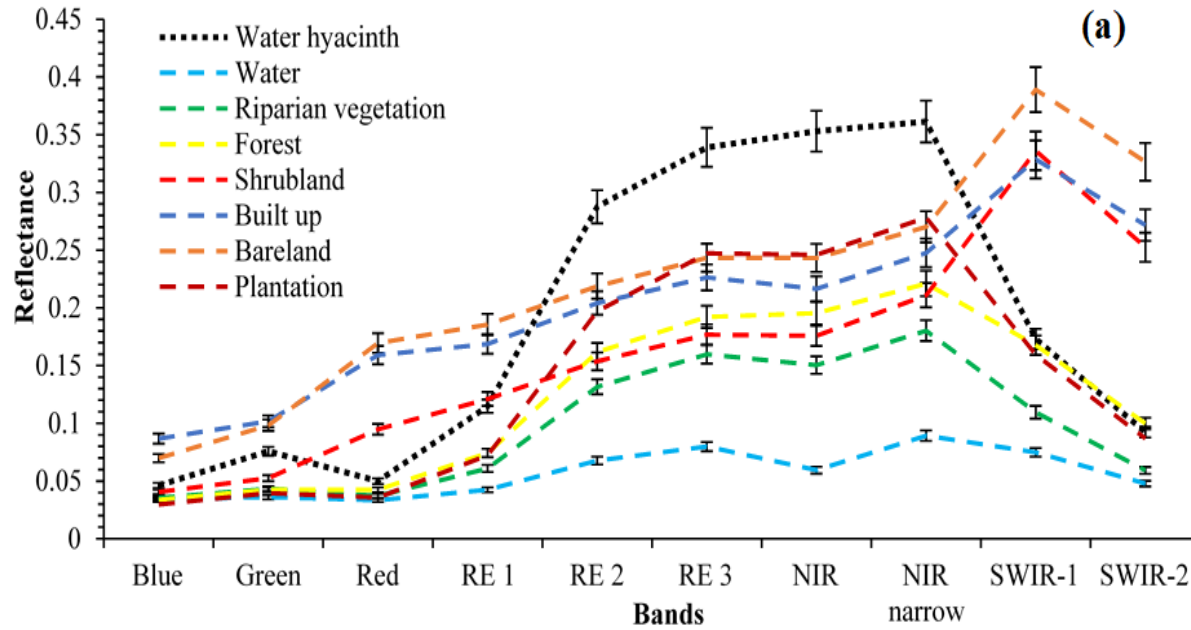


Methodology

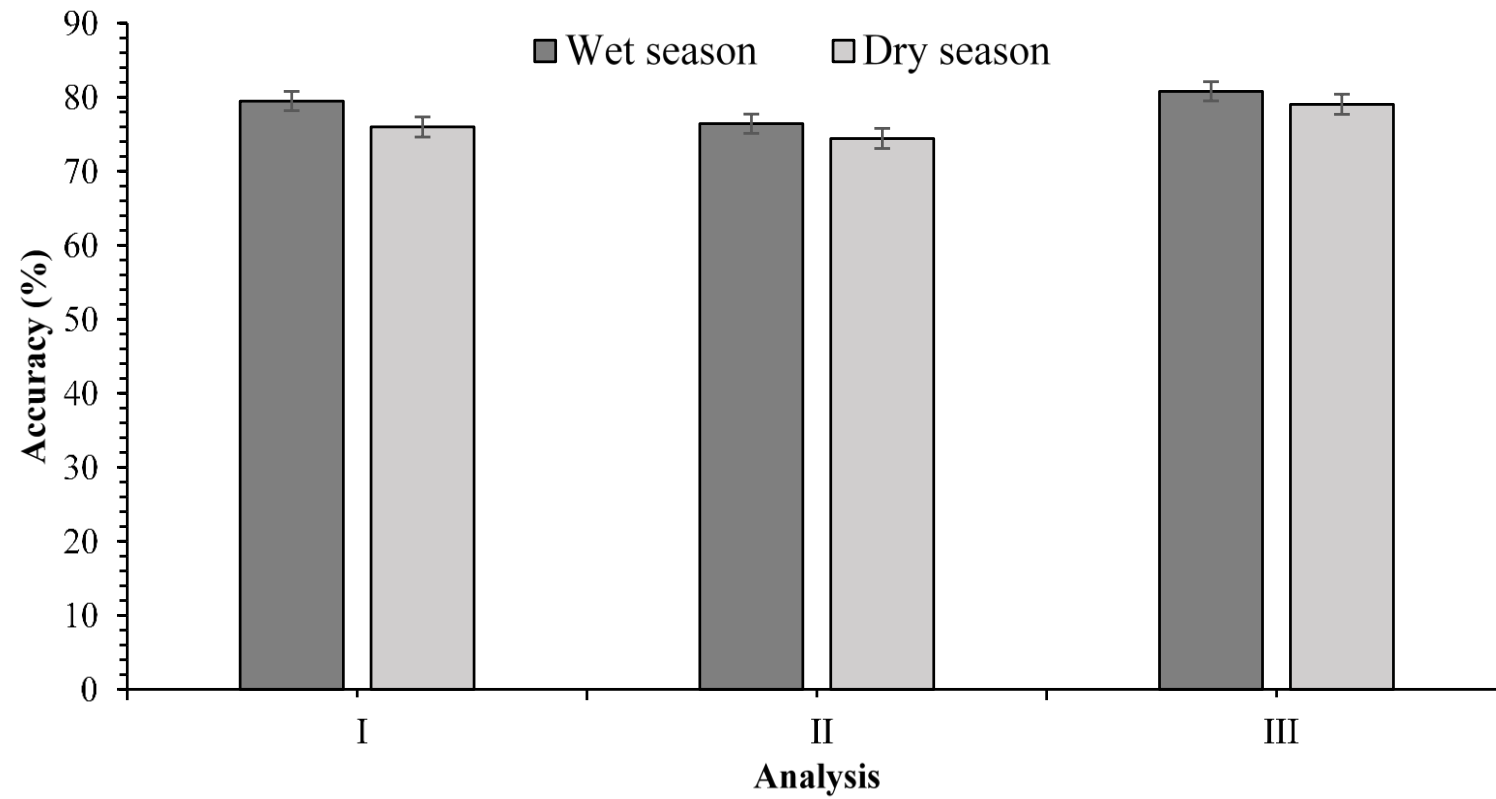


Methodological framework

Results

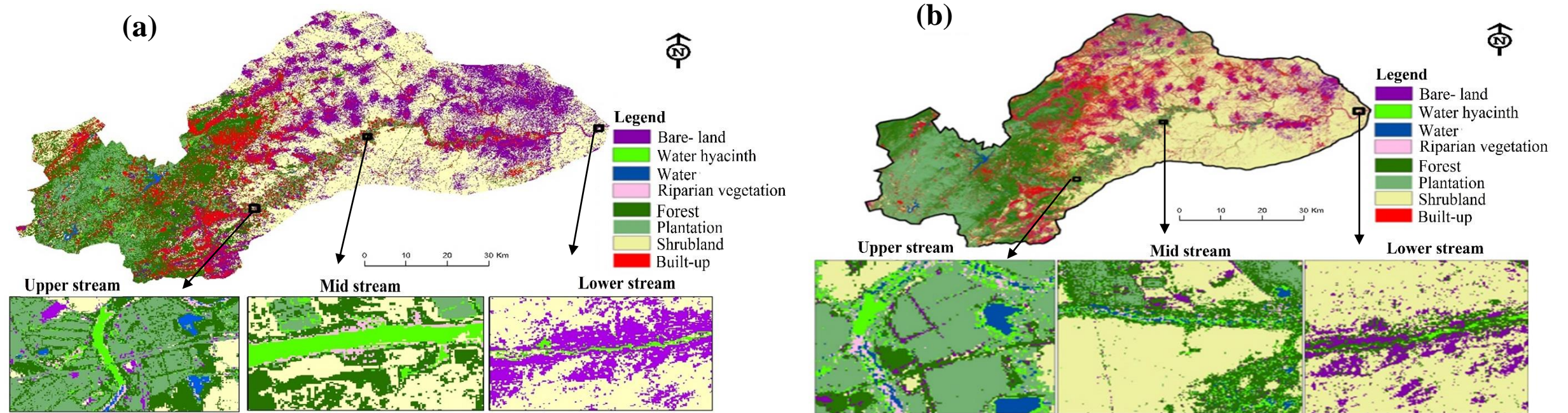


Averaged spectral reflectance derived from Sentinel-2 MSI (a) wet season and (b) dry season

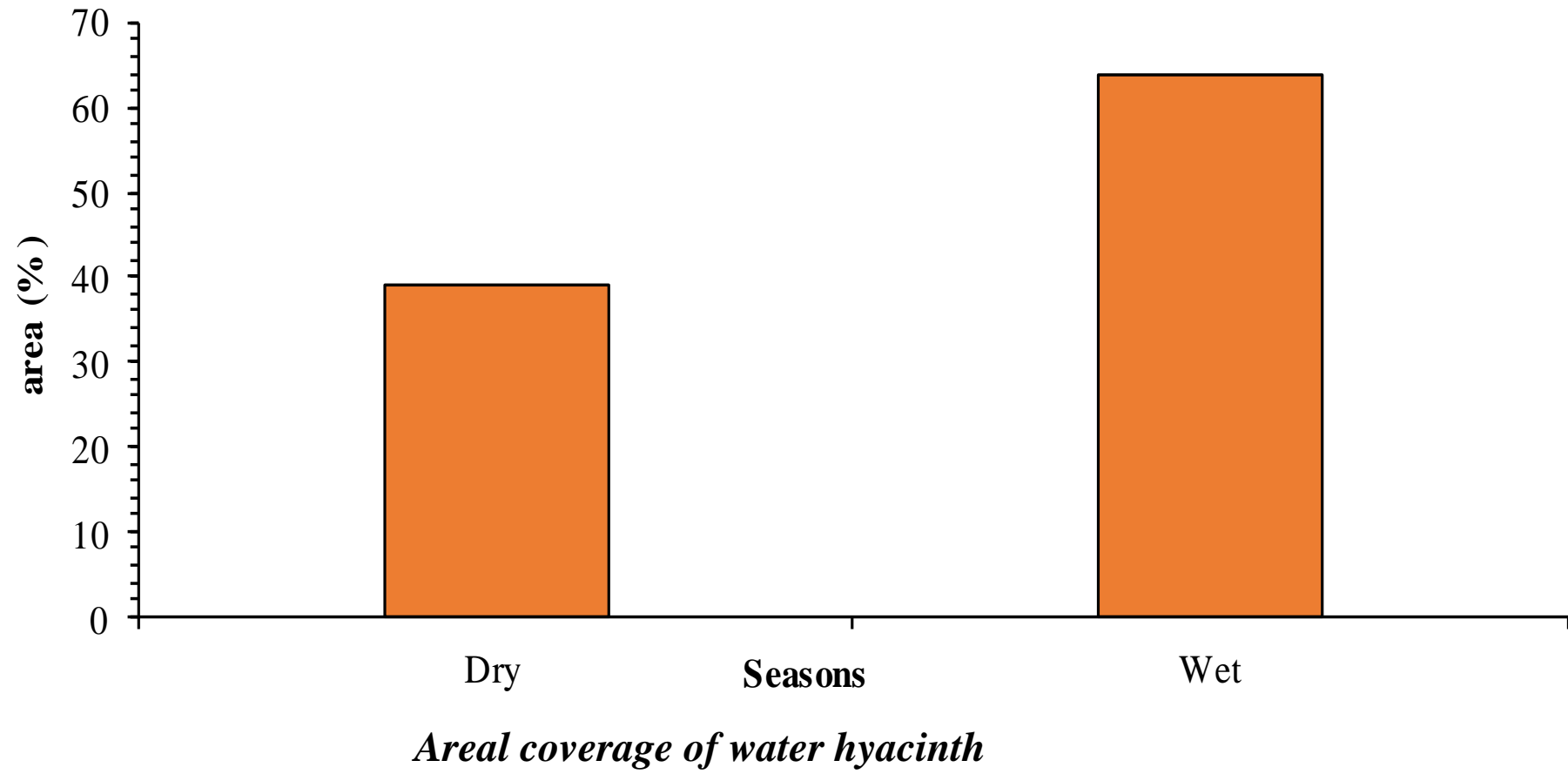


Overall classification accuracy derived from Sentinel-2 during wet and dry season

Results



Seasonal maps derived using Sentinel-2 MSI (a) wet season and (b) dry season



Discussion

- Sentinel-2 - can detect and map the spatial distribution of water hyacinth in narrow river channels.
- Integration of spectral bands and vegetation indices – enhanced the detection of temporal distribution of water hyacinth in freshwater.
- Sentinel imagery provide more accurate and unique information on the spatial distribution and configuration of water hyacinth.
- Provides critical baseline information required in assessing the status of affected rivers within the catchment.
- Seasonal mapping of these species gives a better view in understanding its spatial distribution and configuration required for frequent monitoring, assessment of infestation levels, sustainable remedial, eradication and effective management practices.

Conclusion

- Large coverage of water hyacinth was detected during the wet season, compared to the dry season.
- Sentinel-2 with improved spectral and spatial resolution managed to detect and map the seasonal distribution and spatial dynamics of water hyacinth in a river system.
- This work provided new insights on the usefulness of Sentinel-2 in monitoring water hyacinth,
- Information is crucial to environmentalists, water resource and catchment managers, as well as hydrologists, especially in complex environments.
- Findings - key in decision-making and policy development and draw remedial measures.

Reference

- Gunnarsson, C.C. and Petersen, C.M., 2007. Water hyacinths as a resource in agriculture and energy production: A literature review. *Waste Management*, 27:117-129.

Thank you