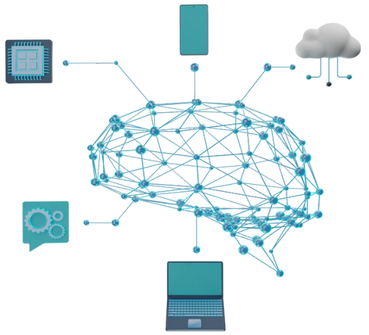

DELINEATING GROUNDWATER-DEPENDENT INVASIVE PLANTS IN HEUNINGNES CATCHMENT SOUTH AFRICA.

Author: Ms Moropane

Supervisor: Prof.Dube (UWC)

Co-supervisor: Dr.Shoko (WITS)

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BACKGROUND

- Invasive Alien Plants (IAPs) threaten ecosystem function and natural resources globally.
- Groundwater-dependent IAPs (GDIAPs) developed adaptive strategies to survive extreme environmental conditions.
- GDIAPs evolved deep roots or shallow spreading roots which enables them to exploit groundwater during dry periods.

Fig 1: Prosopis glandulosa (honey mesquite)

Fig 2: Acacia longifolia (golden wattle)

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BACKGROUND….CONT

- Studies provided evidence that GDIAPs affect groundwater recharge, quality and quantity
- Studies found that Prosopis plant consumed approx. 3.8 million liters of groundwater per hectare per year vs V.karoo plant which consumed 540 000 liters in Northern Cape.
- Tamarix sp invasions quadraupled groundwater salinity from 2250 to 1000 mg/l in Colorado, affecting groundwater quality and purification costs.
- Historically, GDIAPs were detected using traditional methods (i.e field surveys and observations).
- Traditional methods provide robust results but have several limitations (inadequate spatio-temporal coverage, expensive, time consuming and labor intensive).
- The recent tech advancements in remote sensing (RS) and machine learning algorithms (MLA) provide a viable alternative of detecting and monitoring these problematic species.

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RESEARCH GAPS

- Many studies used RS and MLA techniques to map IAPs and GDEs, but few used them to detect and map GDIAPs specifically.
- Many studied highlighted that these techniques provide high spatial and temporal resolutions, they are cost effective and provide reliable results for GDEs and IAPs mapping and monitoring.

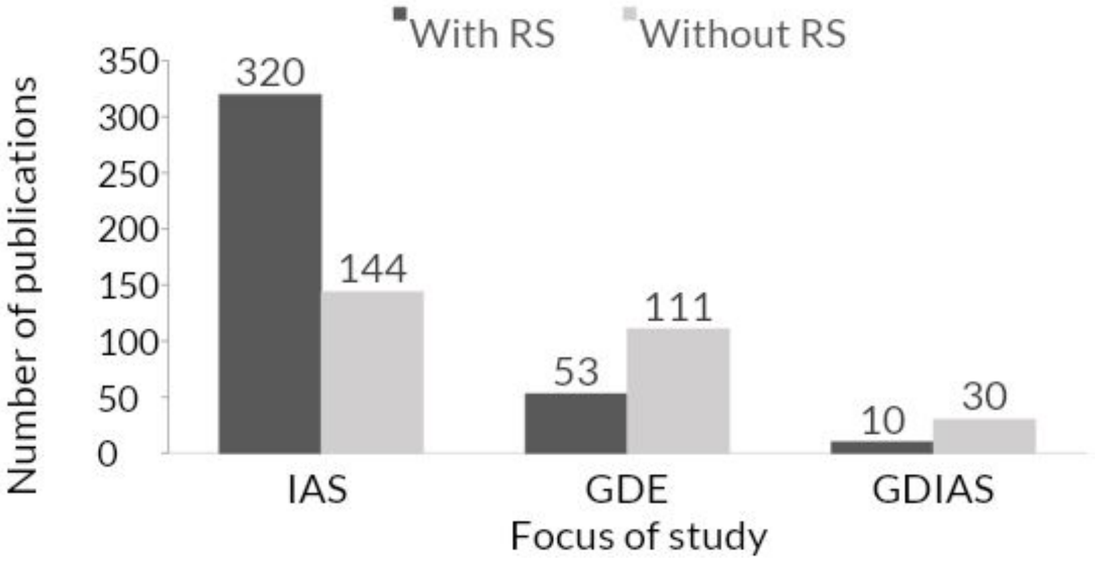

Fig 3: Studies conducted on IAPs, GDEs and GDIAPs between 2000 and 2023.

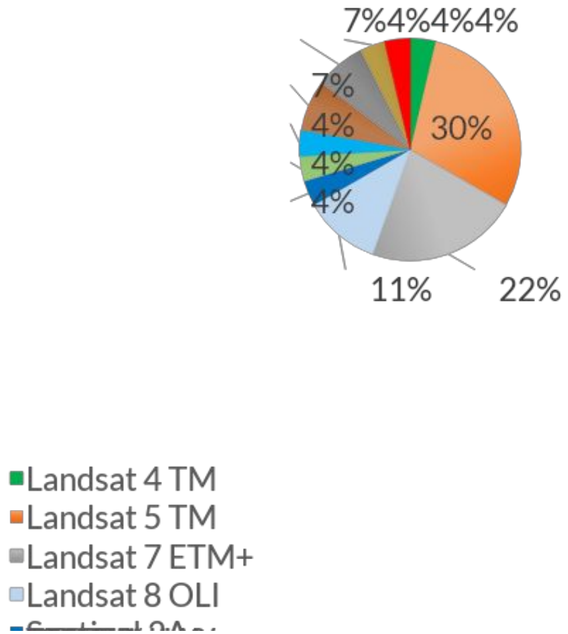

Fig 4: Satellite datasets used to delineate GDIAPs between 2000 and 2023.

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AIMS AND OBJECTIVES

GDIAPs poses significant threats to biodiversity, ecosystem function and limited water resources. Limited studies focused on delineating GDIAPs, especially in semi-arid areas.

01

AIM OF THE STUDY

Our study aims to enhance our knowledge of the application of satellite-based techniques with machine learning algorithms in the monitoring of GDIAPs

02

RESEARCH QUESTIONS

1. Determine how accurately can RS and MLA detect GDEs in Heuningnes basin?
2. Assess MLA performance in differentiating GDIPs and GDNPs?
3. Determine potential impacts of GDIAPs on groundwater levels & GDEs.

03

RELEVANCE OF THE STUDY

Monitoring GDIPs and their potential impacts on groundwater levels and GDEs is crucial for ecosystem protection, invasive species management, and water resource conservation.

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STUDY AREA

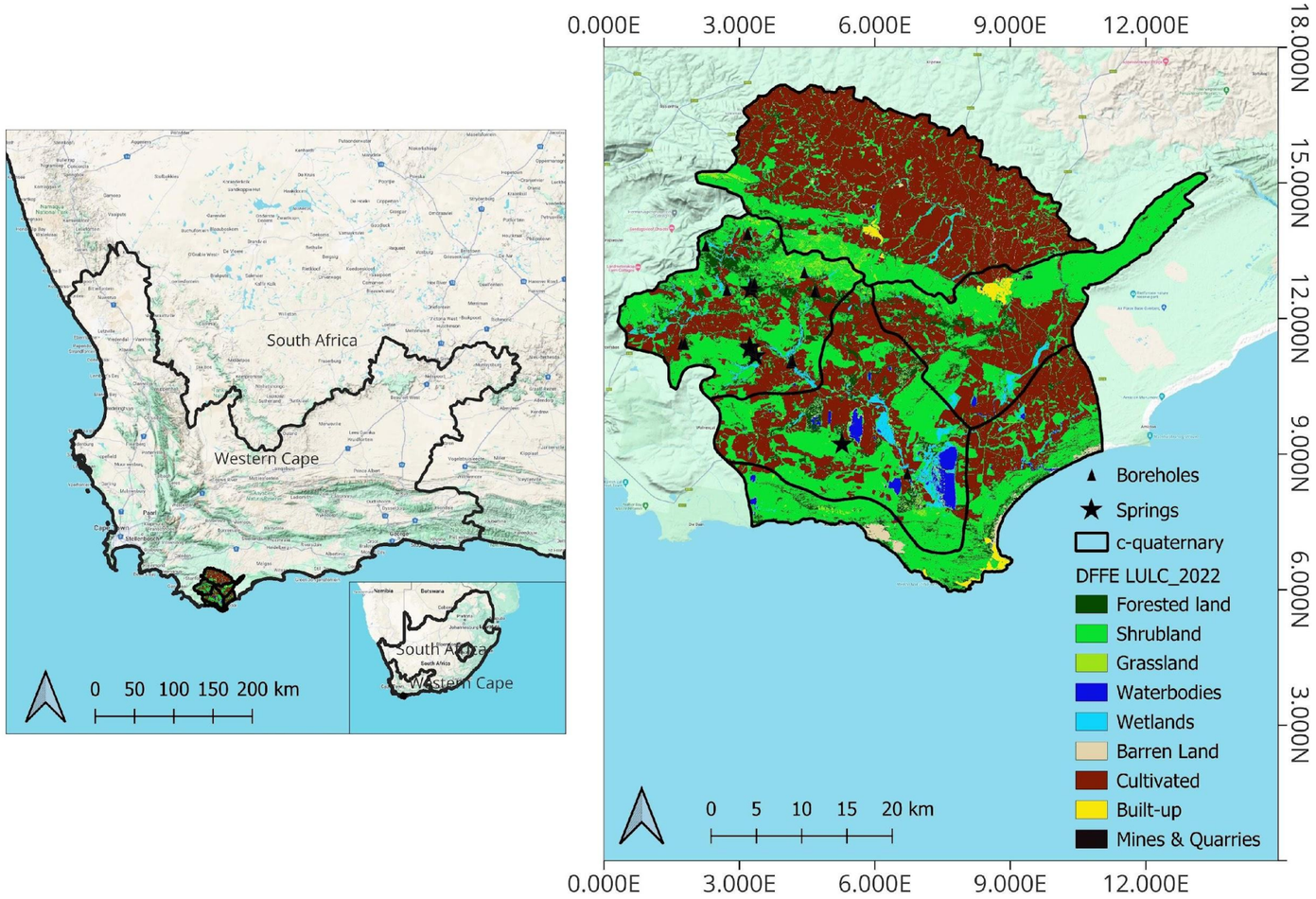

Fig 5: Study Area Map of Heuningnes Catchment

- Heuningnes Catchment- situated within Overberg region, Western Cape, Southern Africa.
- Area covers ~ 1442 km^2 & elevation up to ~837 a.l.s
- Dominant geology –TMG & Bokkeveld Group
- Meditteranean Climate, hot dry summers (Nov-Mar) & wet winters (May to Aug).
- Temp rises from ~ 10°C lowest, up to ~ 27°C max.
- Average rainfall ~ 650 p.a in mountainous regions
- Dominant native veg type is Fynbos, dominant IAS are Acacia species.
- Major land uses are crop cultivation/farming.

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METHODOLOGY

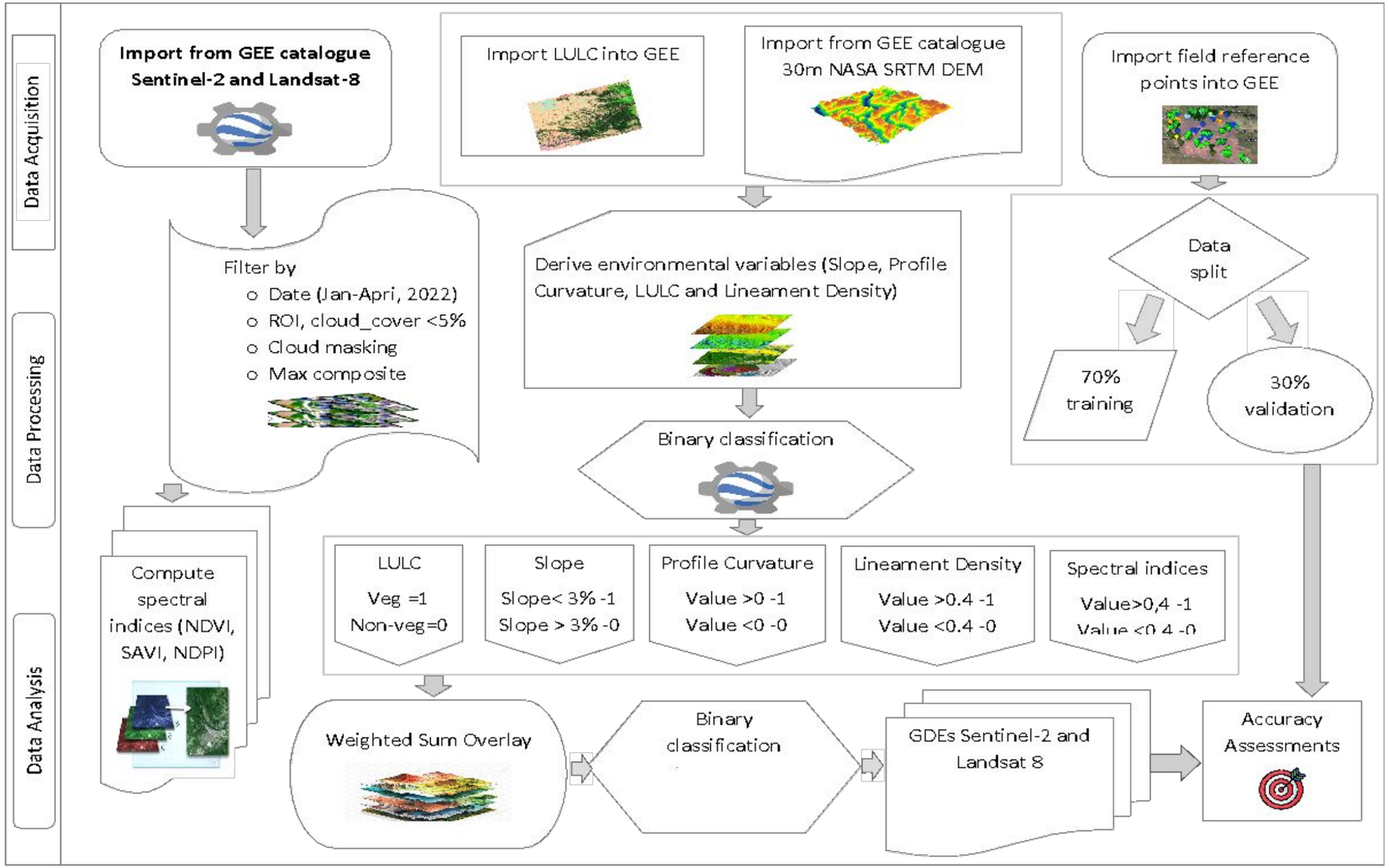

Fig 6: Flowchart illustrating the general methodology applied to delineate potential groundwater-dependent ecosystems (GDEs)

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METHODOLOGY

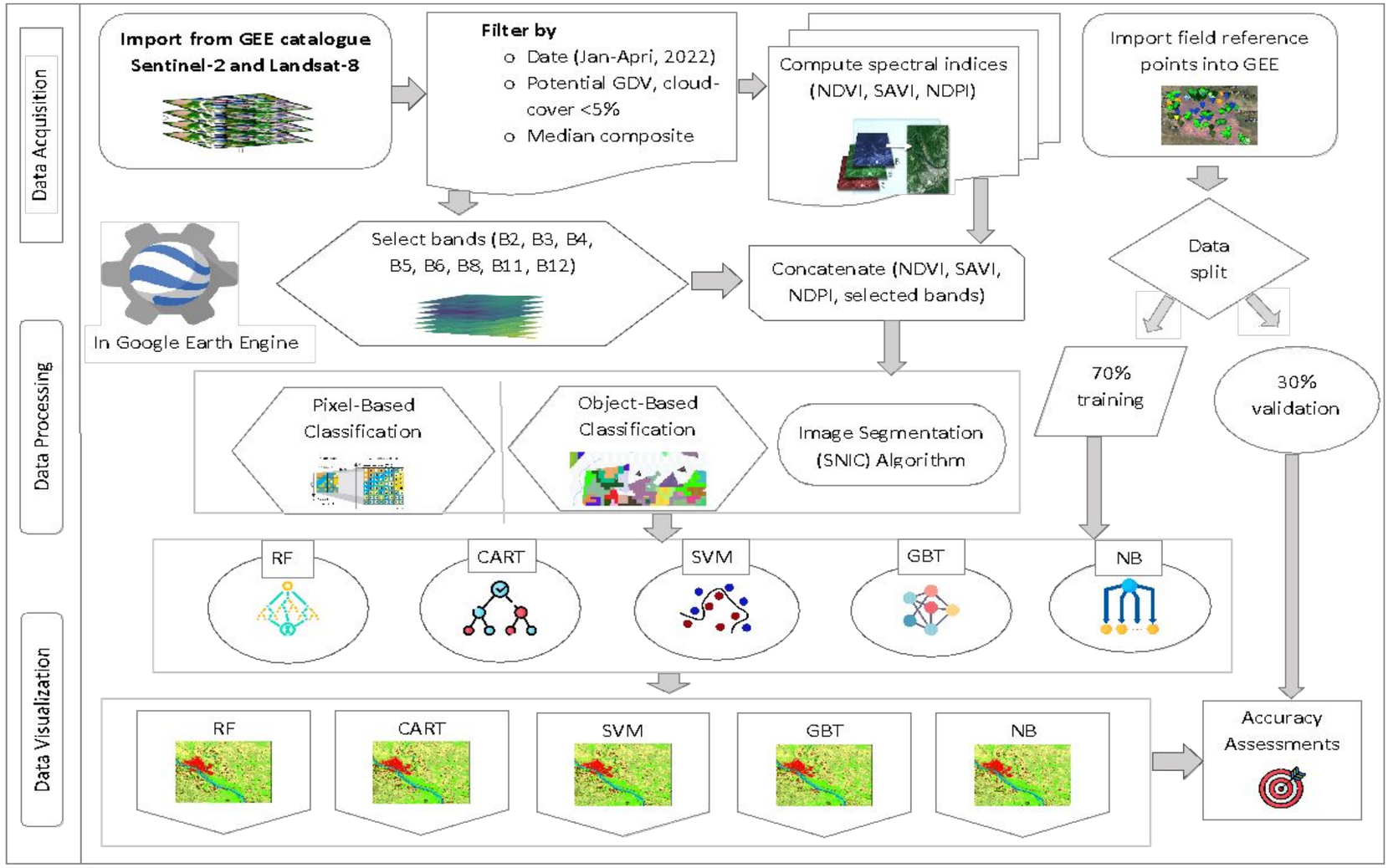

Fig 7: Mapping GDIAPs using Sentinel 2 and Landsat-8 satellite data for 2022

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FINDINGS & ANALYSIS

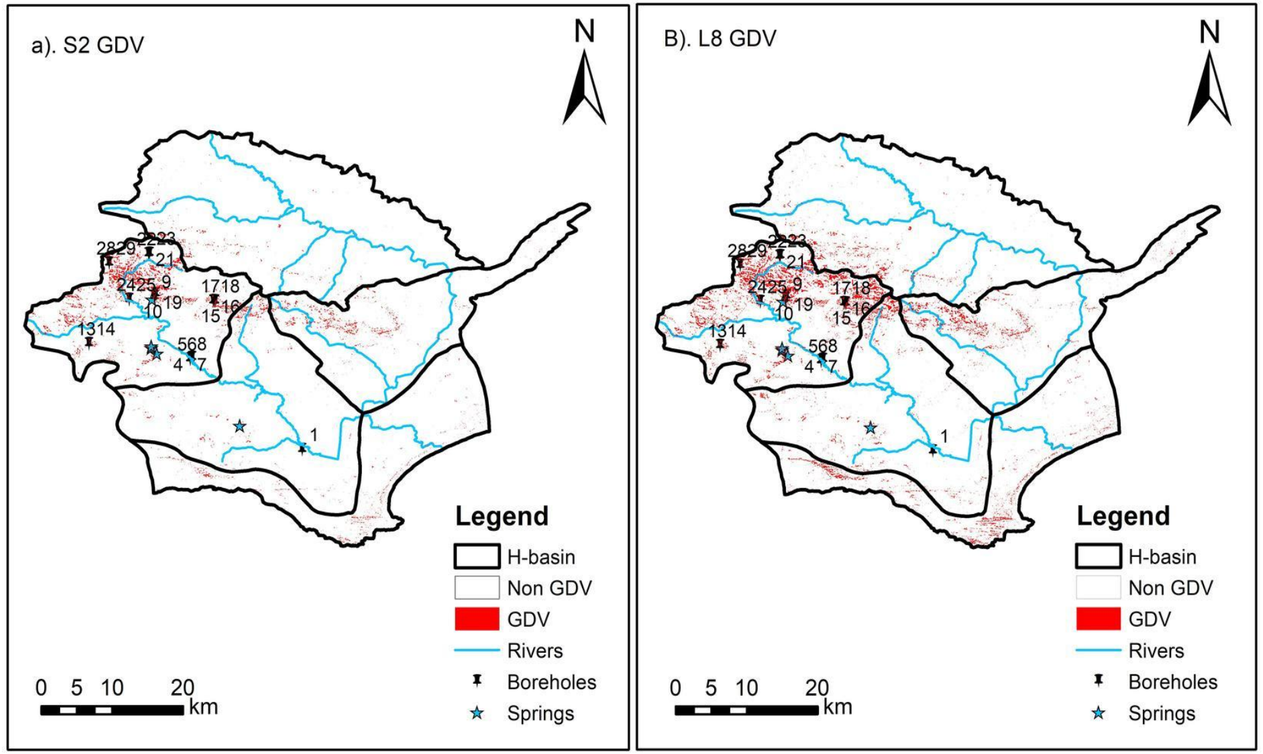

Fig 8: Potential GDEs in Heuningnes Catchment derived using Sentinel 2 and Landsat 8 multispectral data.

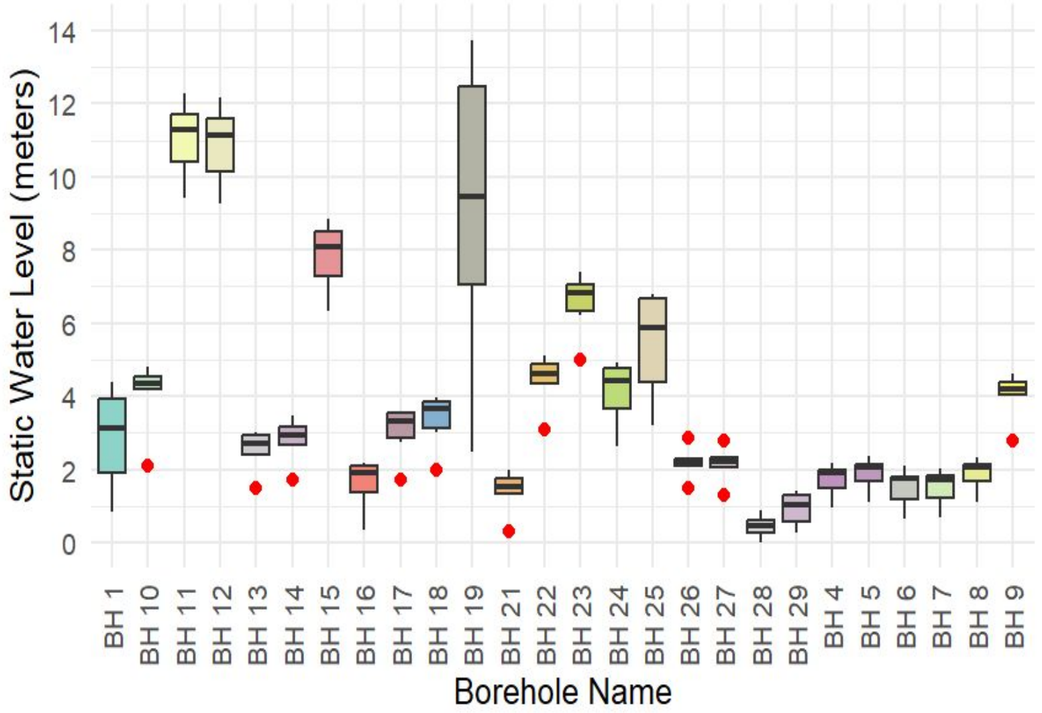

Fig 9: Variations of daily groundwater levels of 27 wells in Heuningnes Catchment during Jan-April 2022.

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FINDINGS & ANALYSIS

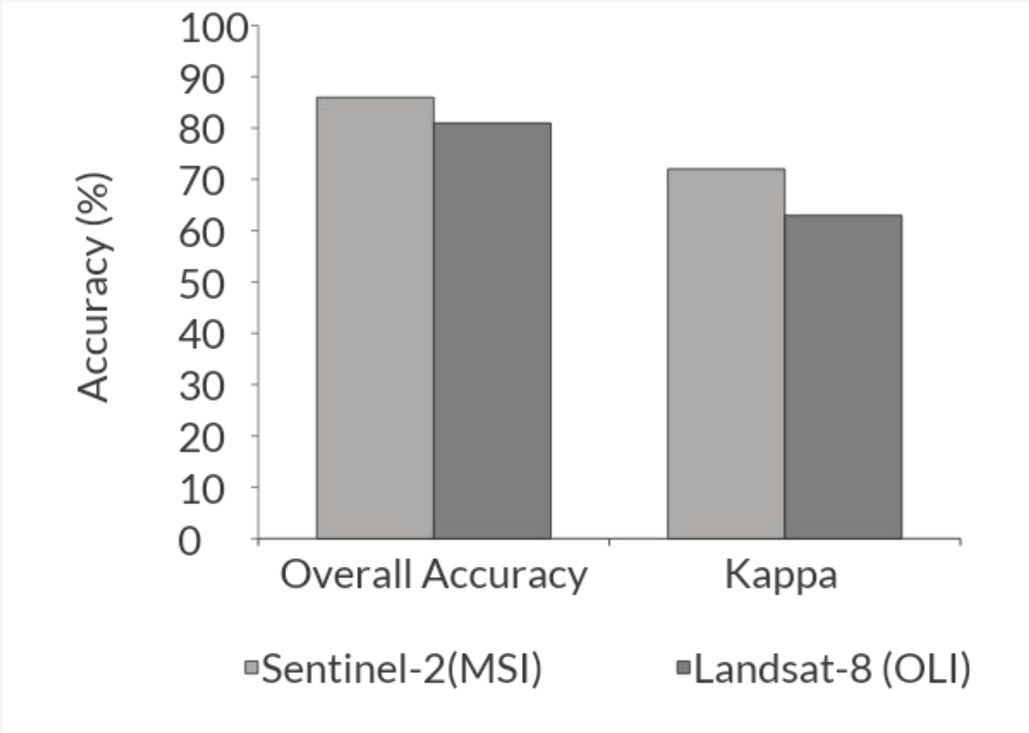

Fig 10: Overall Accuracies achieved by Sentinel 2 and Landsat 8, for detecting GDEs

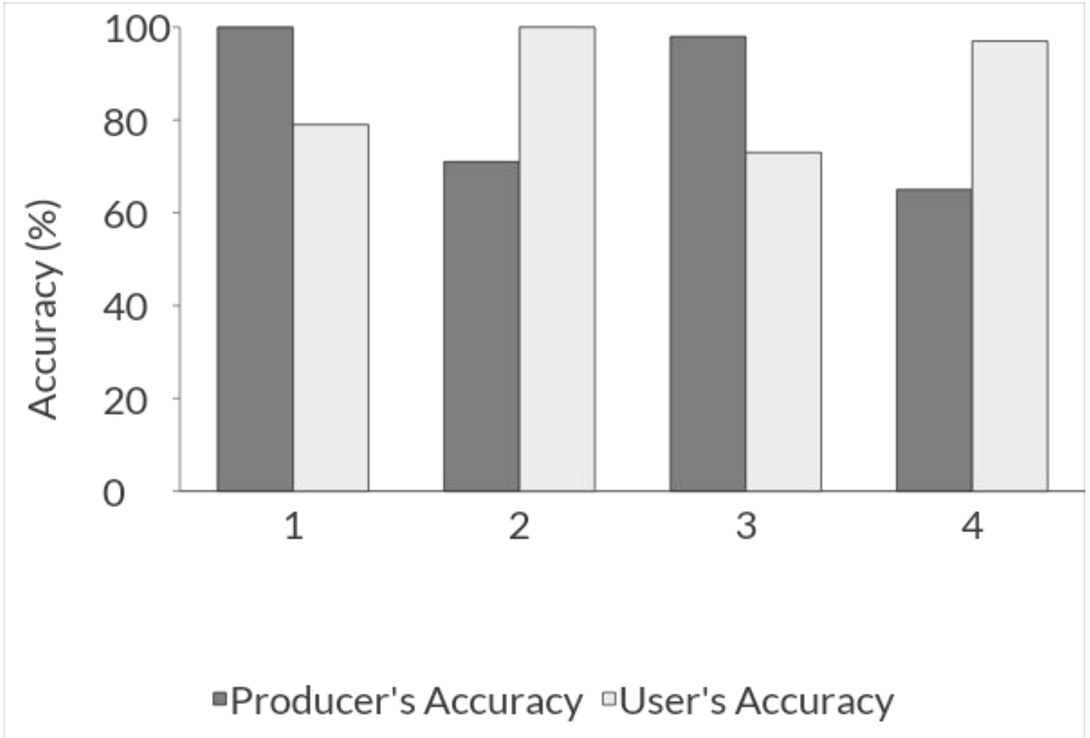

Fig 11: Producer and User's Accuracies achieved by Sentinel 2 and Landsat 8, for detecting GDEs

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FINDINGS & ANALYSIS

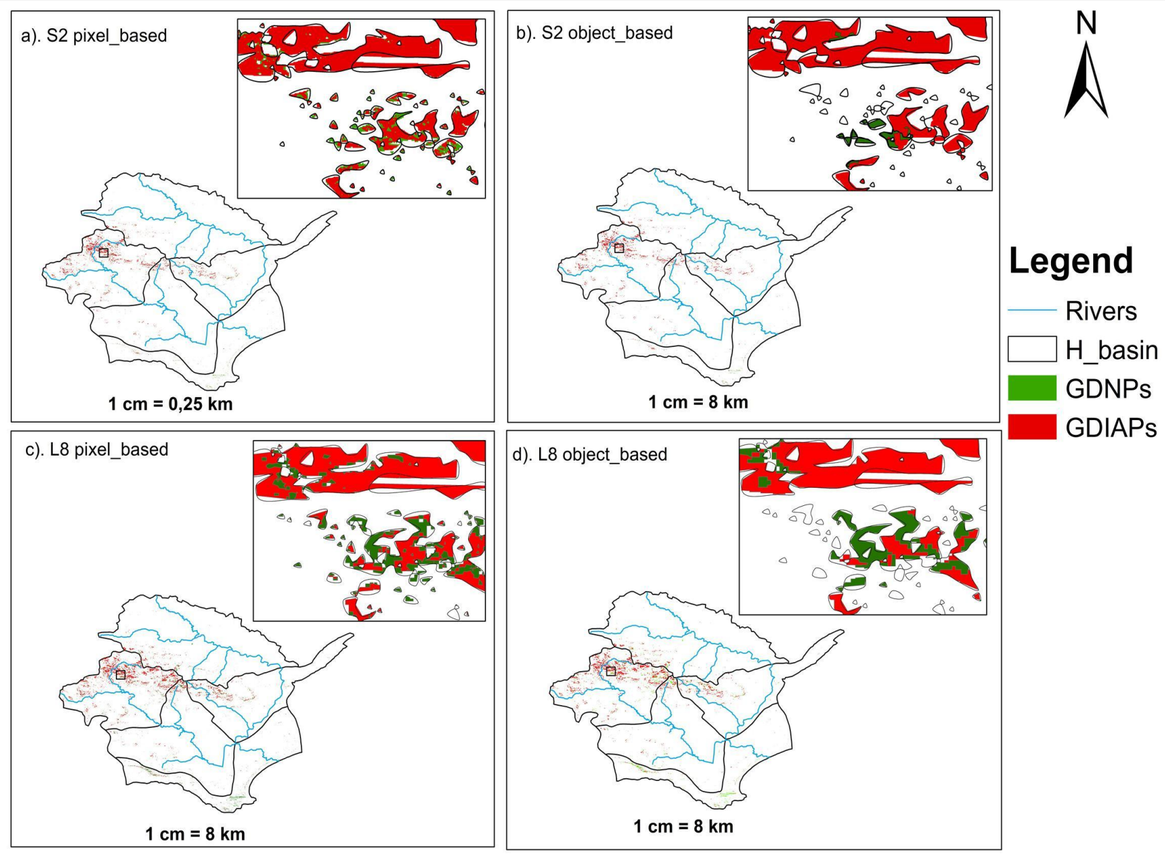

Fig 12: Random forest classification of GDIAPs and GDNPs using Sentinel 2 and Landsat-8 data.

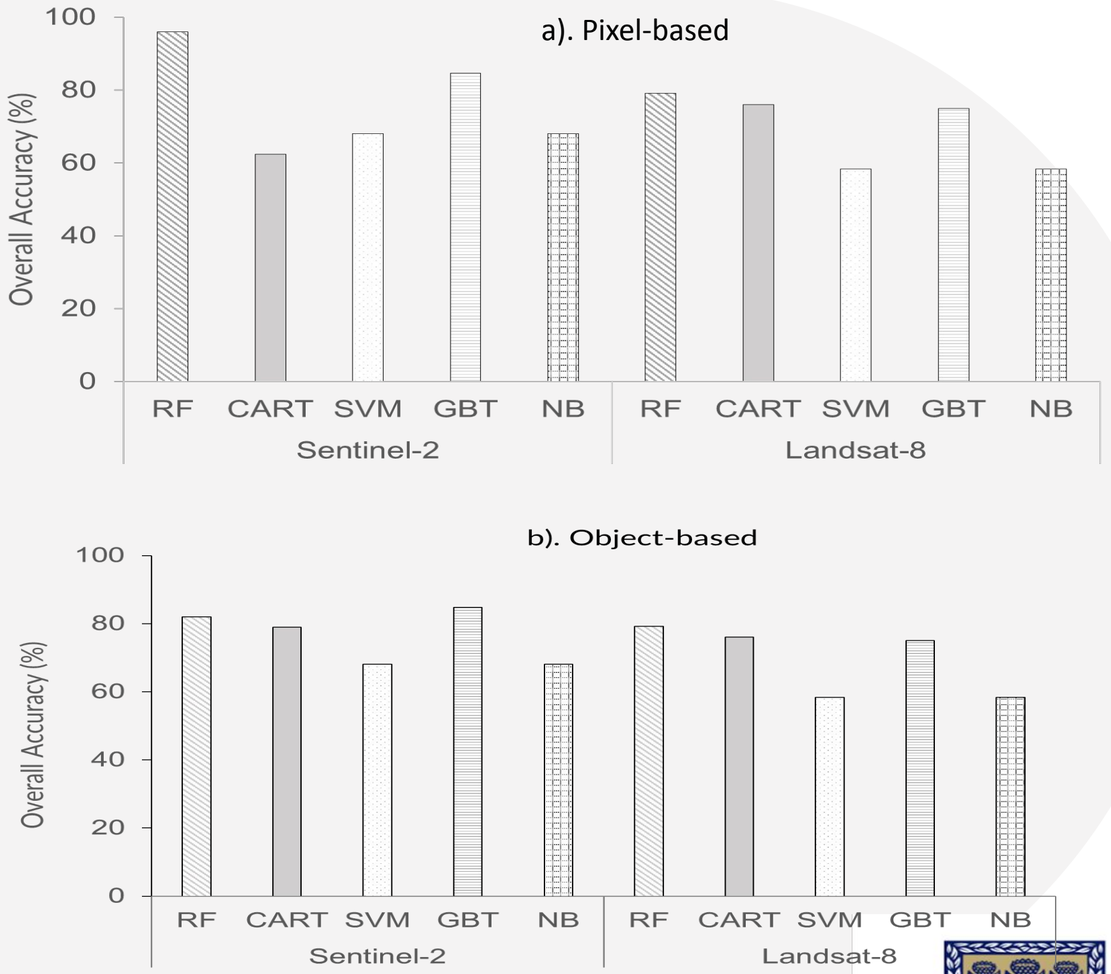

Fig 13: Overall Accuracies achieved by Sentinel 2 and Landsat 8, for detecting GDEs.

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IMPACTS & IMPLICATIONS

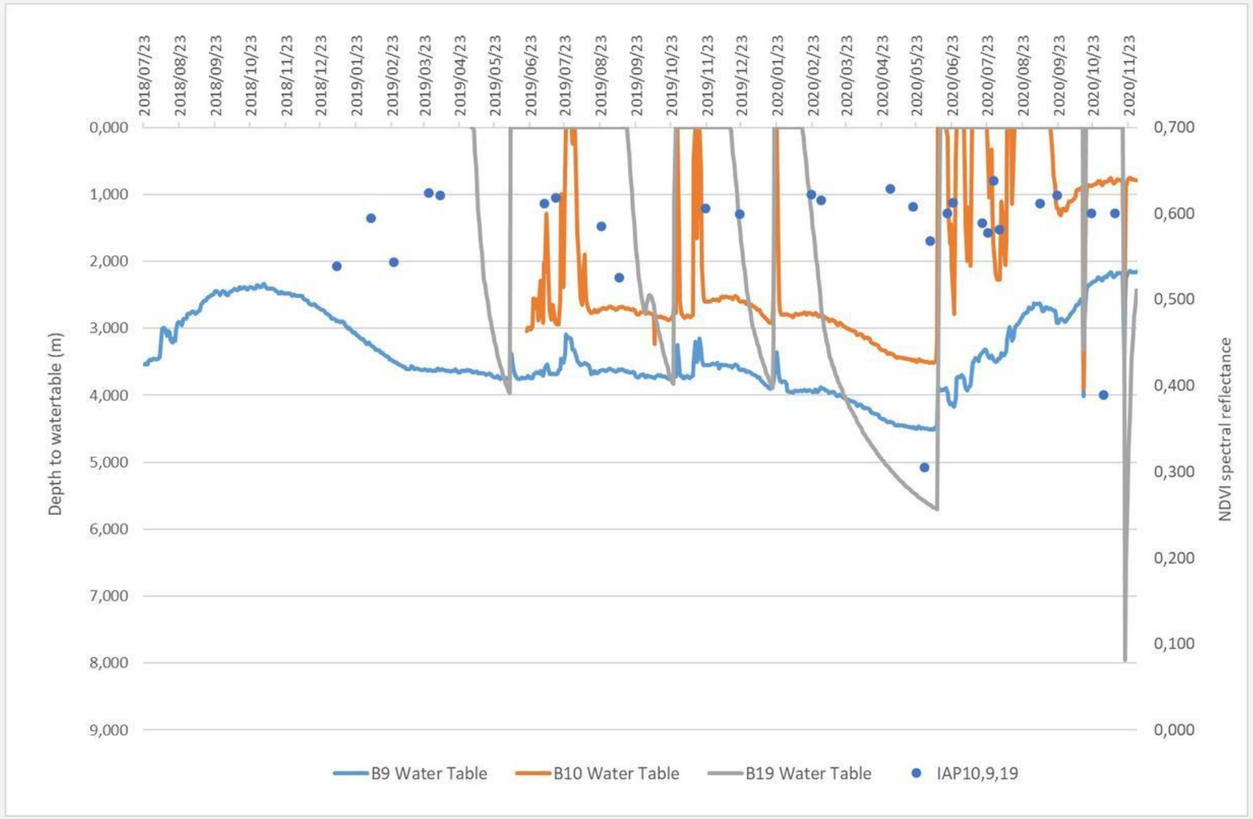
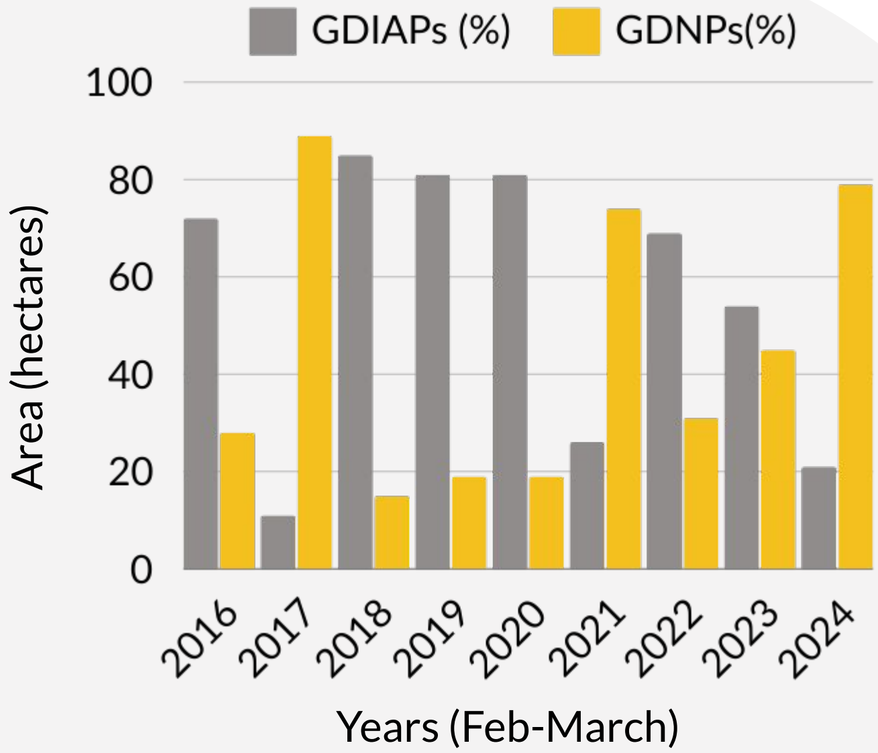


Fig 14:S2 NDVI spectral reflectance of IAPs relative to depth to groundwater



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CONCLUSION

- The need for specialized methods to detect and monitor GDIAPs species
- Invasive species affect groundwater resources and GDEs, and the lack of effective monitoring efforts.
- RS and MLA provides reliable results for monitoring GDIAPs in semi-arid regions.
- Many thanks to SADC-GMI and NRF for Funding this Project.

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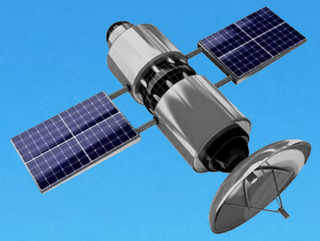

THANK YOU