Detecting woody invasive alien plants using Sentinel-2 imagery in the uMzimvubu Catchment, Eastern Cape

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Introduction

Invasive alien plants (IAPS) impose risks to biodiversity, water security and economies of many countries.

Woody IAPS have been shown to significantly decrease runoff in South Africa (Le Maitre et al., 2016).

7.1 billion Rand was spent between 1998-2020 in clearing efforts (Wilgen, 2022).

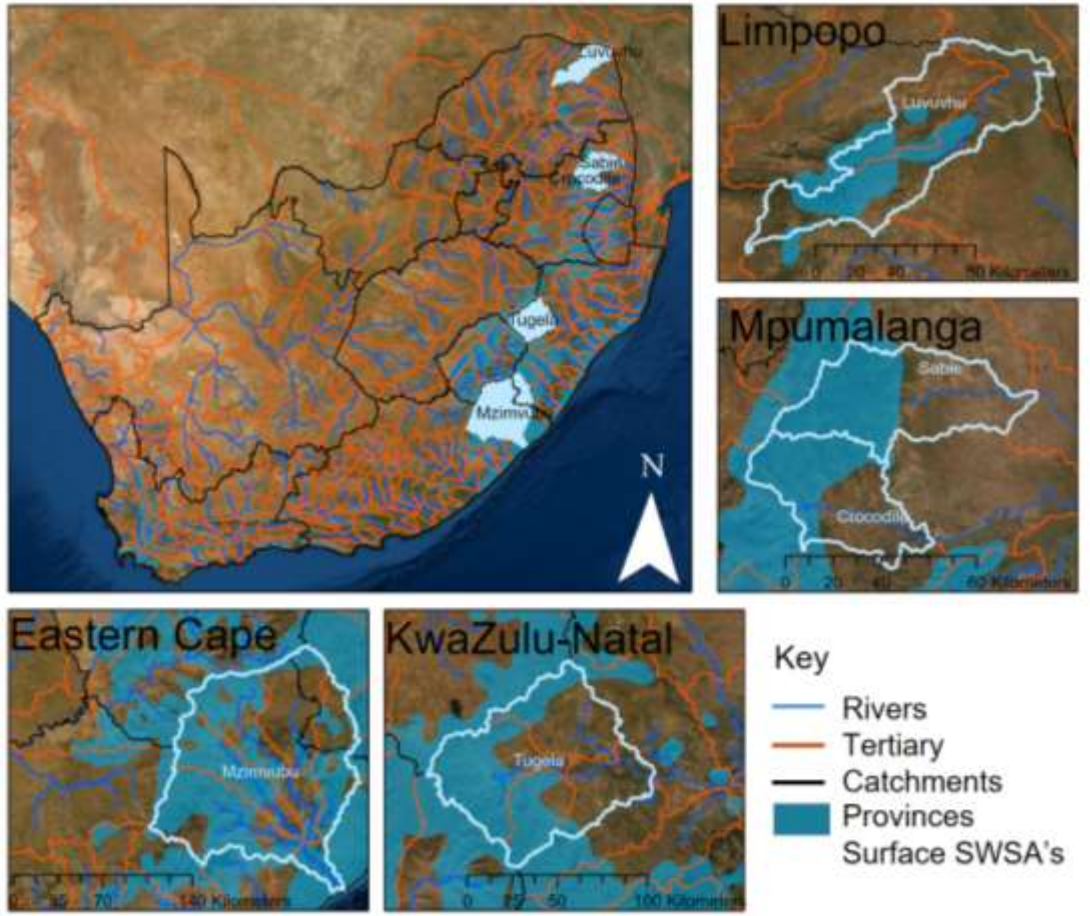
Clearing is hindered by high costs and lack of knowledge on the distribution and severity of invasions (Rebelo et al., 2021; Theron et al., 2022).

MAPWAPS

Mapping woody invasive alien plant species and their impacts in strategic water source areas

Aims – Use freely available satellite imagery to:

1. Map woody invasive alien plants in key SWSA's
2. Estimate the water use of woody invasive alien plants



Methods

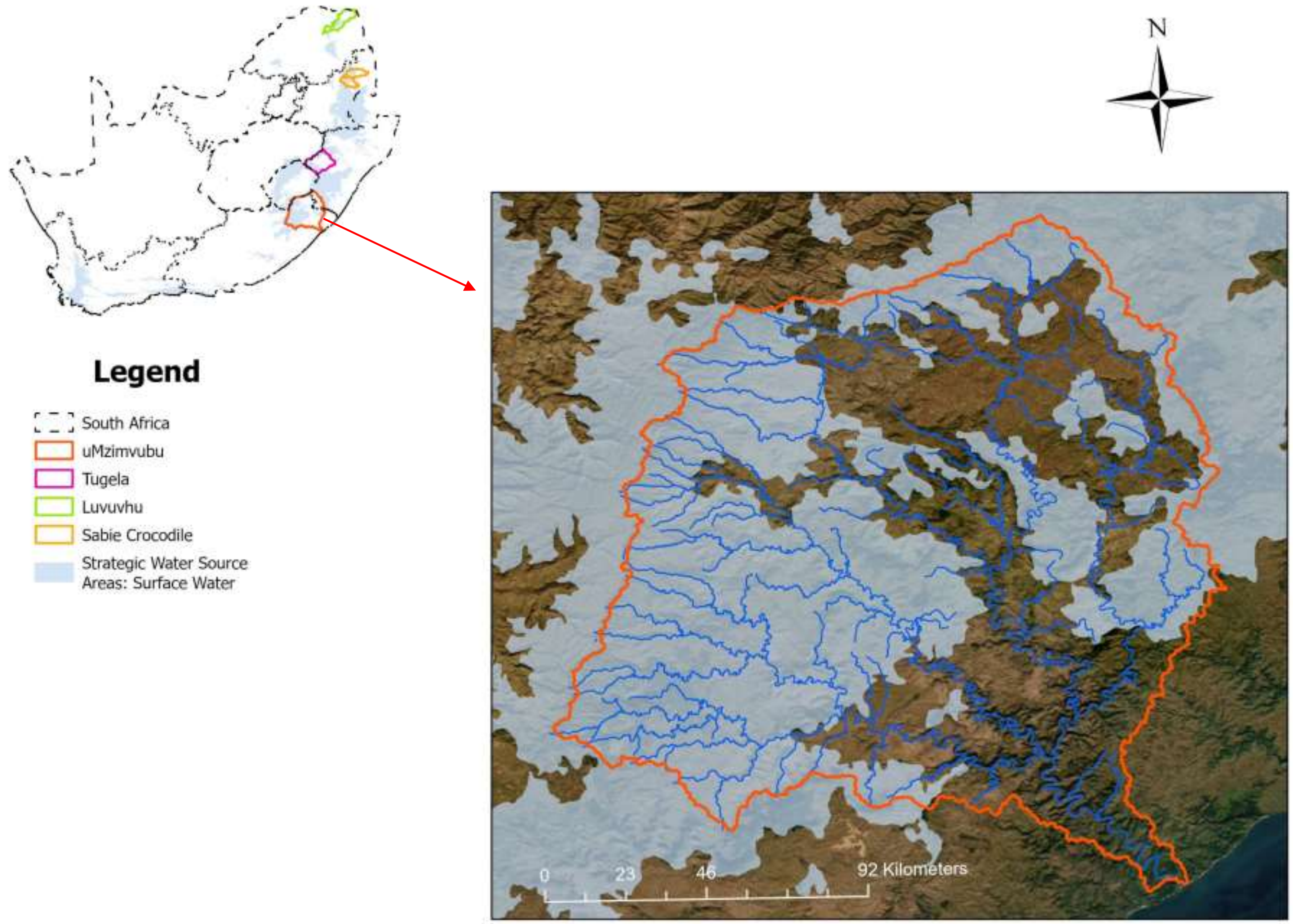
- Hold stakeholder workshops to determine scope
- Collect geotagged photos of LULC as training data using Cybertracker App
- Process training data on ArcGIS Pro
- Perform classification using Google Earth Engine
- Make all training data available on iNaturalist.org

WRC Project: 2022/2023-00901

Dr Alanna Rebelo, Prof Karen Esler, Liam Cogill, Thandeka Skosana; find out more: RebeloA@arc.agric.za

Study Area

- uMzimvubu Catchment
- composed of 5 tertiary catchments
- 19 852 km^2 in area
- The river system is approximately 400 km in length (Sellick, 2005).
- The river is least constructed and preserves its natural flow regime (Zunckel, 2013).



Methodology: Stakeholder workshop

- In person workshop on the 22nd February 2023.
- At the uMzimvubu Catchment Partnership (UCP) quarterly meeting

Aims of the workshop

- Solicit input regarding problematic invasive alien plants in the catchment
- Learn more about access to dense stands of invasive alien plants

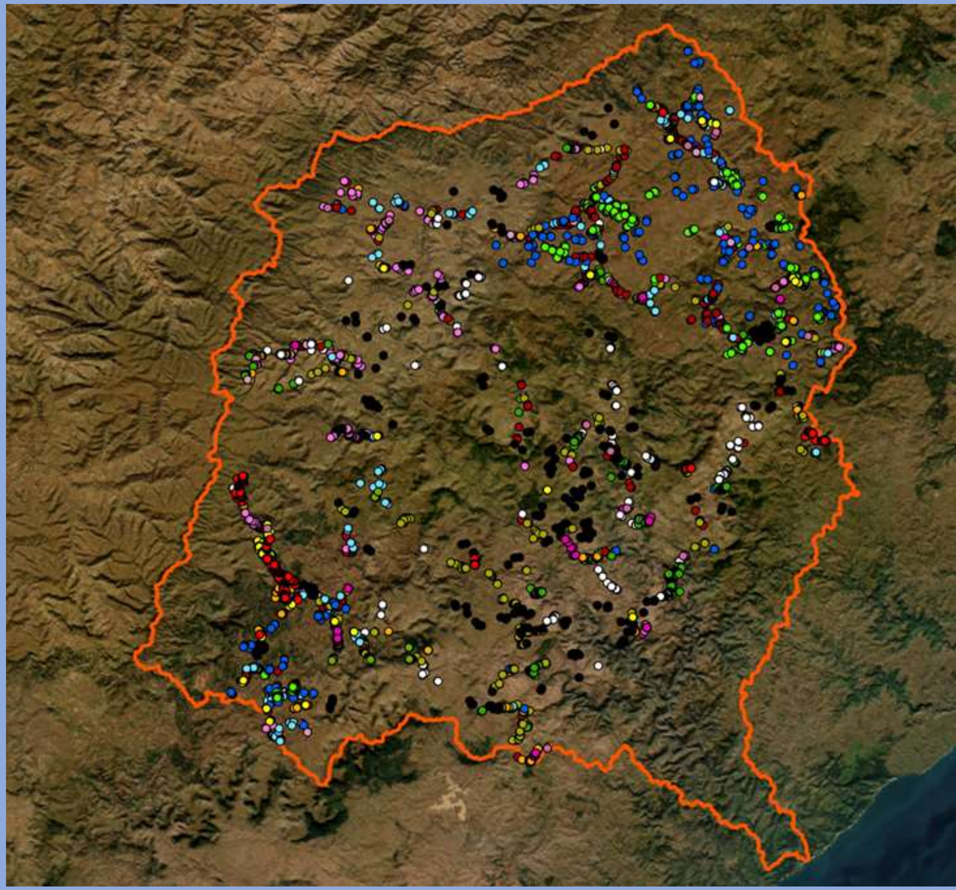
UMZIMVUBU CATCHMENT PARTNERSHIP PROGRAMME

Methodology: Fieldwork

- 19 May- 6 June 2023
- Collected geotagged pictures of different land use land cover (LULC) using road networks on Cybertracker
- Process training data on ArcGIS Pro
- Upload pictures on iNaturalist.

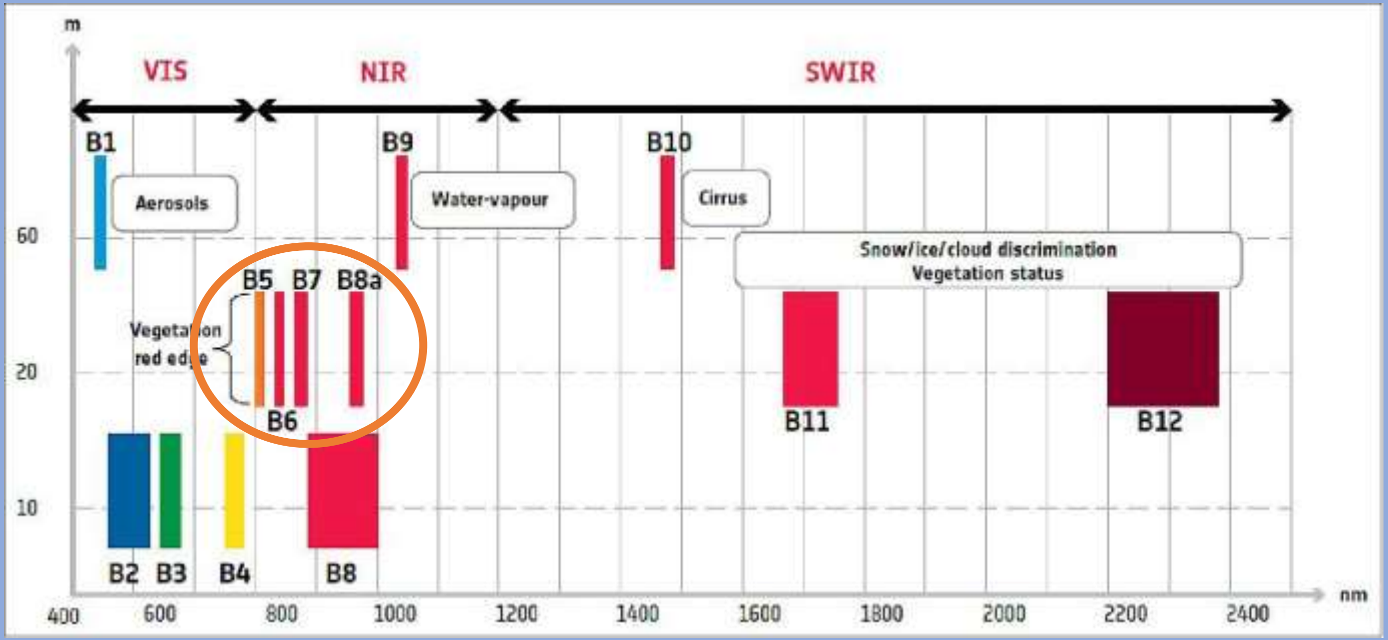
Metadata
Land use land cover type
Coordinates
Direction from LULC
Distance from LULC (m)
Age estimation of IAPs
Density of IAPs (% cover)

	LULC CLASS
	Irrigated Agriculture
	Dryland Agriculture
	Maize
	Grassland
	Indigenous Bush
	Water
	Wetland
	Bare Ground
	Urban
	Indigenous Forest
	Silver Wattle
	Black Wattle
	Poplar
	Pine
	Gum
	Other IAP



Methodology: Data analysis

- Red-edge vegetation bands improve IAP detection (Masemola et al., 2020).
- Spectral vegetation indices and bands promotes high accuracies in multispectral sensors (Kandwal et al., 2009; Rajah et al., 2020; Rebelo et al., 2020 Holden et al., 2021).
- Use code on GEE, method from Holden et al., 2021
- Sentinel-2 imagery from May 2023
- Accuracy assessment (Overall accuracy %)



Classification	Description	Motivation	Classifier	Features
Classification 1	All bands + all indices+ S1	All	SVM	B2, B3, B4, B5, B6, B7, B8, B8A, B11, B12, NDVI, Chlogreen, LAnthoC, LCaroC, LChloC, BAI, GI, gNDVI, MSI, NDrededgeSWIR, NDTI, NDVIre, NDVI1, NDVI2, NHI, EVI, EVI2, EVI2_2, MSAVI, NormG, NormNIR, NormR, RededgePeakArea, RedSWIR1, RTVIcore, SAVI, SRBlueRededge1, SRBlueRededge2, SRBlueRededge3, SRNIRnarrowBlue, SRNIRnarrowGreen, SRNIRnarrowRed, SRNIRnarrowRededge1, SRNIRnarrowRededge2, SRNIRnarrowRededge3, STI, WBI, NDMI, NDBR, VV,VH

Research Question

Is it possible to discriminate between different species of wattle using Sentinel-2 in the uMzimvubu Catchment?

Black Wattle

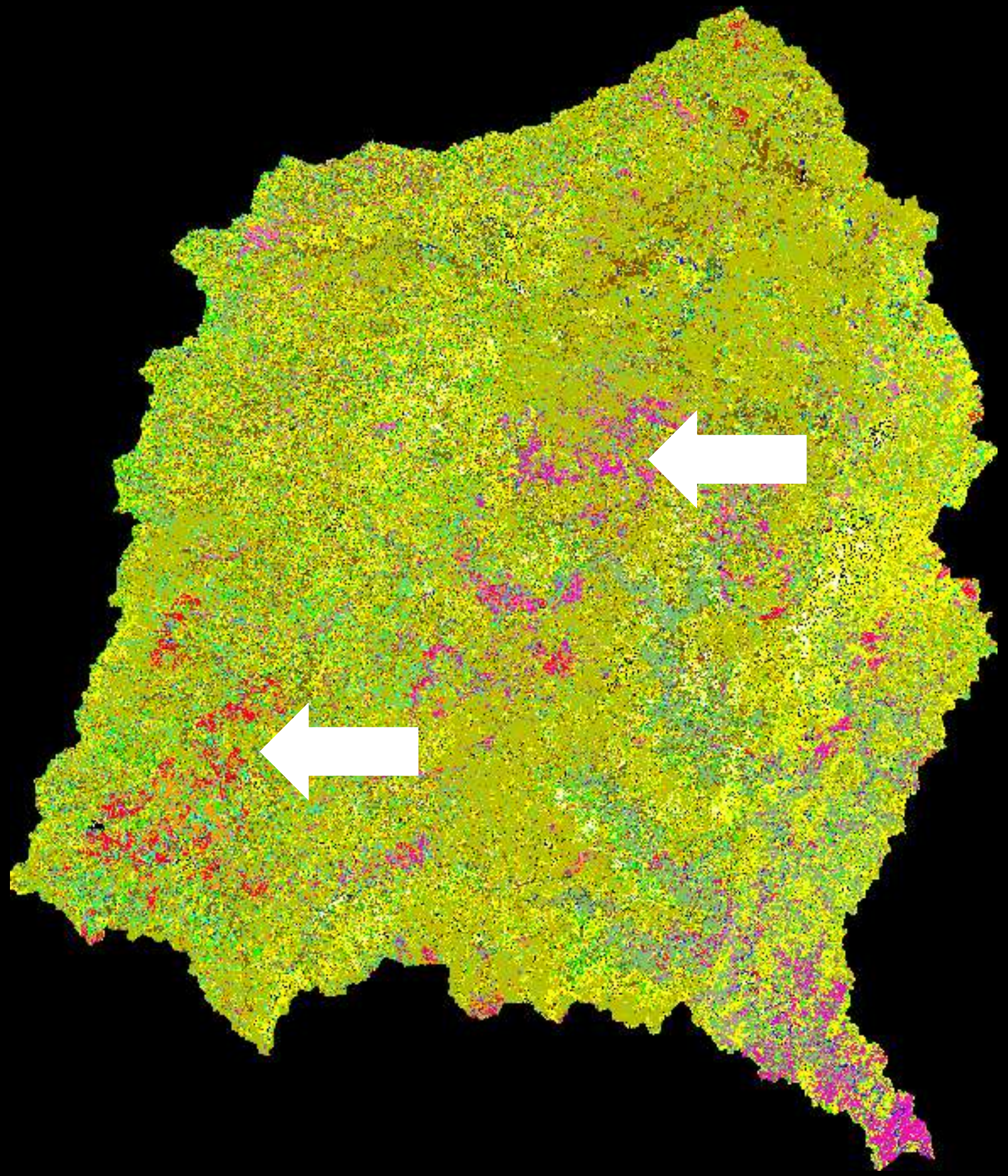
Silver Wattle

Green Wattle

Results: Fieldwork observations

- Silver Wattle dominating in riverine areas and grasslands
- Maize is the dominant land use
- Pine plantations present
- Old Gum plantations
- Wetlands are a prominent feature

Results: Overall classification

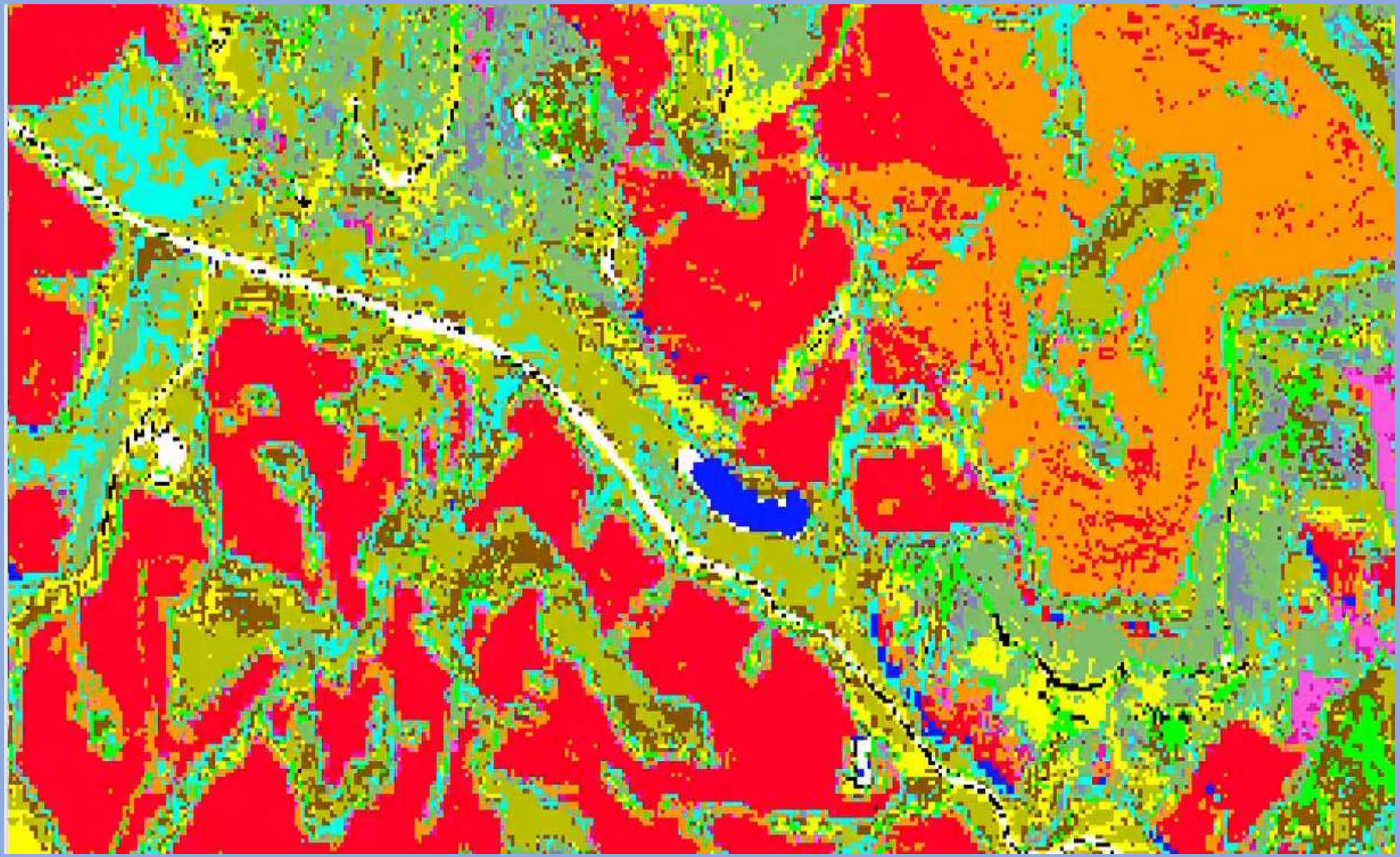


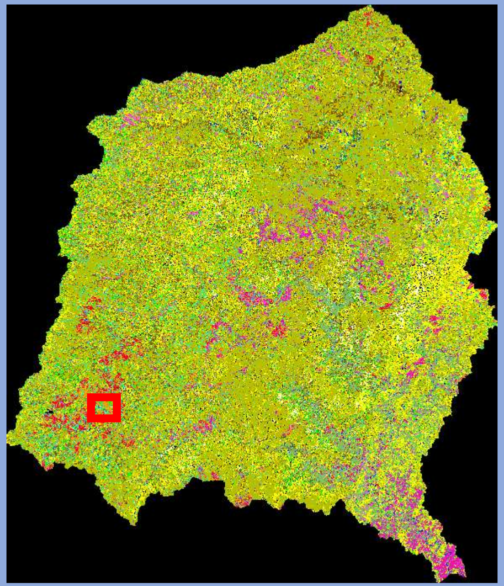
Overall accuracy=77%

Legend

- Bare Ground
- Black Wattle
- Dryland Agriculture
- Grassland
- Green Wattle
- Gum
- Indigenous Bush
- Irrigated Agriculture
- Maize
- Pine
- Poplar
- Silver Wattle
- Other IAP
- Water
- Wetland
- Urban

Results: Pine and Gums plantations

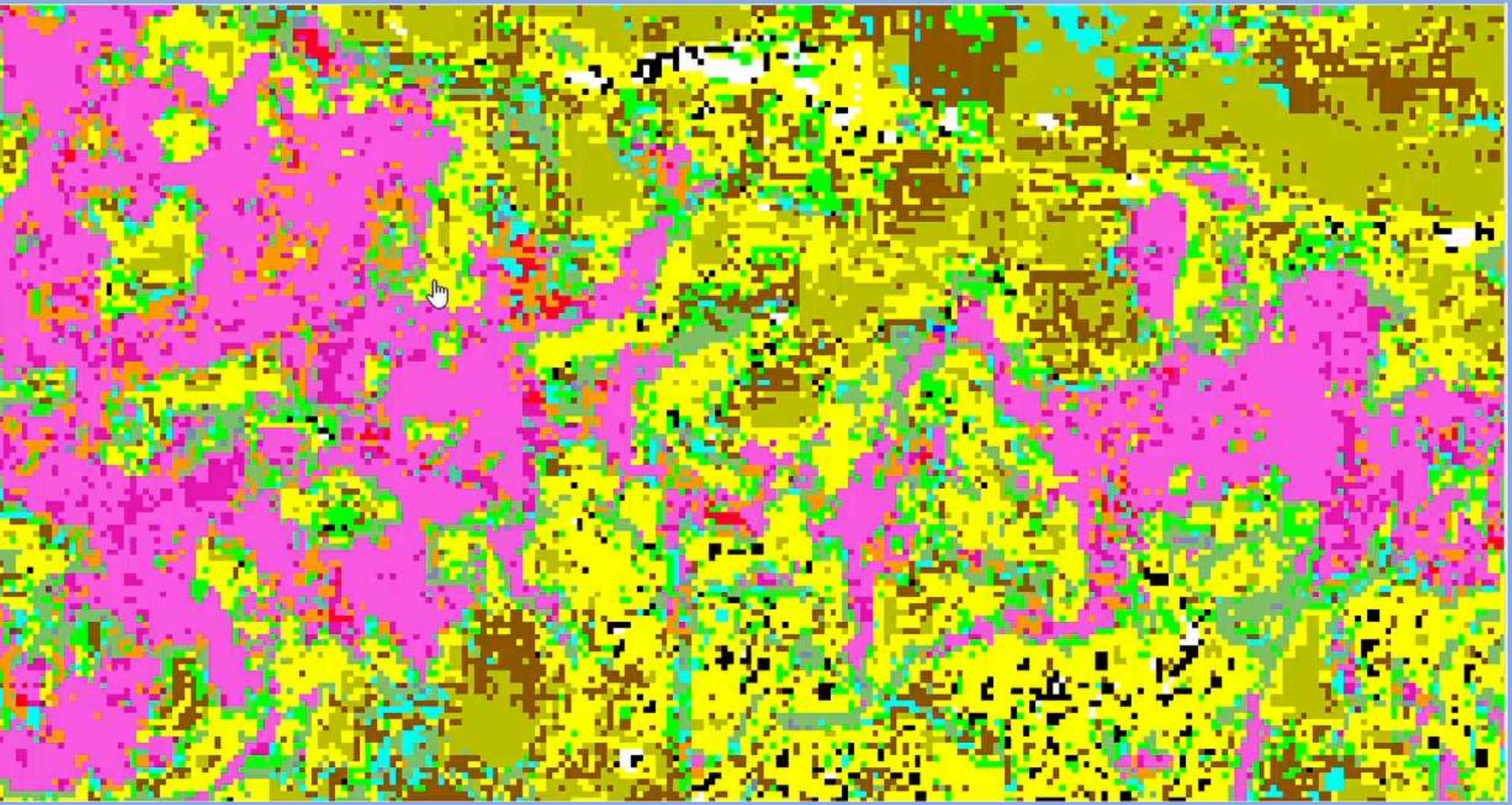


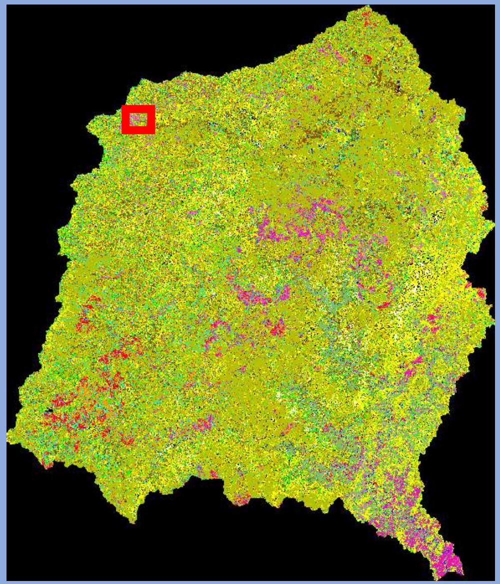


Legend

Grassland
Indigenous Bush
Pine
Gum
Water

Results: Silver Wattle

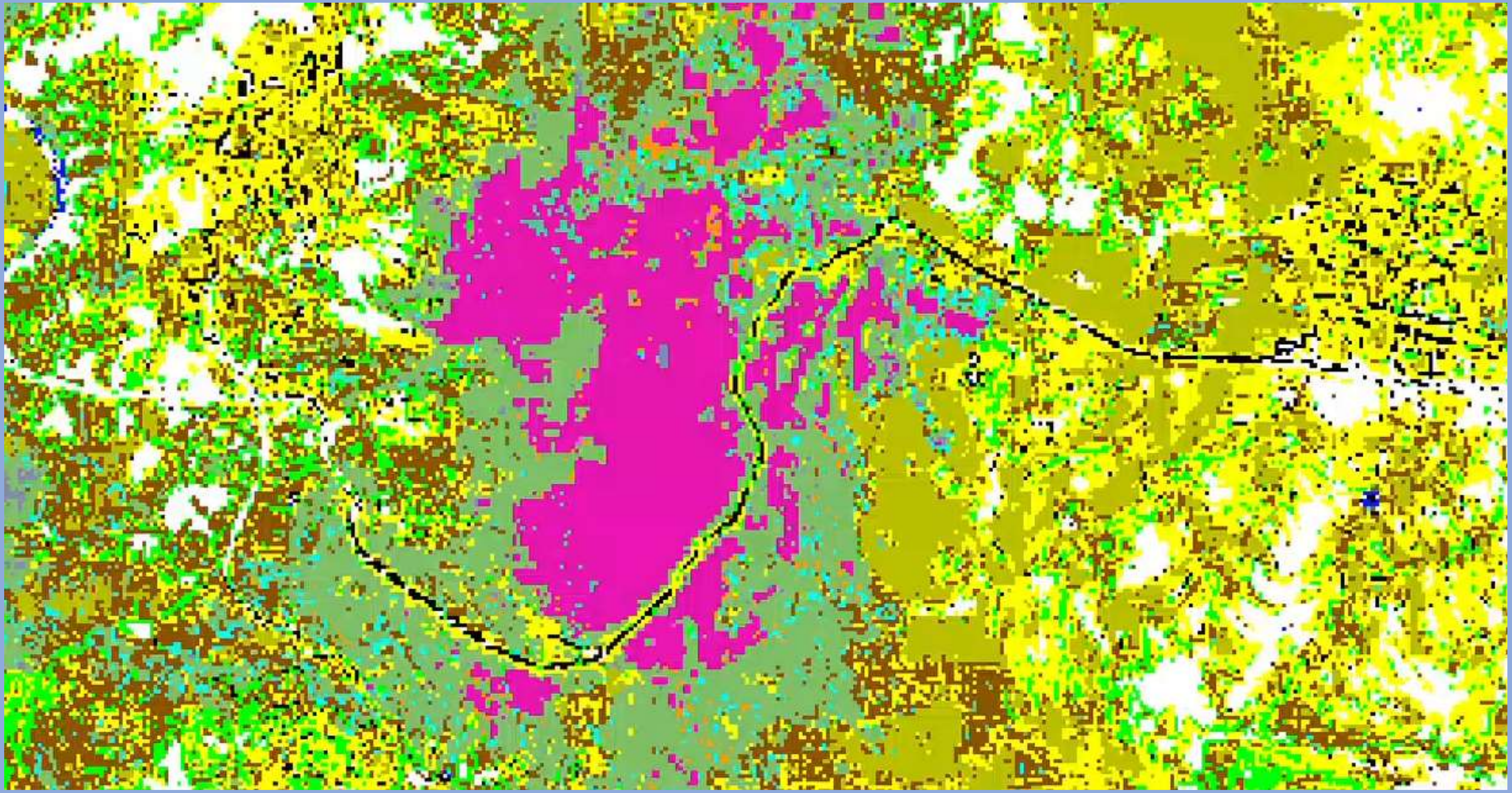


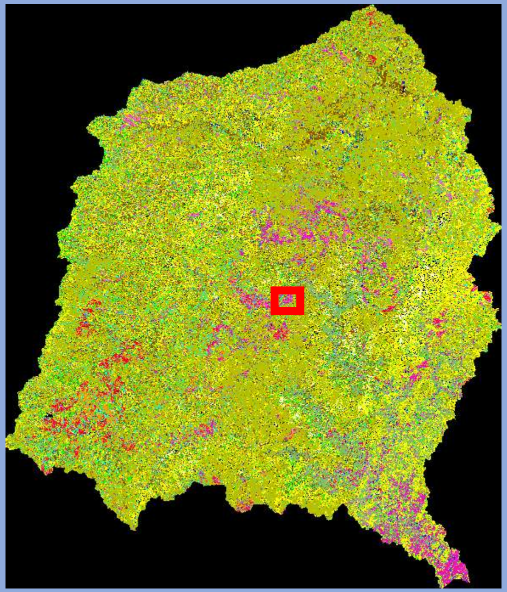


Legend

- Grassland
- Indigenous Bush
- Silver Wattle
- Dryland Agricultu

Results: Black Wattle

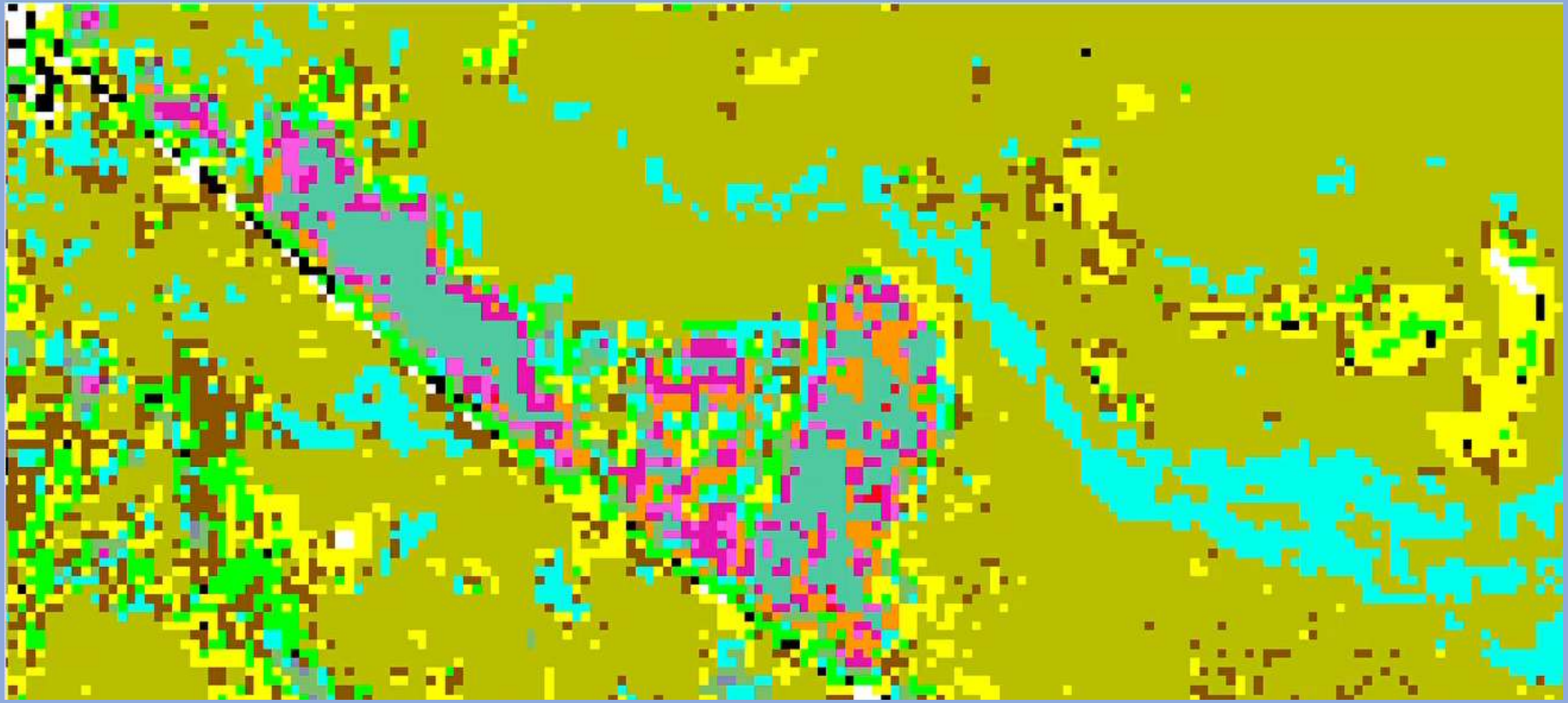


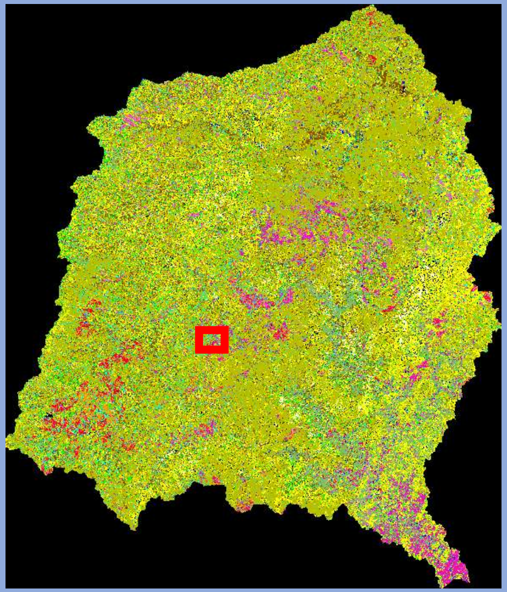


Legend

- Grassland
- Indigenous Bush
- Black Wattle
- Maize

Results: Green Wattle





Legend

Grassland

Green Wattle

Wetland

Closing remarks

- Sentinel proved to be able to discriminate between different wattle species.
- However, in some cases Silver Wattle was mixed with Black Wattle.
- These results, maps of the different Wattle species, will assist local people and organization with strategic management.
- Further analysis like phenology studies could be used to improve results.

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WATER
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ERS
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UMZIMVUBU
CATCHMENT
PARTNERSHIP
PROGRAMME

Thank you to the stakeholders of the UCP