



agriculture,  
forestry & fisheries

Department:  
Agriculture, Forestry and Fisheries  
REPUBLIC OF SOUTH AFRICA



UNIVERSITY OF  
BIRMINGHAM



# Predictive characterization

Willem Jansen van Rensburg

Final Dissemination Meeting  
23<sup>rd</sup> – 25<sup>nd</sup> November 2016



# Introduction

---

## Predictive characterization

- Assigns potential traits
- Based on the ecogeographical conditions
- Assume certain ecogeographical conditions encourage the development of certain adaptive traits
- e.g. that drought tolerance will develop in areas of low rainfall.



# Materials and Methods

- SANBI Occurrence dataset
- DIVA
  - All mapping
- CAPFITOGEN
  - TesTable - Data quality
  - ELCmapas - ELC Map
  - ECOGEOA - Summary of the ecogeographical conditions
  - FIGS\_R - predictive characterization
  - Selecvar - Variable selection



# Results: Crops

## Sorghum

- African grain crop.
- Basic staple for rural communities.
- Planted October to December.
- Rainfall pattern and other weather
  - Planting period
  - Length of the growing season.
- Shallow and heavy clay soils.
- Mainly cultivated in drier areas.
- Free State and Mpumalanga Provinces.
- 2008 to 2013: 203 700 tons annually.



# Results: Crops

---

- Cowpea
  - African crop.
  - Commercial and small holder farmers
  - Pulse, leafy and fodder.
  - Important source of protein.
  - Drought tolerant.

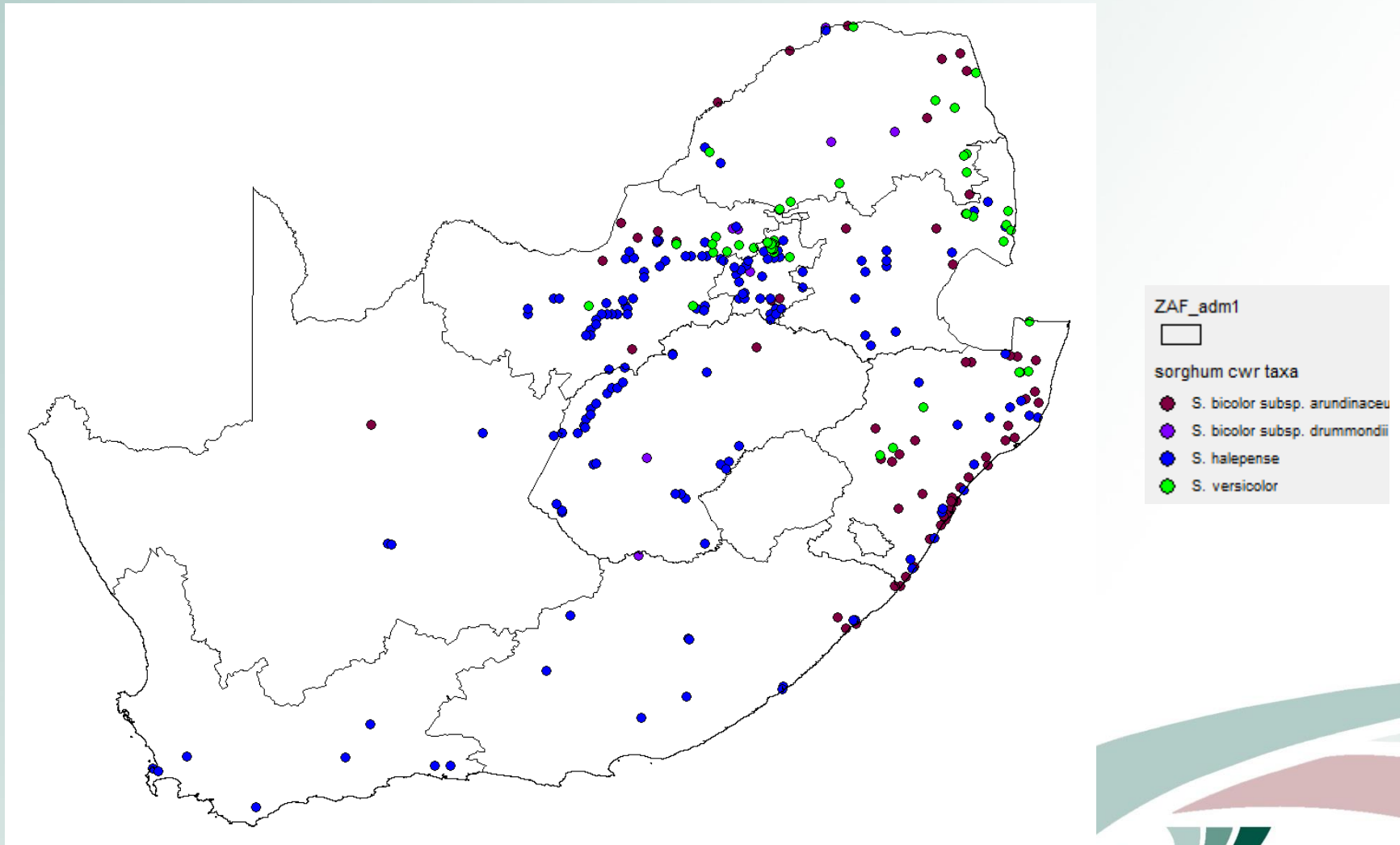


# Results: Occurrence Data

<b><i>Sorghum</i> wild Relative</b>	<b>Number of accessions in dataset</b>
<i>Sorghum bicolor</i> subsp <i>arundinaceum</i>	86
<i>Sorghum bicolor</i> subsp <i>drummondii</i>	11
<i>Sorghum versicolor</i>	56
<i>Sorghum halapense</i>	183

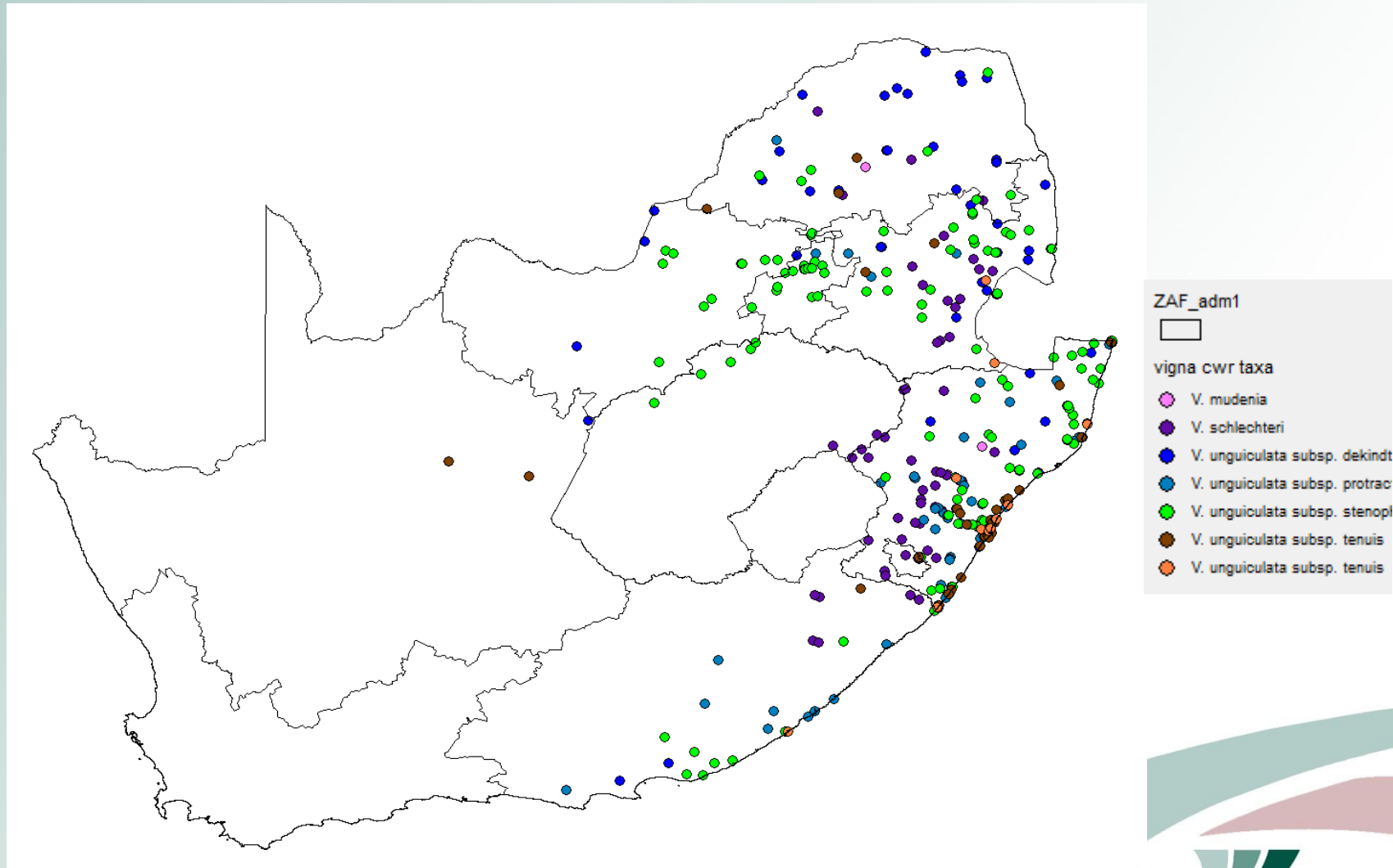
<b><i>Cowpea</i> wild Relative</b>	<b>Number of accessions in dataset</b>
<i>Vigna mundenia</i>	12
<i>Vigna schlechteri</i>	123
<i>Vigna unguiculata</i> subsp. <i>dekindtiana</i> var. <i>dekindtiana</i>	77
<i>Vigna unguiculata</i> subsp. <i>protracta</i>	118
<i>Vigna unguiculata</i> subsp. <i>stenophylla</i>	212
<i>Vigna unguiculata</i> subsp. <i>tenuis</i>	104
<i>Vigna unguiculata</i> subsp. <i>tenuis</i> var. <i>ovata</i>	15

# Results: Occurrence Data



Sorghum CWR occurrence data

# Results: Occurrence Data



Cowpea CWR occurrence data



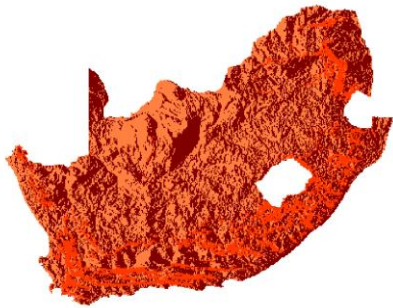
# Results: ELC Map

---

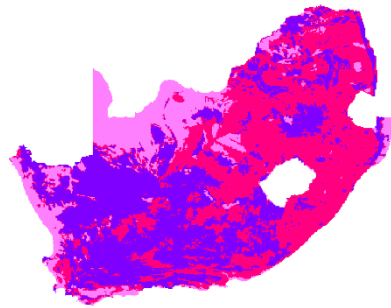
## Ecogeographical Land Characterization map

- Bioclimatic variables:
  - Annual average temperature
  - Average temperature for the wettest quarter
  - Annual rainfall mm
  - Rainfall during the wettest quarter (3 rainiest months)
- The soil (edaphic) variables:
  - Sand content in surface soil
  - Apparent bulk density in surface soil
  - Surface soil pH in a soil-water solution
  - Cation exchange capacity in surface soil (general) cmol/kg
- The geophysical variables:
  - Orientation (in degrees) of the land surface
  - Gradient (in degrees) of the land surface
- 27 distinct ecogeographical categories

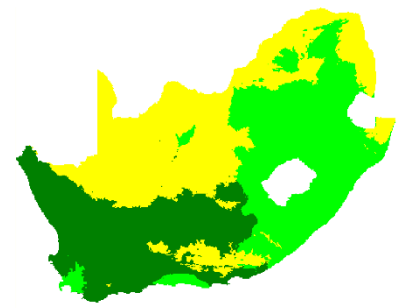
# Results: ELC Map



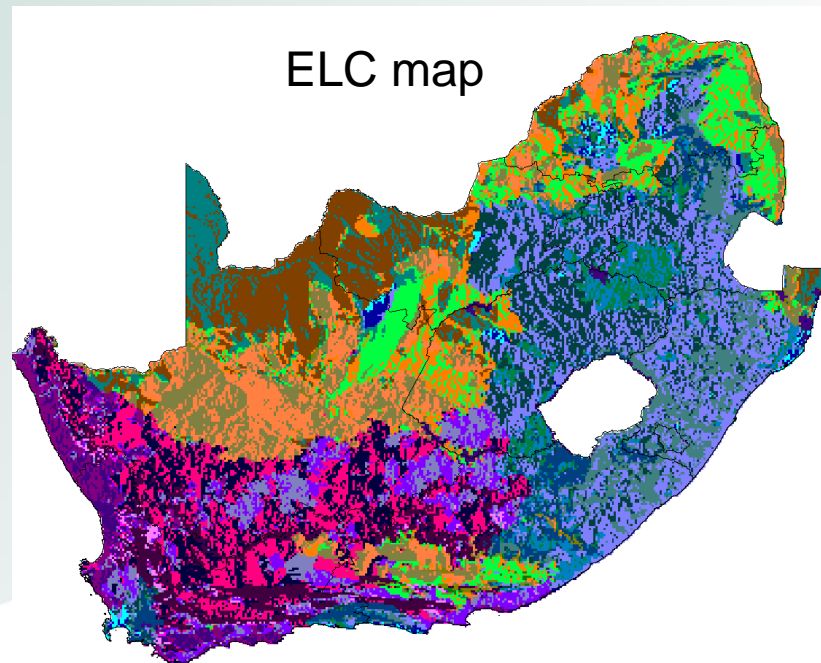
Geo-physical



Edaphic

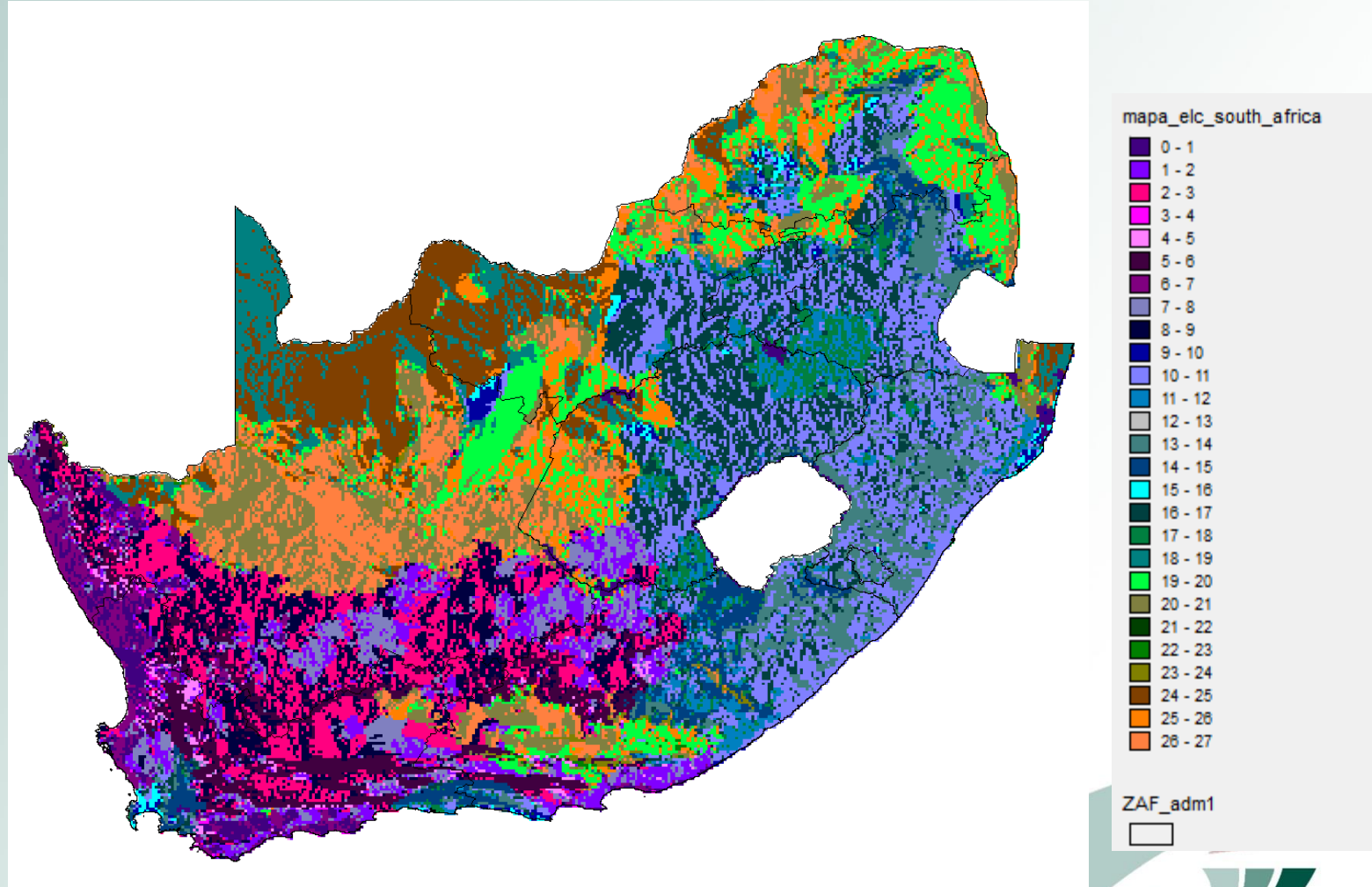


Bioclimatic



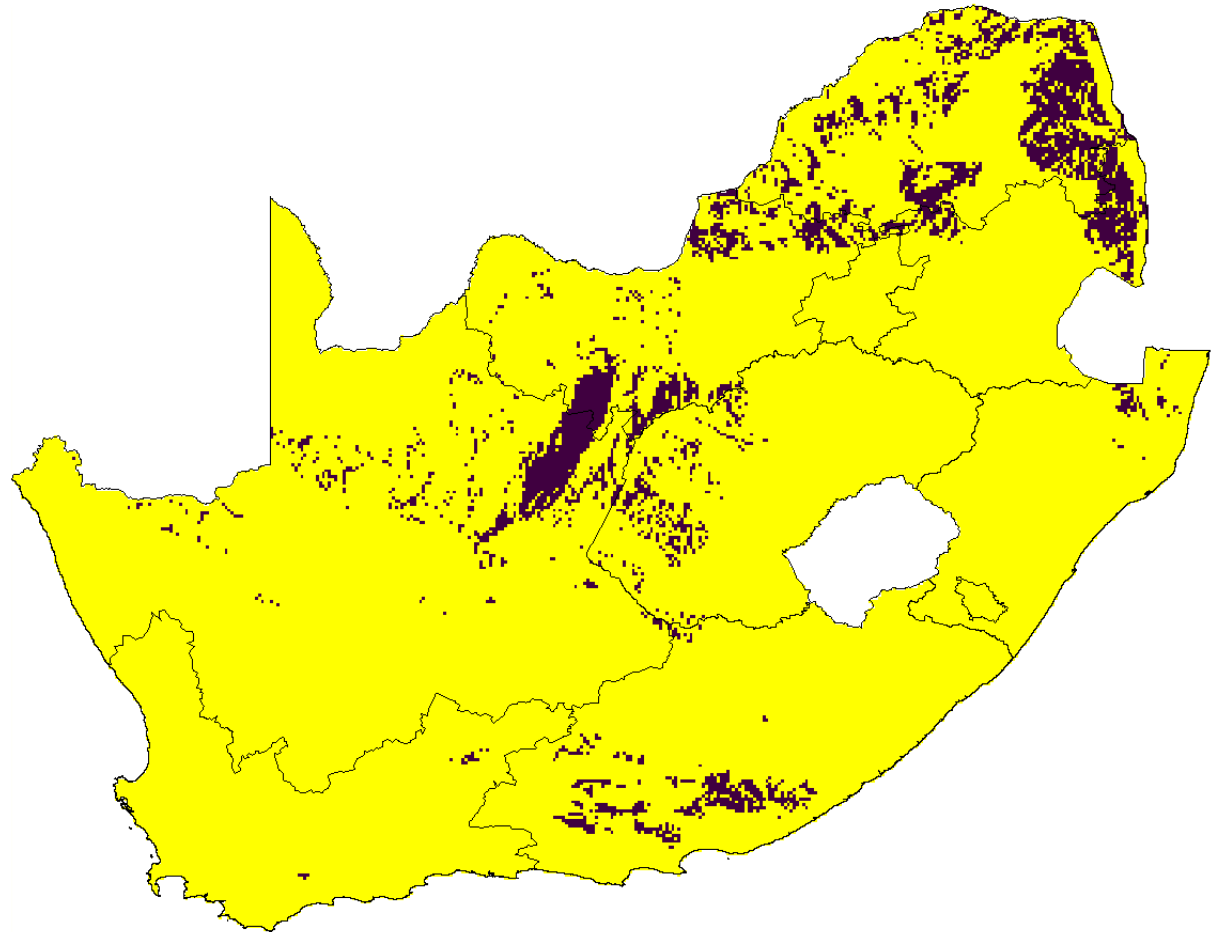
ELC map

# Results: ELC Map



# Results: ELC Map

ELC_CAT		20
Annual rainfall (mm )	Min	58
	Max	900
Rainfall during the wettest quarter (3 rainiest months) (mm)	Min	22
	Max	425
Annual average temperature (°C)	Min	15.9
	Max	24.5
Average temperature for the quarter with most rain (°C)	Min	18
	Max	28
Orientation (in degrees) of the land surface (°)	Min	13.84
	Max	188.06
Gradient (in degrees) of the land surface (°)	Min	0
	Max	3.96
Sand content in surface soil %	Min	34.44
	Max	85
Cation exchange capacity in surface soil (general) cmol/kg	Min	3.48
	Max	19.28
Apparent bulk density reference in surface soil kg/dm <sup>3</sup>	Min	1.27
	Max	1.61
Surface soil pH in a soil-water solution -log(H <sup>+</sup> )	Min	4.8
	Max	8.46



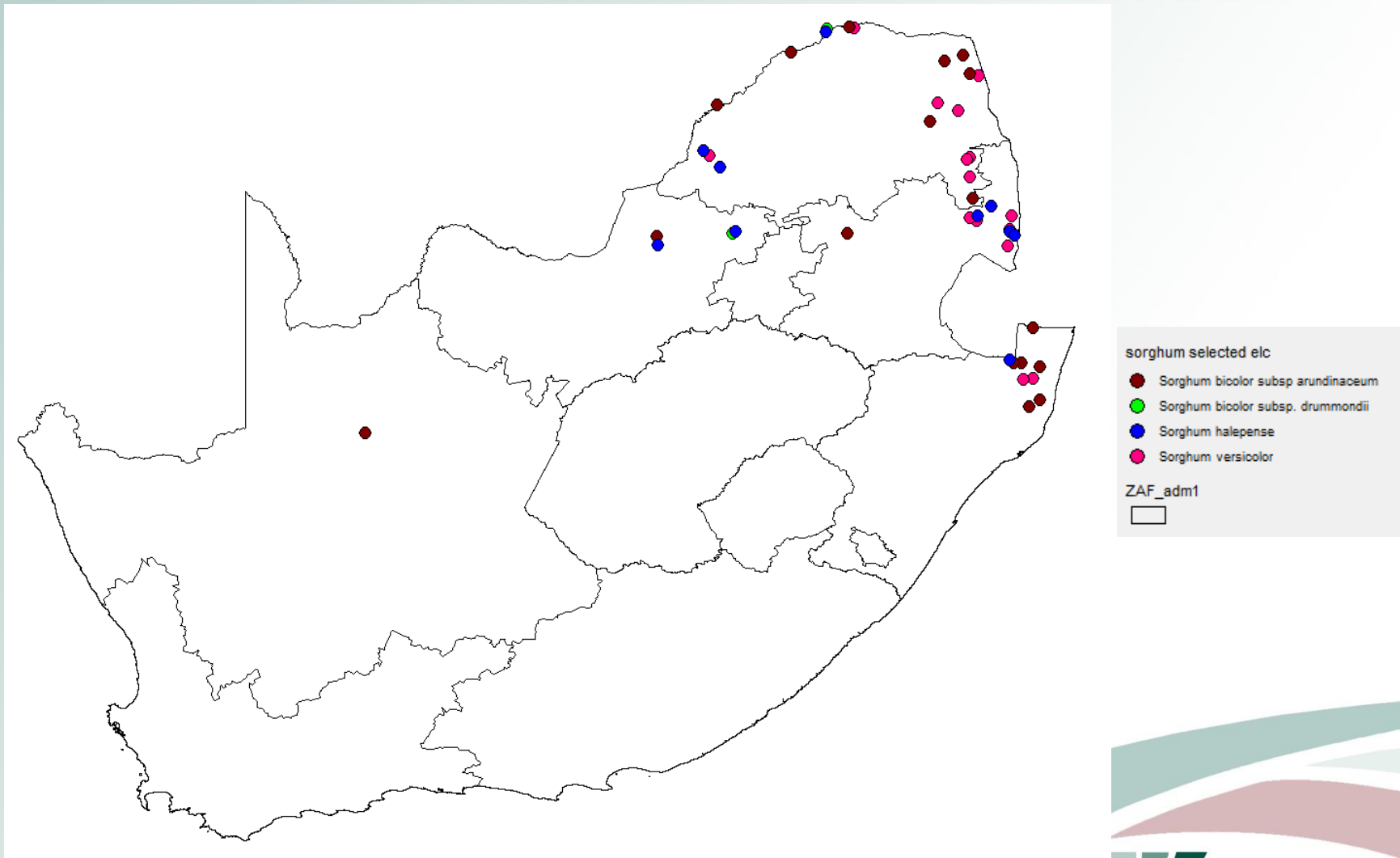
# Results: Predictive characterization

DECLATITUDE	Sorghum			Vigna		
	Min	Max	Aver	Min	Max	Aver
Annual rainfall mm	182.0	1148.0	688.0	282.0	1296.0	799.7
Rainfall during the wettest quarter	62.0	599.0	314.3	128.0	618.0	352.3
Annual average temperature °C	13.1	23.2	18.2	8.5	23.2	18.1
Average temperature for the wettest quarter	13.0	26.9	22.1	12.7	26.9	21.5

## Drought tolerance:

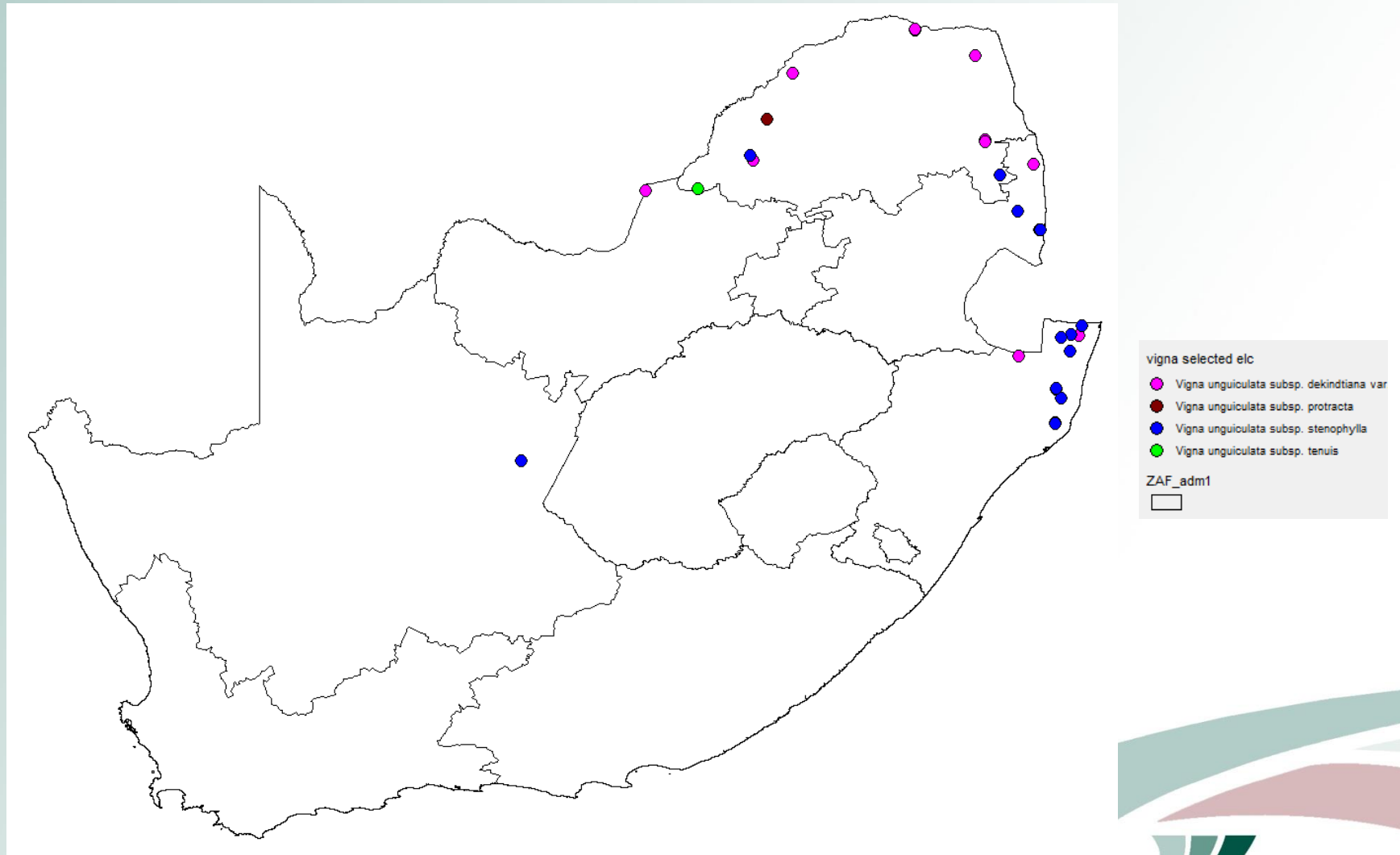
- Sorghum and cowpea are summer crops
- Rainfall during the wettest quarter
  - Average 599mm and 618mm
  - Minimum 314mm and 352mm
- **→** Select less than 350mm
- 25% with highest temperature
  - 46 Sorghum CWR
  - 29 Cowpea CWR

# Results: Predictive characterization

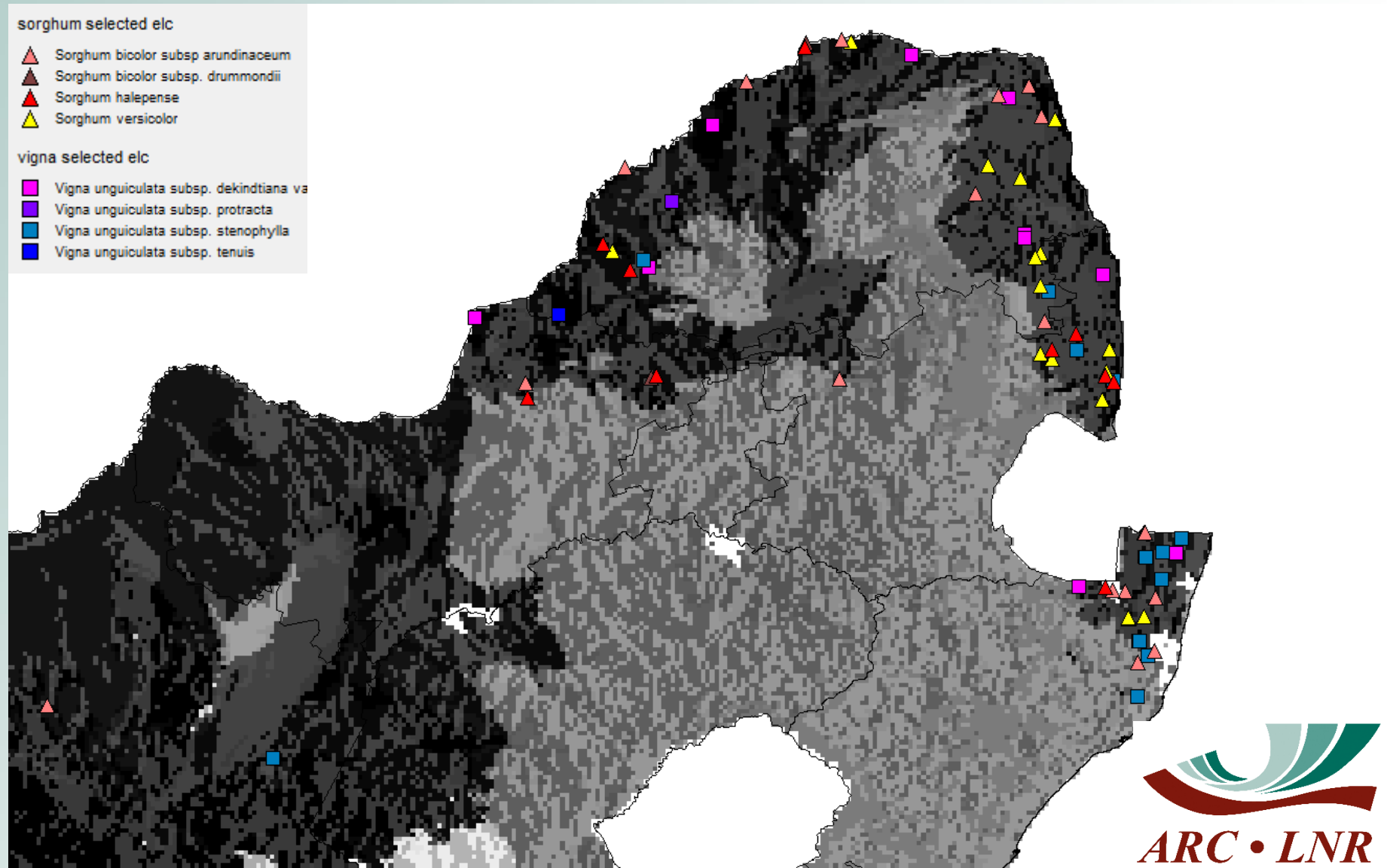


Putative drought tolerant Sorghum CWR

# Results: Predictive characterization



# Results: Predictive characterization





# Conclusion

---

- Assumed drought tolerant characteristics in:
  - 10 sorghum wild relative populations
  - 2 cowpea wild relative populations
- Source increase drought tolerance in sorghum or cowpea,
  - Collect
  - Characterised for drought tolerance
- Maxted modelling to search for alternative populations

# THANK YOU



**DANKIE  
NGIYATHOKOZA  
ENKOSI  
NGIYABONGA  
KE A LEBOGA**

**KE A LEBOHA  
KE A LEBOGA  
NGIYABONGA  
NDI A LIVHUHA  
NDZA KHENSA**