2nd EvIDENz stakeholder workshop
National Disaster Management Center, Pretoria, South Africa
4th June 2018

Towards the implementation of the Sendai framework: Understanding agricultural drought risk and measuring Targets B and C for the example of Eastern Cape, South Africa

Yvonne Walz

Karen Dall

Motivation and background

EVIDENZ

Sendai Framework
for Disaster Risk Reduction
2015 - 2030

Affected people/
global population
2020-2030 Average << 2005-2015 Average

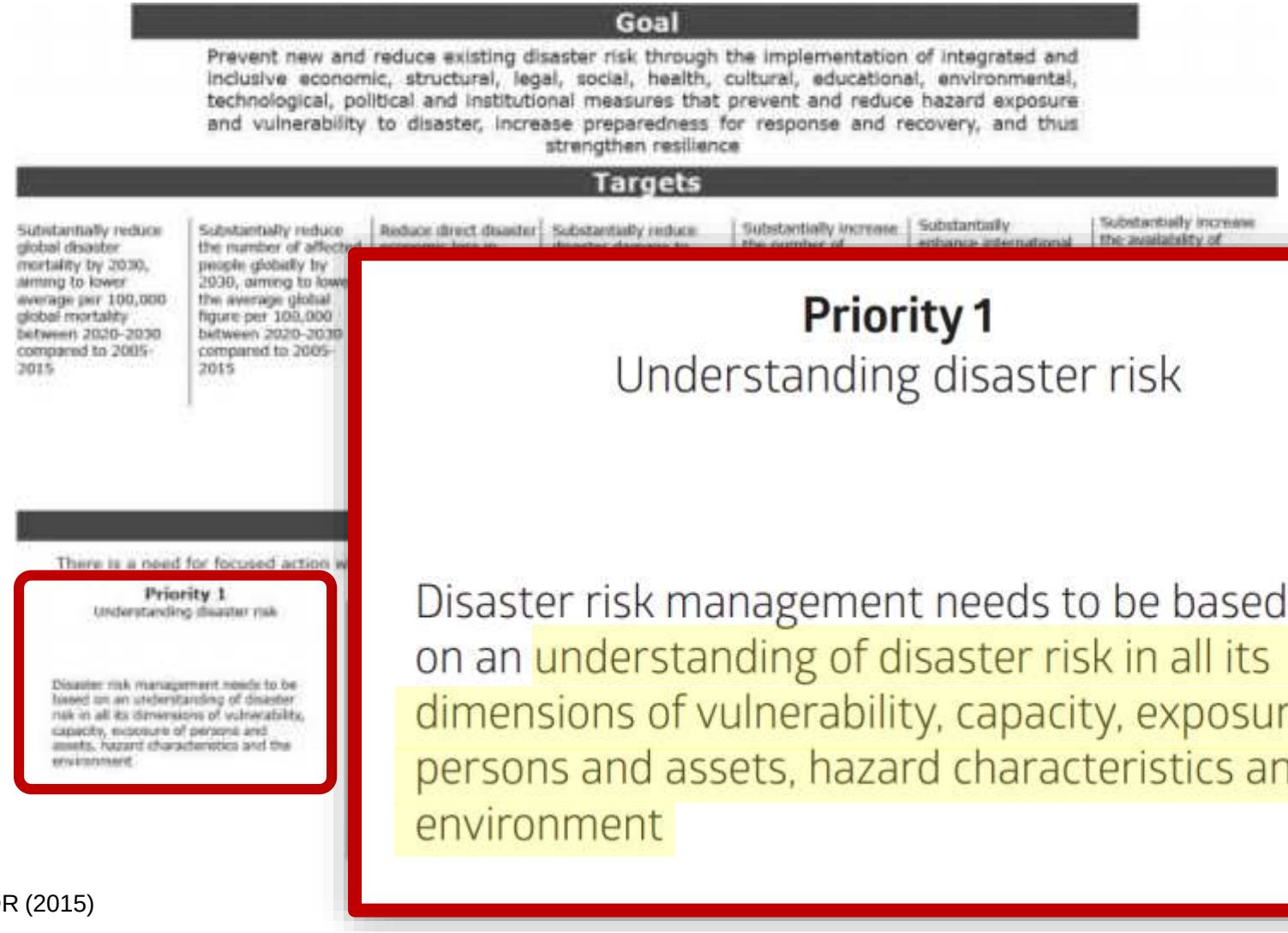
Economic loss/
global GDP
2030 Ratio << 2015 Ratio

7 Global Targets

Priority 1 **Understanding disaster risk**
Policies and practices for DRR should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment.

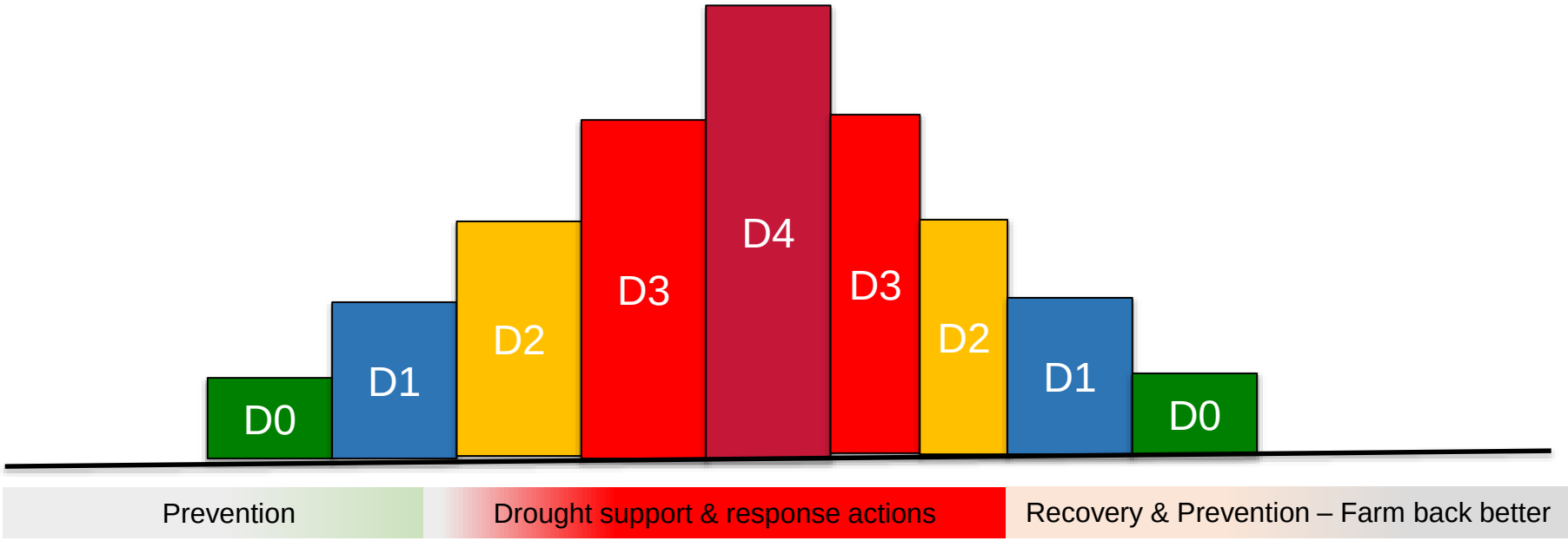
4 Priorities for Action

The Sendai Framework priority 1



Source: UNISDR (2015)

Drought management in South Africa



Source: A. Jordaan, 2018

Source: A. Jordaan, 2018


Hazard characteristics (biophysical indicators)
Priority 1
Understanding disaster risk
Disaster risk management needs to be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment
Source: UNISDR (2015)
Source: A. Jordaan, 2018

Research gap identified

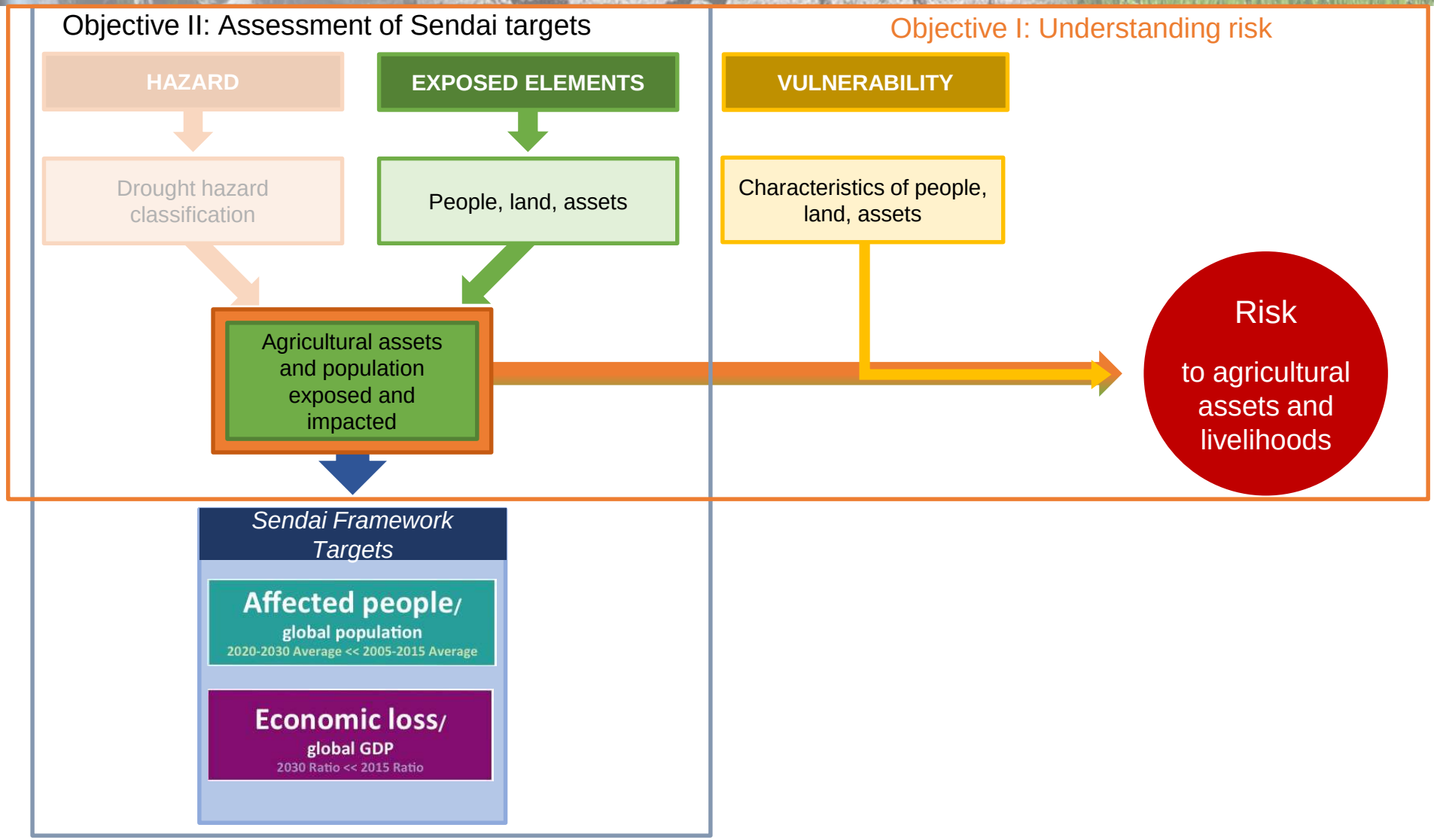
1. Test plausibility of drought hazard severity indicators as basis for decision making

2. Integrate dimensions of exposure, vulnerability and capacities into the existing drought severity classification scheme.

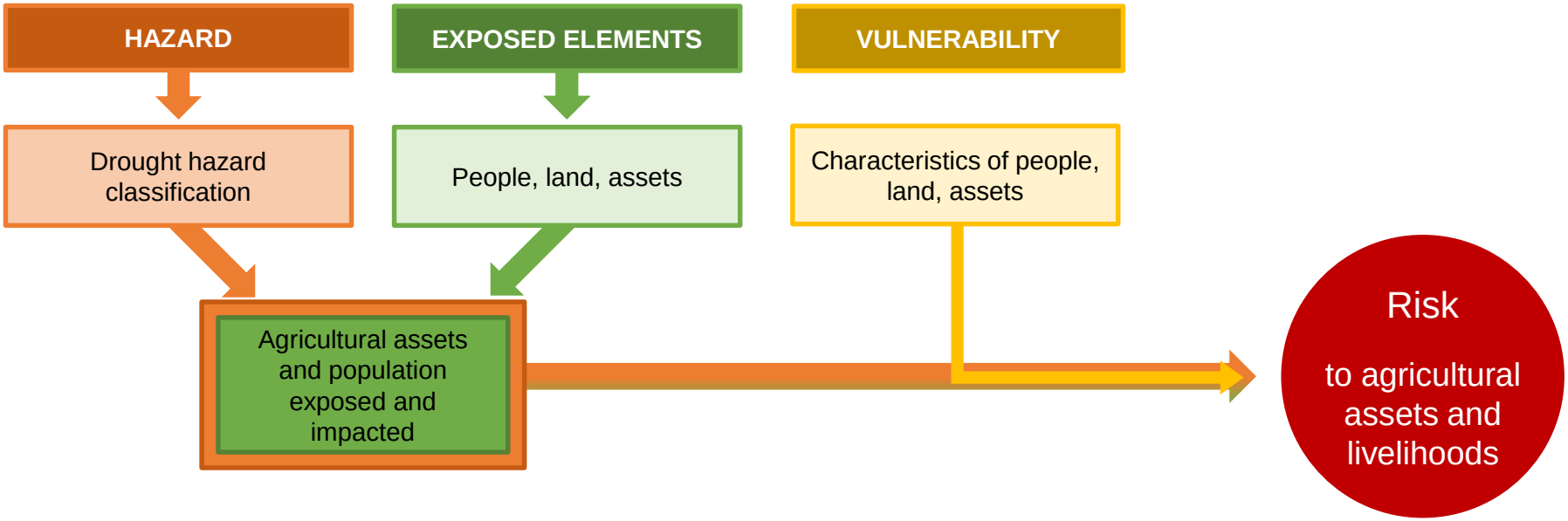
3. Bridge between specific information relevant in the local context and information needs at the provincial and national level to target drought risk reduction measures.

East London, South Africa
2. – 3. November 2016

EvIDENz approach



Understanding drought risk



Understanding drought risk

Why can moderate drought hazard lead to extreme impacts, while extreme drought hazards do not?

Drought exposure
people, property, livelihoods and systems which are subject to potential losses by drought

UNISDR 2009

Drought vulnerability
characteristics of the exposed people dependent on agriculture and the agricultural land that increase their susceptibility to the drought.
These characteristics are determined by physical, social, economic and environmental factors.

UNISDR 2016

Indicator-based drought risk assessment

Components

Domain

Indicators

Agricultural drought risk

Hazard

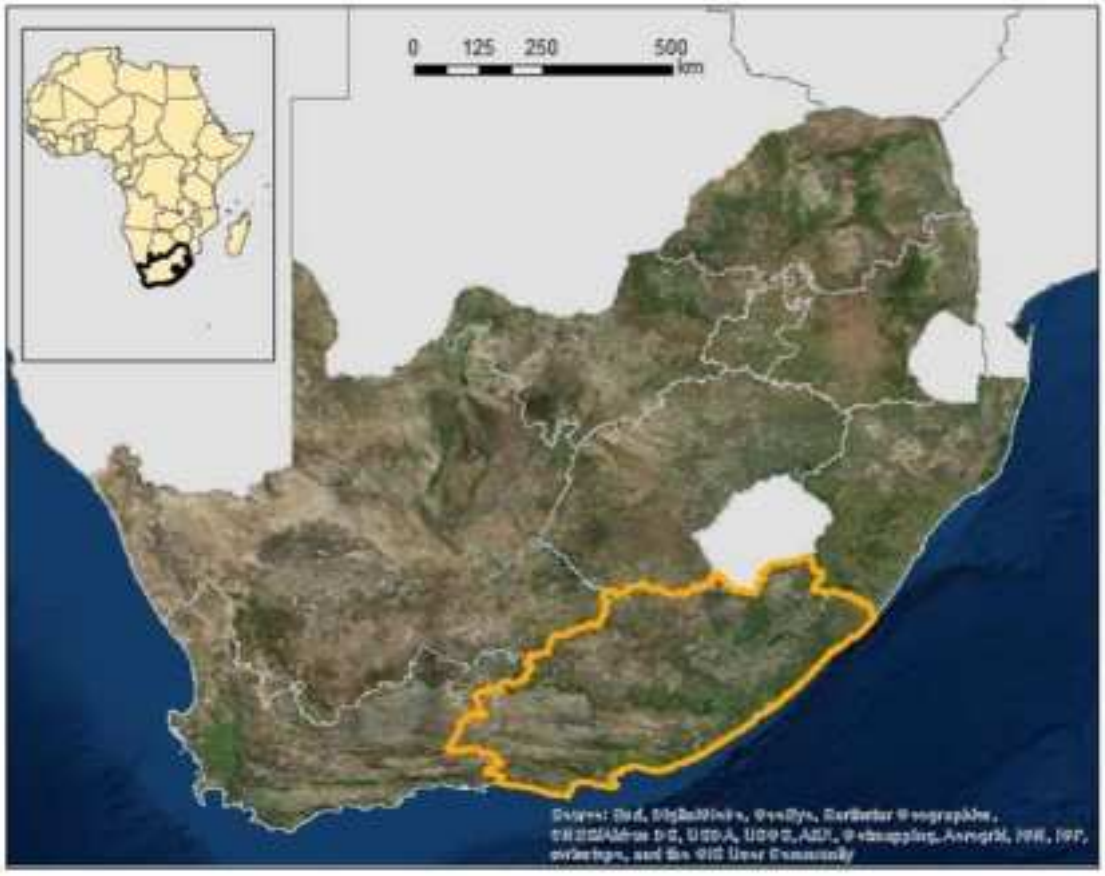
Exposed elements

Vulnerability

Exposed elements: Social	Exposed elements: Ecological	Vulnerability: Social	Vulnerability: Ecological
Agricultural dependent population	Agricultural land	Unemployment	Soil quality
…	…	Social dependency	Land degradation
		Education	Surface water
		…	…

Normalization

The study region – Eastern Cape

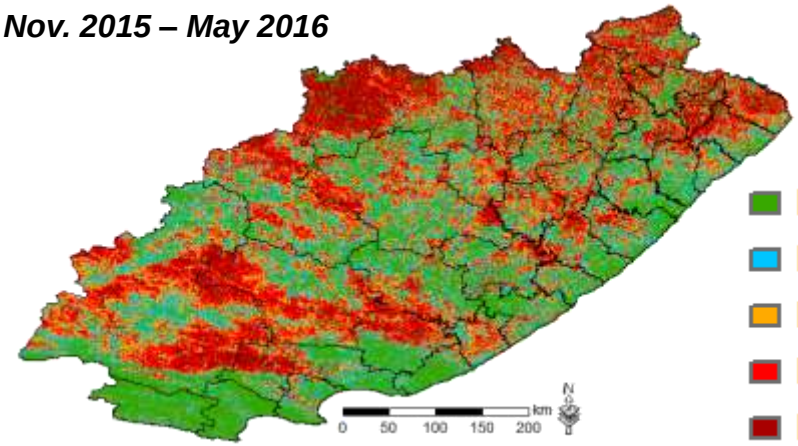


provided by ZFL

Agricultural drought hazard: Example of 2015/2016

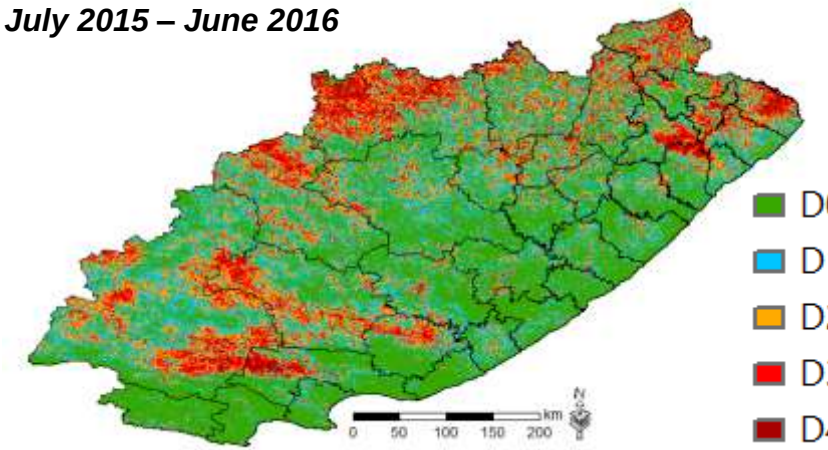
D0
D1
D2
D3
D4

Median VCI
Nov. 2015 – May 2016



- D0 (VCI > 40)
- D1 (VCI 40 to >30)
- D2 (VCI 30 to >20)
- D3 (VCI 20 to >10)
- D4 (VCI <=10)

Median VCI
July 2015 – June 2016



- D0 (VCI > 40)
- D1 (VCI 40 to >30)
- D2 (VCI 30 to >20)
- D3 (VCI 20 to >10)
- D4 (VCI <=10)

provided by ZFL

Cropland

https://www.sa-venues.com/attractionswc/paarl.php

Grassland

https://www.britannica.com/science/veld

Exposure to agricultural drought: Elements of interest

Elements considered for exposure assessment

Elements of environmental system

Elements of social system

Cropland

https://www.sa-venues.com/attractionswc/paarl.php

Grassland

https://www.britannica.com/science/veld

Crop-dependent population

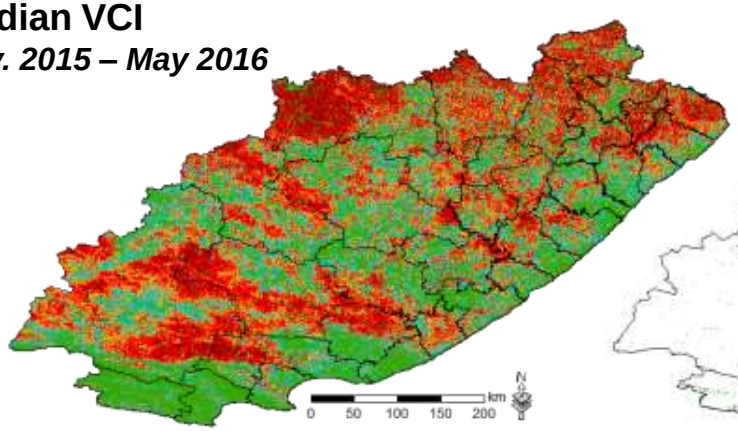
http://www.statssa.gov.za/?p=1447

Livestock-dependent population

Photo: O. Girard (CIFOR), https://ccafs.cgiar.org/blog/climate-change-impacts-livestock-what-do-we-know#.Ww5cfZq-mUk

Agricultural drought hazard exposure: Example of 2015/2016

Agricultural drought hazard for cropland
Median VCI
Nov. 2015 – May 2016



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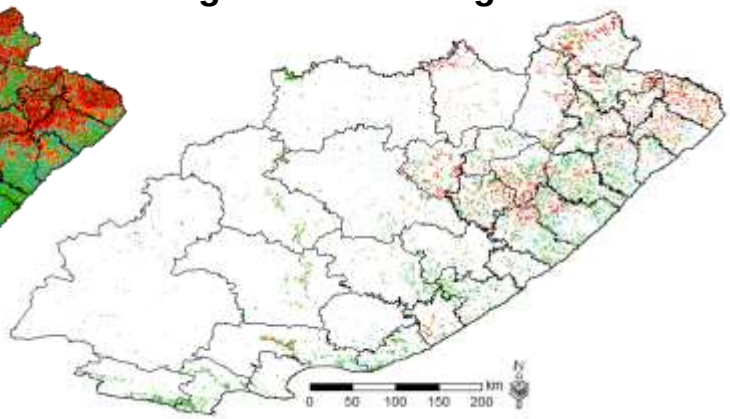
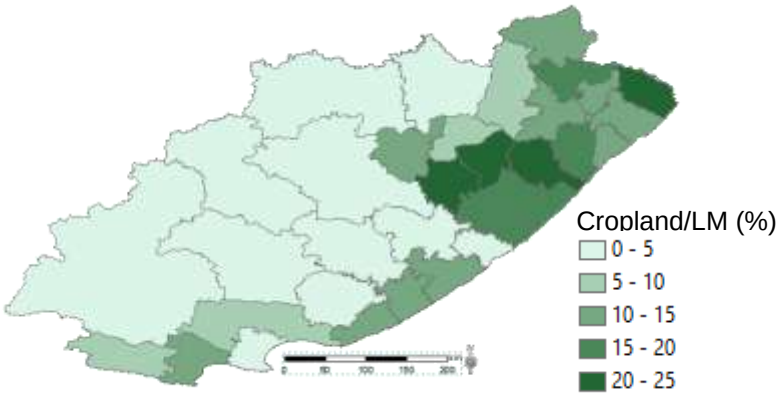
Cropland exposed to agricultural drought hazard



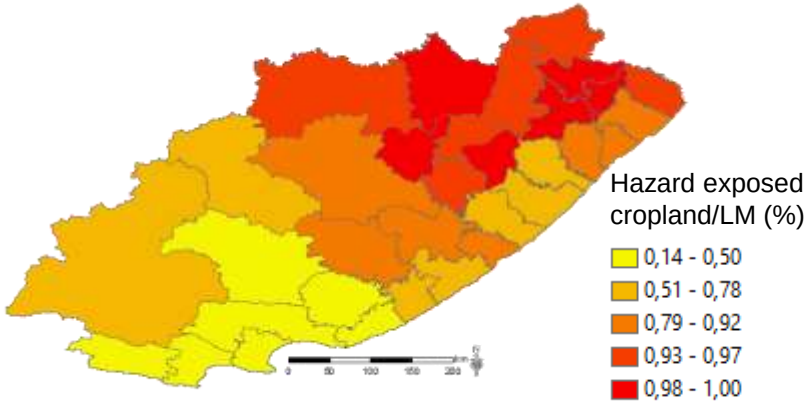
https://www.sa-venues.com/attractionswc/paarl.php

Datasource on cropland: DEA (2015)

Share of cropland per local municipality

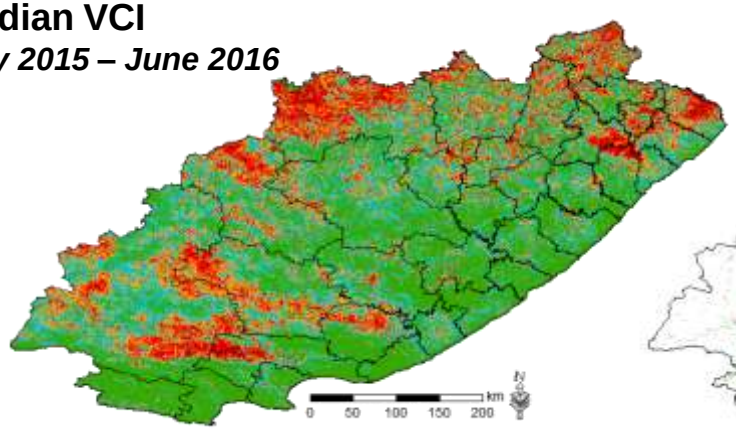


Share of cropland exposed to agricultural drought hazard



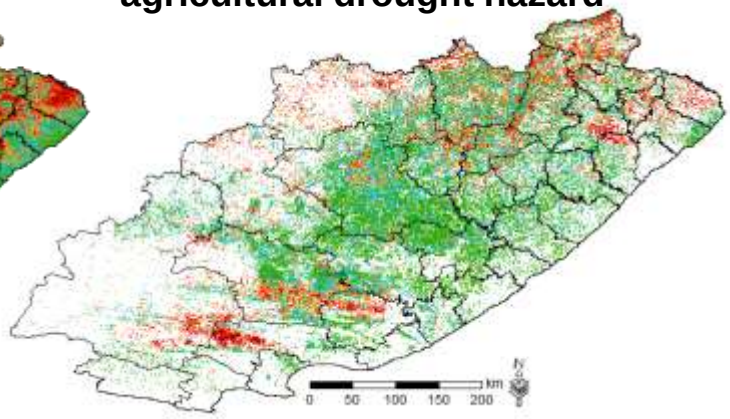
Agricultural drought hazard exposure: Example of 2015/2016

Agricultural drought hazard for grassland
Median VCI
July 2015 – June 2016



provided by ZFL

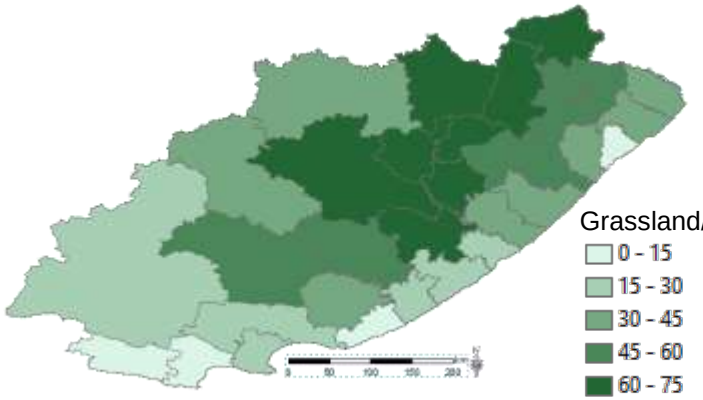
Grassland exposed to agricultural drought hazard



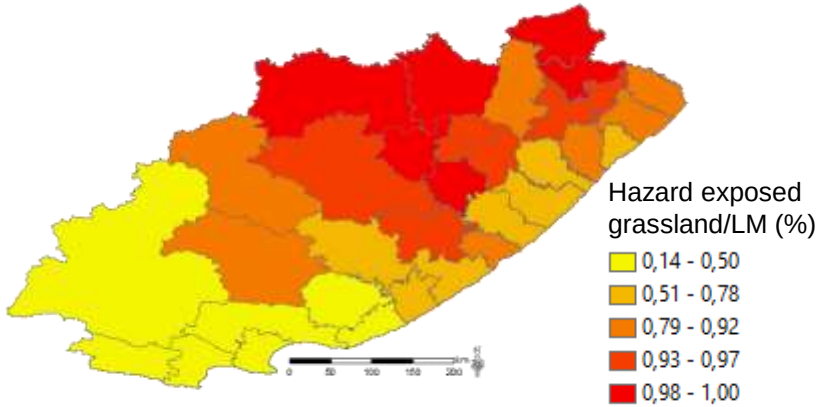
https://www.britannica.com/science/veld

Datasource on cropland: DEA (2015)

Share of grassland per local municipality



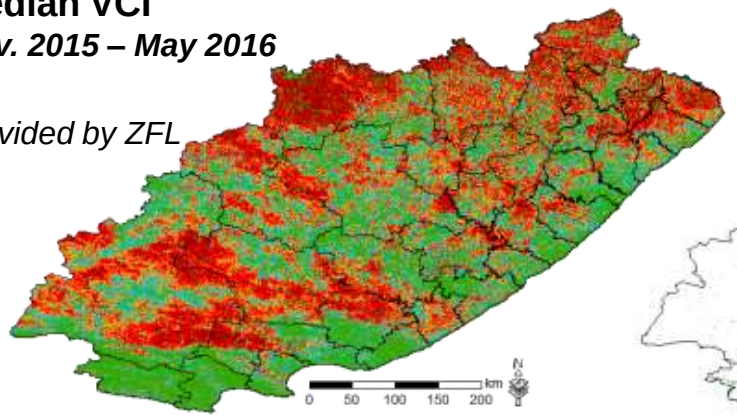
Share of grassland exposed to agricultural drought hazard



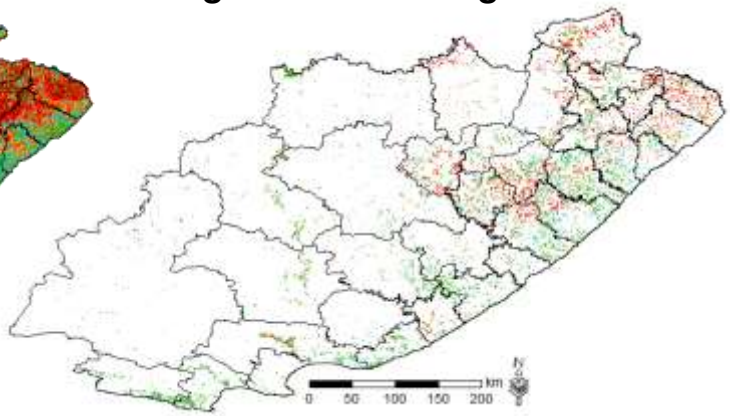
Agricultural drought hazard exposure: Example of 2015/2016

Agricultural drought hazard for cropland
Median VCI
Nov. 2015 – May 2016

provided by ZFL



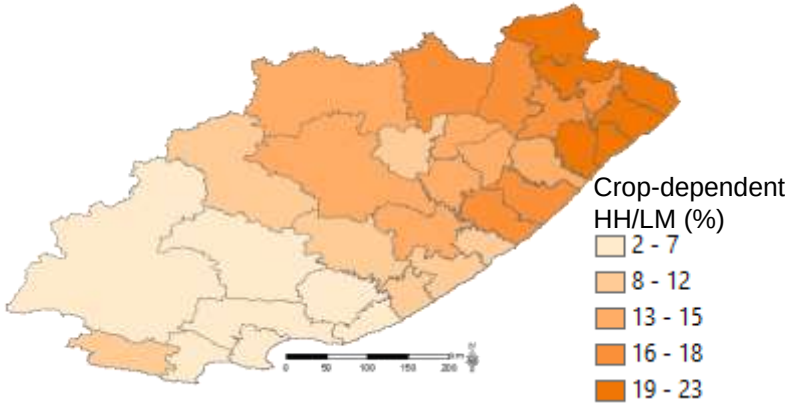
Cropland exposed to agricultural drought hazard



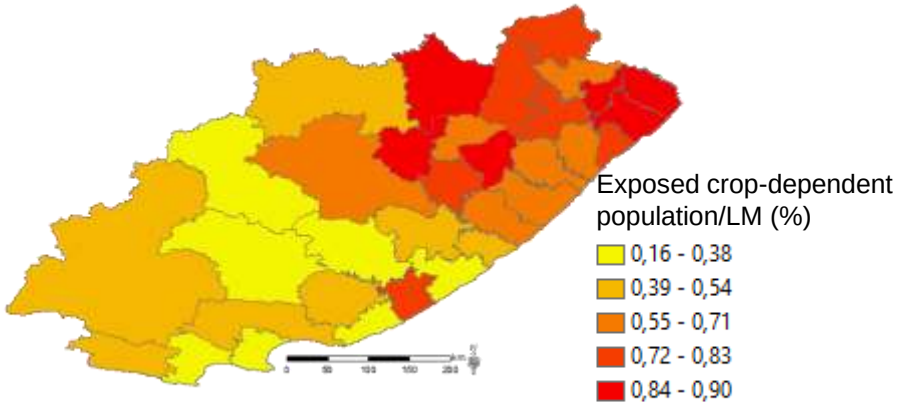
http://www.statssa.gov.za/?p=1447

Datasource on crop-dependent households: StatSA (2011a); StatSA (2016)

Share of crop-dependent households per local municipality



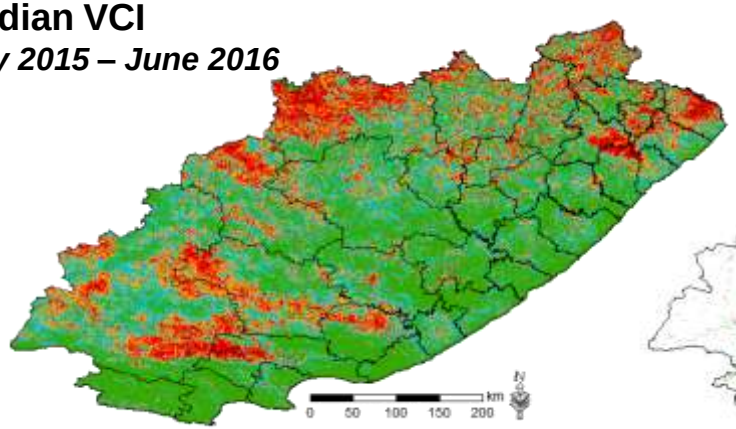
Share of crop-dependent population exposed to agricultural drought hazard



EvIDENz · Universität Bonn · ZFL · United Nations University UNU-EHS · United Nations Office for Outer Space Affairs UN-SPIDER · IKD · UFS UV · Bundesministerium für Wirtschaft und Energie

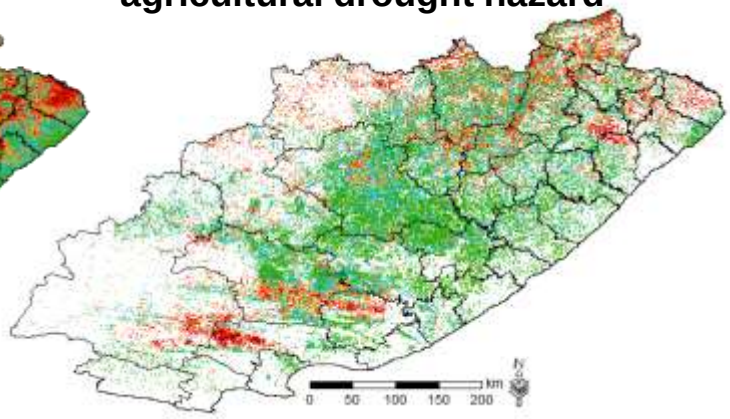
Agricultural drought hazard exposure: Example of 2015/2016

Agricultural drought hazard for grassland
Median VCI
July 2015 – June 2016



provided by ZFL

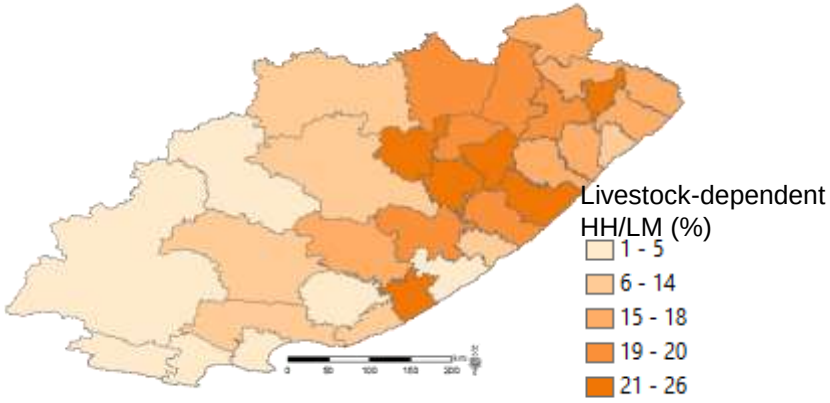
Grassland exposed to agricultural drought hazard



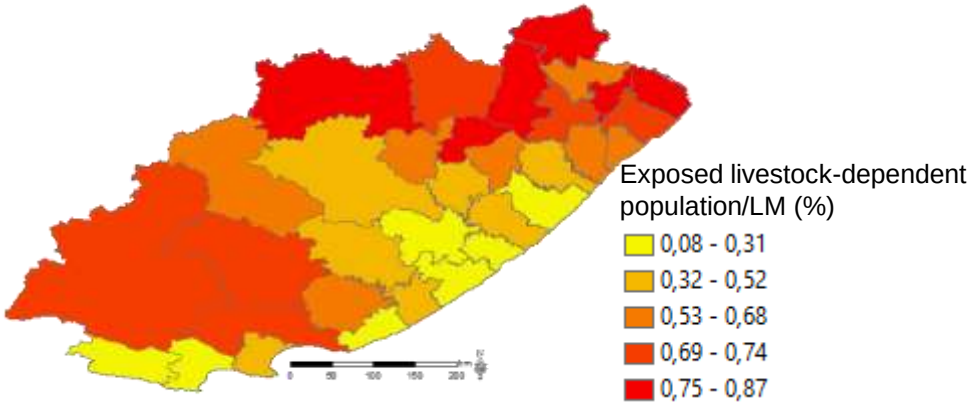
Livestock-dependent population

Photo: O. Girard (CIFOR), https://ccafs.cgiar.org/blog/climate-change-impacts-livestock-what-do-we-know#.Ww5cfZq-mUk
Datasource on livestock-dependent households:
StatSA (2011a); StatSA (2016)

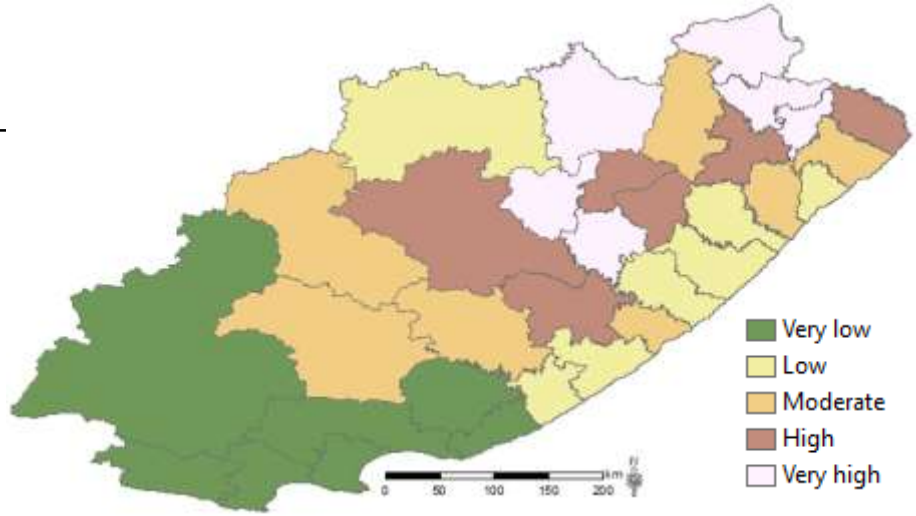
Share of livestock-dependent households per local municipality



Share of livestock-dependent population exposed to agricultural drought hazard

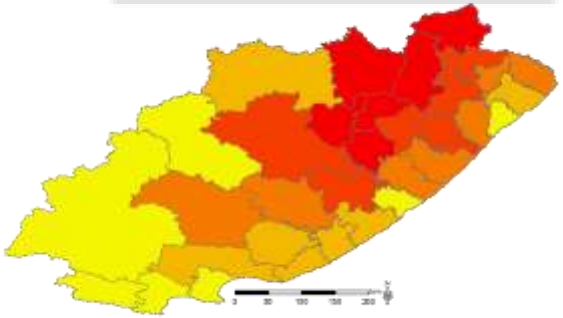


Exposure to agricultural drought hazard

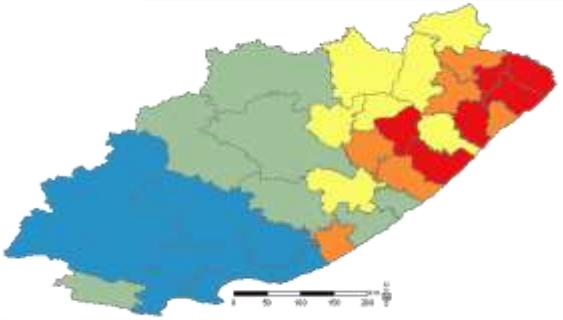


Agricultural land exposed to drought hazard

Agricultural dependent population (ADP) exposed to drought hazard



Share of exposed agricultural land (%)
- 0,19 - 0,37
- 0,38 - 0,62
- 0,63 - 0,69
- 0,70 - 0,88
- 0,89 - 1,00

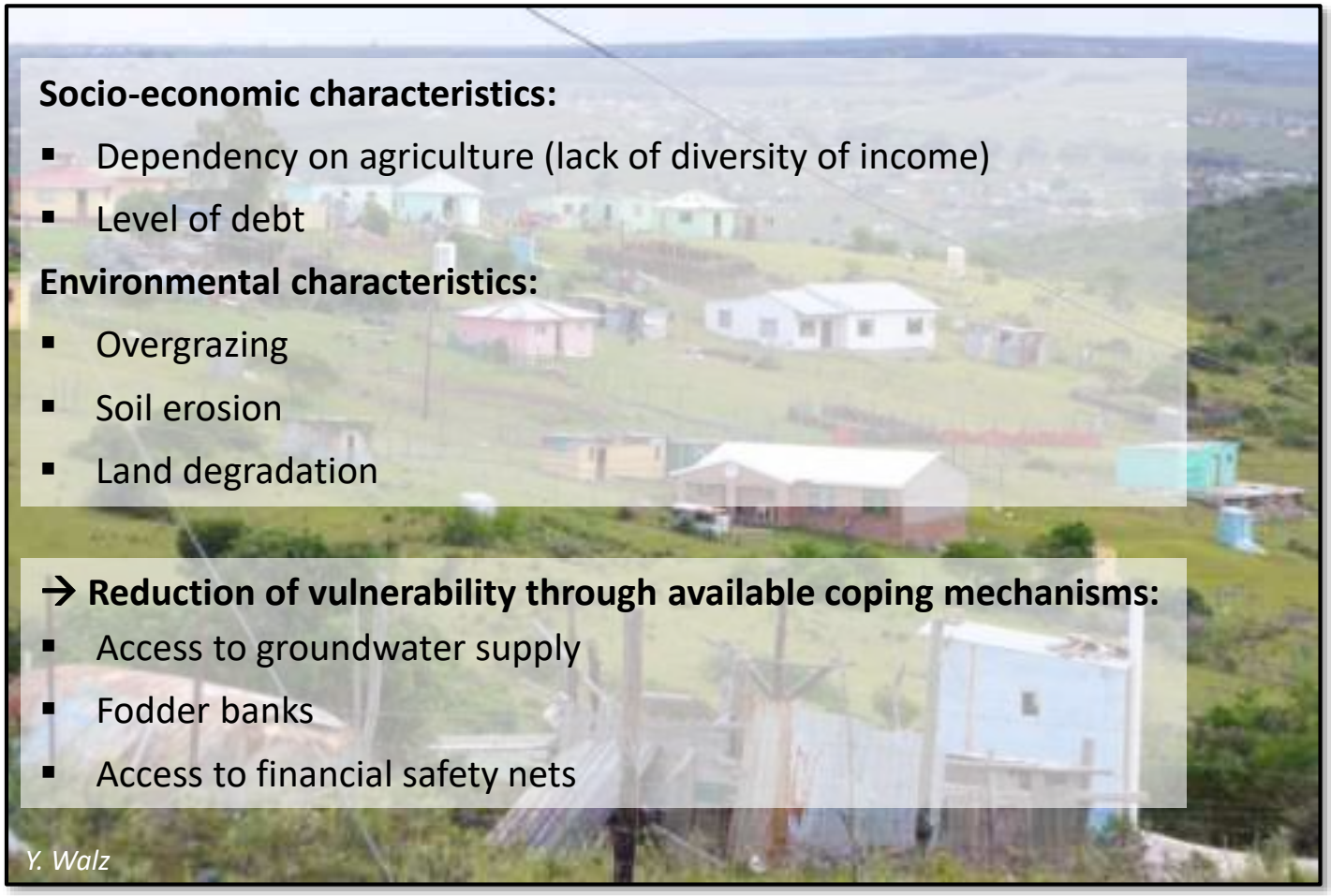


Share of exposed ADP (%)
- 0,07 - 0,28
- 0,29 - 0,60
- 0,61 - 0,84
- 0,85 - 0,92
- 0,93 - 1,00

Vulnerability

The **characteristics** and circumstances of a community, system or asset that make it **susceptible to the damaging effects of a hazard**.

(Source: UN-ISDR)



Socio-economic characteristics:

- Dependency on agriculture (lack of diversity of income)
- Level of debt

Environmental characteristics:

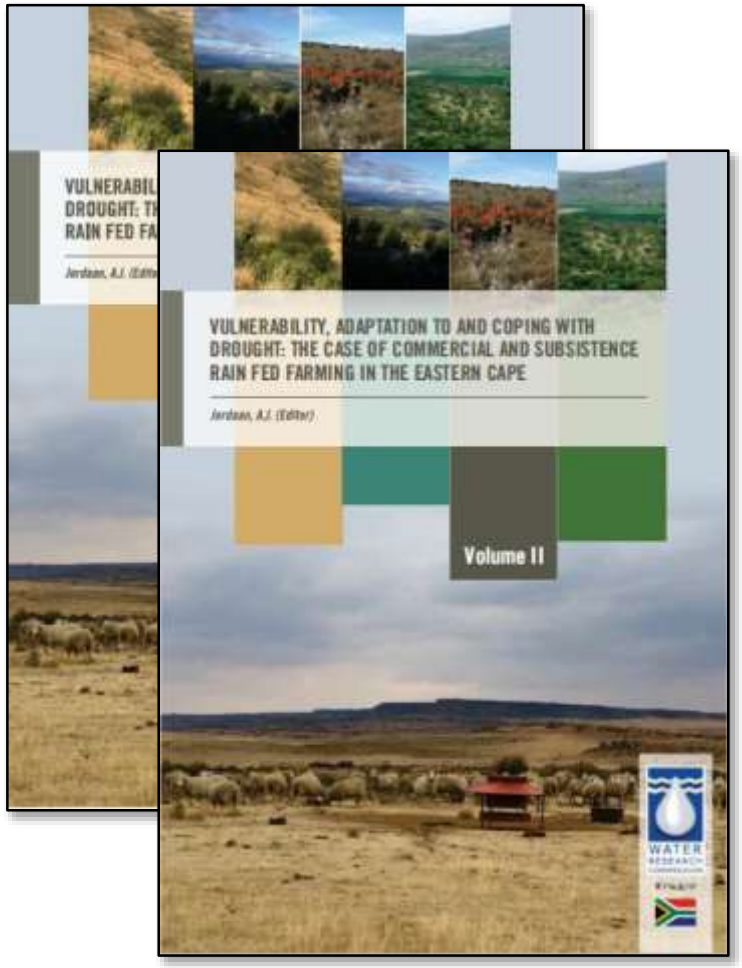
- Overgrazing
- Soil erosion
- Land degradation

→ **Reduction of vulnerability through available coping mechanisms:**

- Access to groundwater supply
- Fodder banks
- Access to financial safety nets

Y. Walz

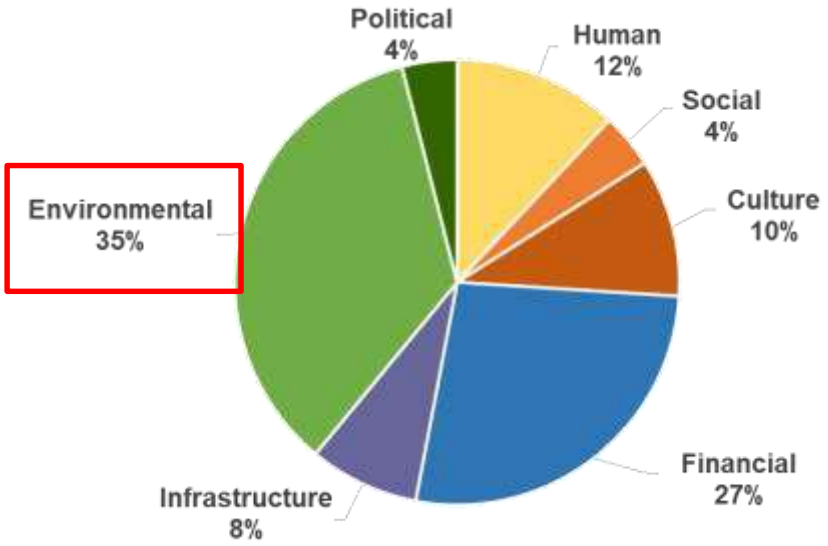
Vulnerability
bottom-up approach from field-based measurement



→ 41 indicators of drought vulnerability have been selected and measured for Eastern Cape

→ Weighting scheme for capitals and individual indicators developed in participatory approach

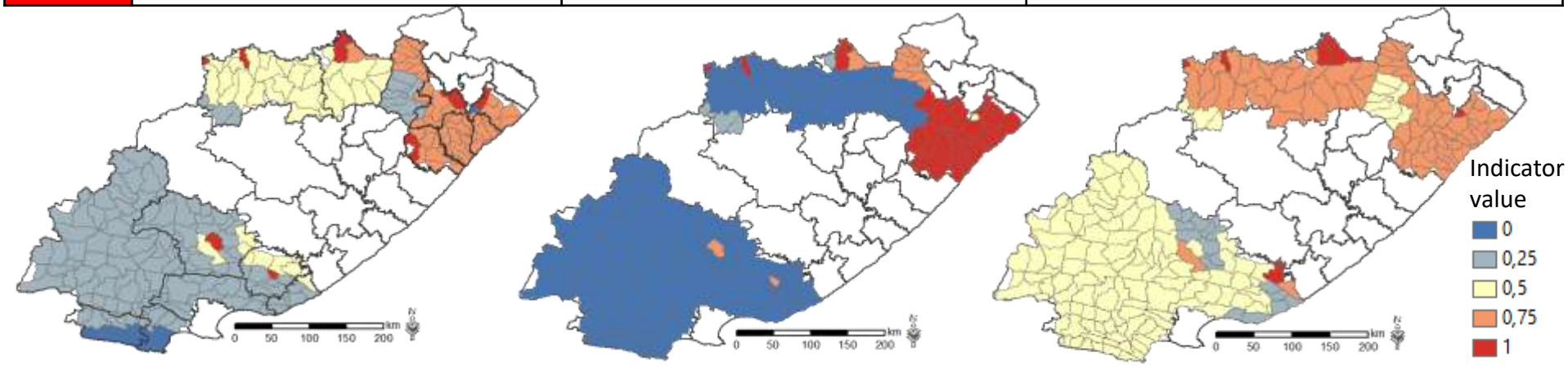
Susceptibility	Coping capacity
18	23



Jordaan et al., 2017a,b

Environmental susceptibility indicators

Index	Land degradation	Land use	Predator threat
0	No signs of degradation at all	100% secure property rights with agriculture use	No threat at all
0.25	Limited degradation	Secure property rights, but leased out	Small predator threat
0.5	Degraded	Open access. Good control by land owners and or Chiefs	Significant predator threat
0.75	Highly degraded	Totally open access. Some and regulated somewhat by chiefs/land owners	High predator threat. Have to kraal livestock during lambing season. 20% progeny loss
1	Extremely degraded	Totally open access. No regulation	High predator threat. Have to kraal livestock always. >50% progeny loss



Upscaling Vulnerability
From quaternary catchment to local municipality

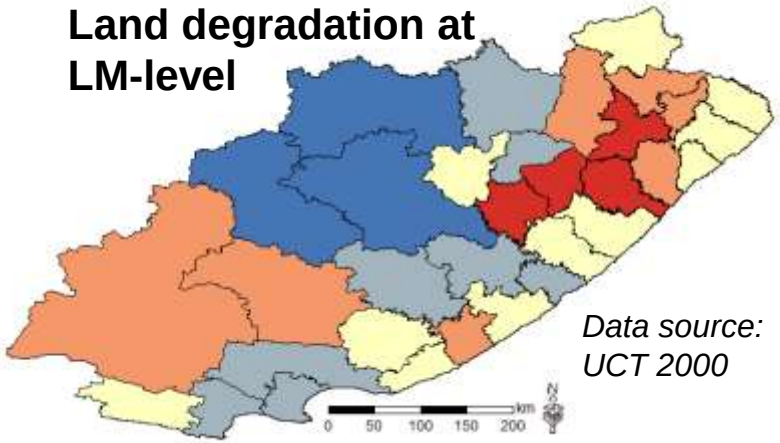
Overall aim:

Selection of the most relevant information (indicators) to understand drought vulnerability and risk at provincial and national level as basis for decision making.

Criteria:

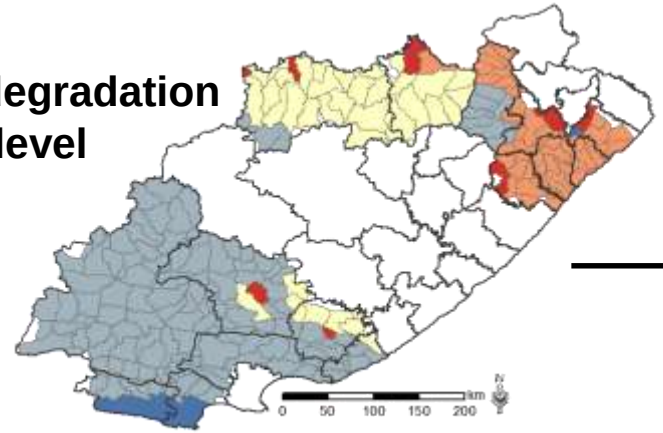
- ✓ Selection of relevant capital based on weight
- ✓ Weight of indicators per relevant capital
- ✓ Data availability on local municipality level

Land degradation at LM-level



Data source: UCT 2000

Land degradation at OQ-level



QC = Quaternary Catchment
LM = Local Municipality

Most relevant vulnerability indicators selected at quaternary catchment level

	Capital	Indicator-QC	Weight
Susceptibility	Human	Education	0,5
	Culture	Dependency planning	0,6
	Financial	Market access	0,4
	Environmental	Land degradation	0,6
Coping capacity	Human	Management skills	0,35
	Cultural	Experience	0,6
	Financial	Alternative on-farm income	0,3
	Environmental	Surface water supply	0,5

- Eight indicators were selected to be relevant
- Six of eight indicators can be measured at LM level

Set of available vulnerability indicators measured at local municipality level

Susceptibility indicator	Measure	Data source
Education	**% of HH without formal education (+)**	**StatSA 2011a**
Social dependency	**Rate of population at the age of 0-14 and >65 in % (+)**	**StatSA 2011b**
Stock theft	Number of stock thefts per 1000 HH (+)	ECSECC Database 2016
Age	% of HH between the age of 15 and 55 (-)	StatSA 2011a
Income	Share of HH living from less than R9600/year (+)	StatSA 2011b
Gender	gender parity (% unempl female/% unempl male) (+)	StatSA 2014
Unemployment	Unemployment rate in % (+)	StatSA 2011b
Access to infrastructure	**Infrastructure index (+)**	**ECCSEC 2012**
Land degradation	**Soil erosion index (+)**	**UCT 2000**

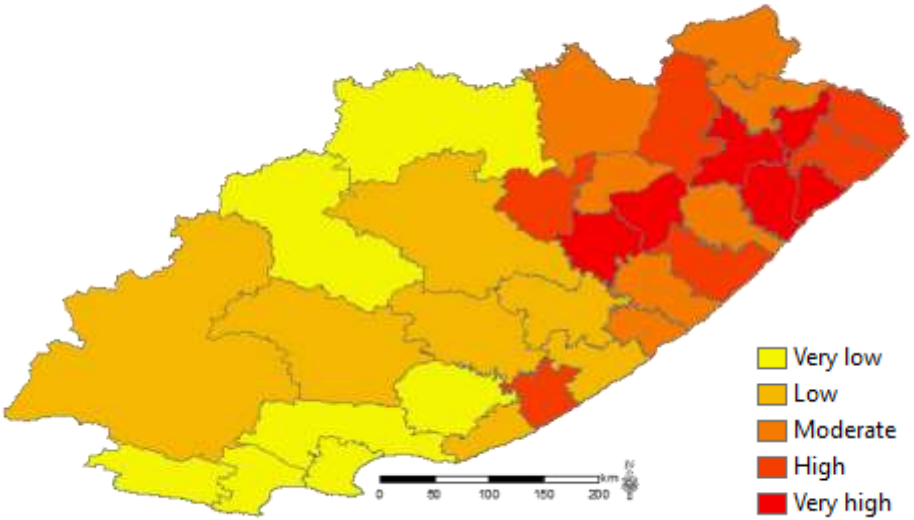
Capacity indicator	Measure	Data source
Access to information	% of HH with access to internet (+)	StatSA 2011b
Alternative on- farm income	**% of agricultural HH in other agricultural activities (+)**	**StatSA 2011a**
Soil fertility	clay content and base status of the soil index (+)	UCT 2000
Surface water	**Surface water/agricultural land ratio (+)**	**DEA 2015**

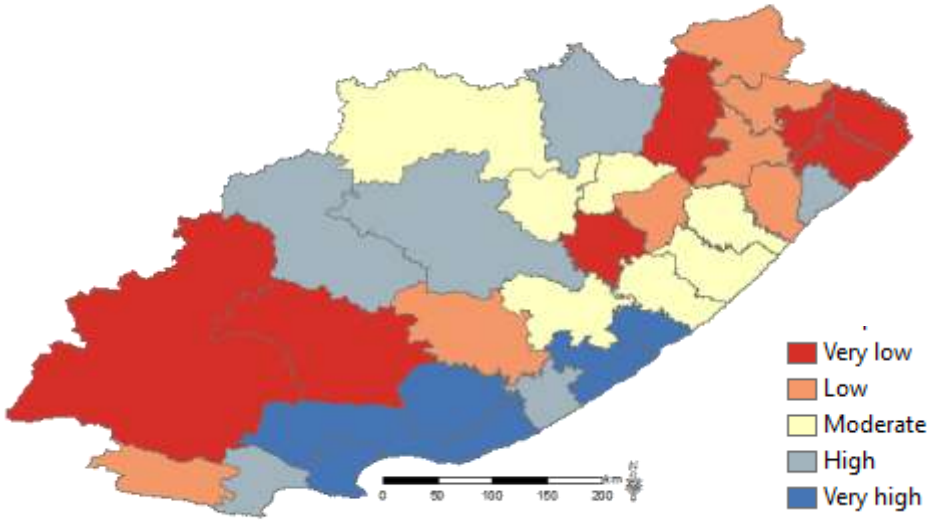
Vulnerability to agricultural drought

Vulnerability to agricultural drought

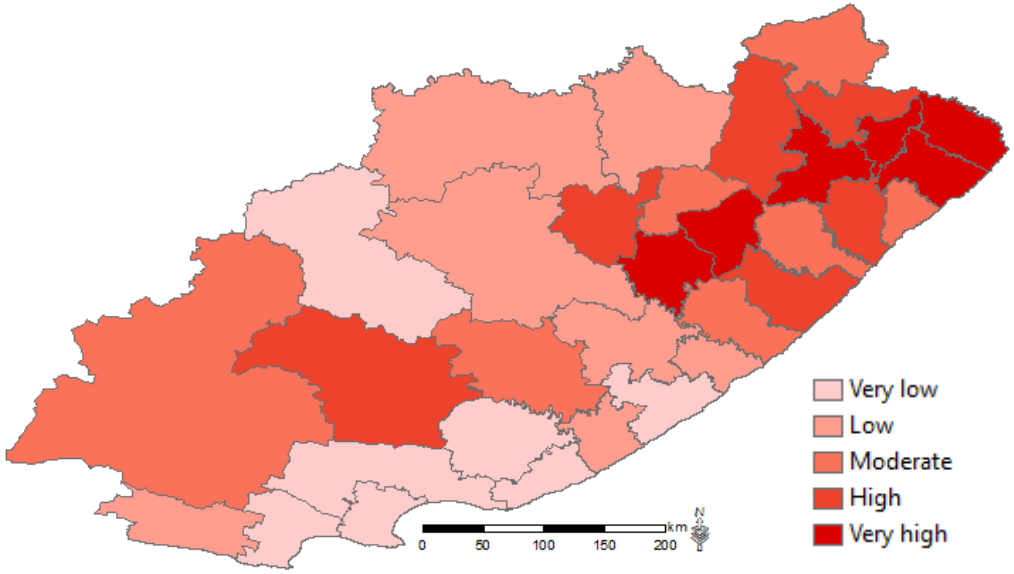
Susceptibility

Coping capacity

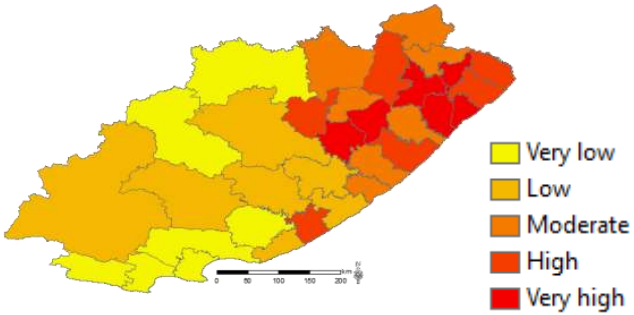




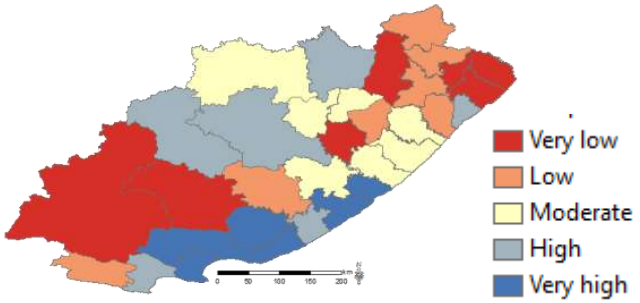
Vulnerability to agricultural drought



Susceptibility



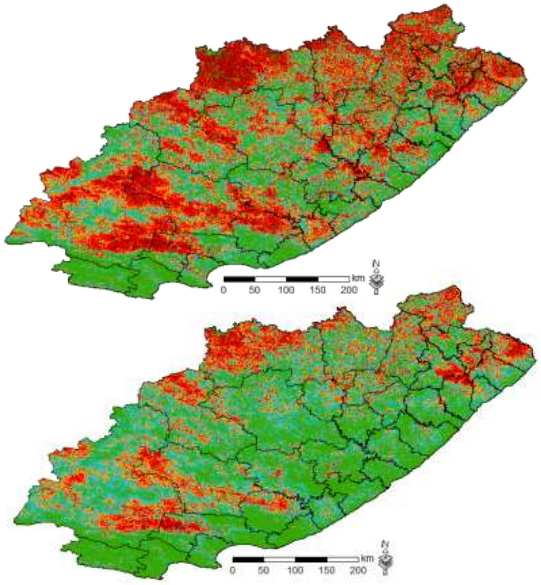
Coping capacity

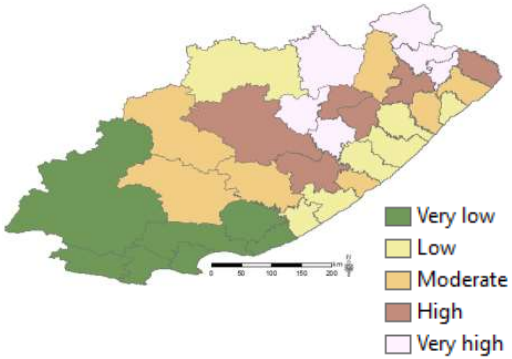


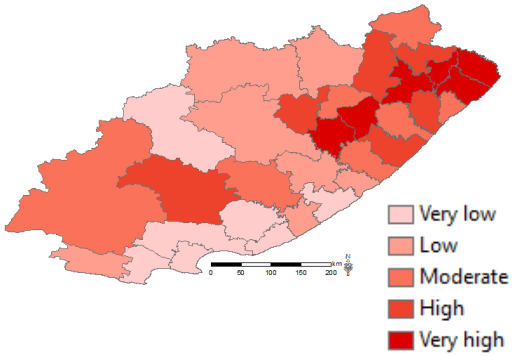
Assessment of agricultural drought risk

Agricultural drought risk

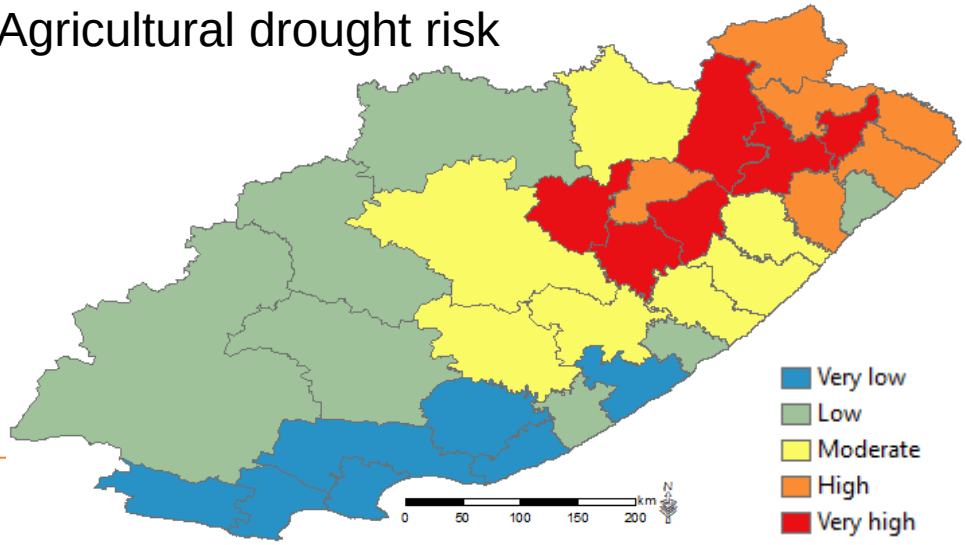
Hazard | Exposed elements | Vulnerability







Agricultural drought risk

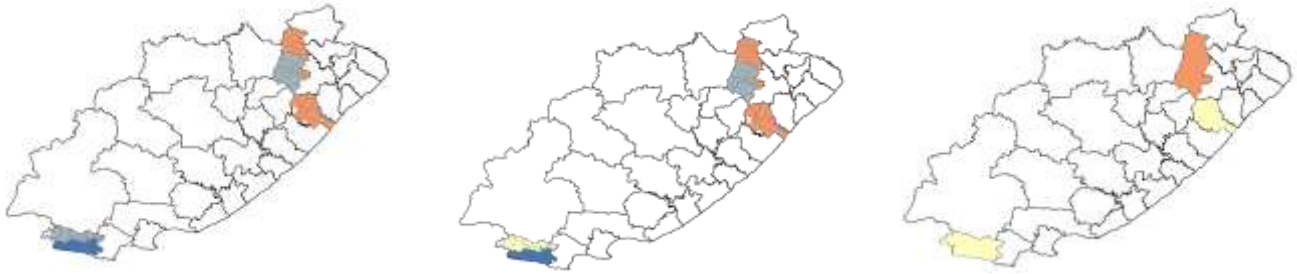


Evaluation of vulnerability assessment

QC = Quaternary Catchment
LM = Local Municipality

How does the vulnerability assessment measured with less indicators and other input data represent the results of field-based assessment?

- Very low vulnerability
- Low vulnerability
- Moderate vulnerability
- High vulnerability



Local Municipality	**Mean-Vulnerability 41 indicators on QC level**	**Mean-Vulnerability 14 selected indicators on QC level**	**Vulnerability 14 selected indicators on LM level**
Kou-Kamma	0,26	0,33	0,48
King Sabata Dalindyebo	0,7	0,73	0,59
Elundini	0,51	0,58	0,67
Data source:	Data / field estimates sampled during surveys with farmers		Statistical data from the Census in 2011 *(STATSSA, 2011)*

Evaluation of risk assessment based on “loss and damage data” from media analysis

Cat	Description	Possible Impacts & actions
D0	Dry	Dry period: Short term dryness slowing plant growth of crops and pastures; fire risk above average; some lingering water deficiencies; pastures and crops not fully recovered
D1	Moderate drought	Some damage to crops & pastures; fire risk is high; Levels of streams, reservoirs or wells are low; Some water shortages are imminent and developing; voluntary water restrictions requested; Early warning
D2	Severe drought	Crop and pasture losses likely; Fire risk very high; Water shortages common; Water restrictions imposed; drought warning messages; Institutions to prepare for response mechanisms.
D3	Extreme drought	Major crop and pasture losses; Extreme fire danger; Widespread water shortages and restrictions compulsory; Extended duration with critical impacts; Warning messages must be adhered to; drought declaration; Institutions to implement active response actions
D4	Exceptional drought	Exceptional and widespread crop & pasture losses; Exceptional high fire risk; shortages of water in reservoirs, streams and wells; creating water emergencies; Potential food insecurity; Water restrictions compulsory; Warning messages must be adhered to; Active response mechanisms; Impacts critical to larger economy

Media analysis approach

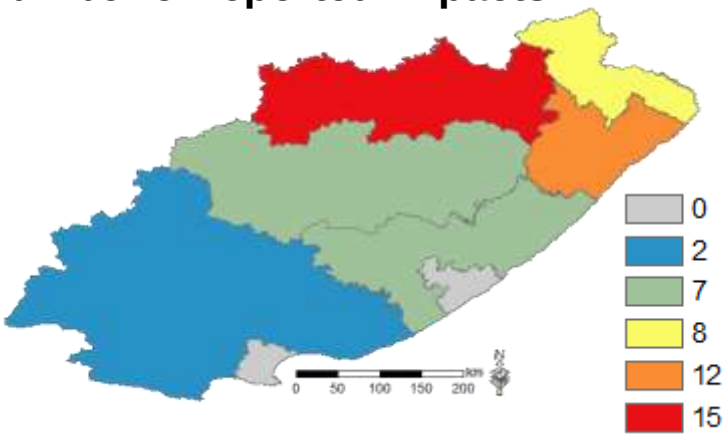
- Identification of relevant (English) newspaper in EC
- Search term: „drought“
- Time period: drought in growing season 2015/2016
- Selection criteria:
  - Spatial information (e.g. name of LM)
  - Impact information (e.g. dam level, drought relief)

Newspaper name	Hits	Relevant articles
Daily Dispatch	> 100	15
Go!&Express	0	0
Grocotts Mail	34	6
The Herald	> 100	0
jBaynews	41	1
EC provincial treasury	1	1
		23

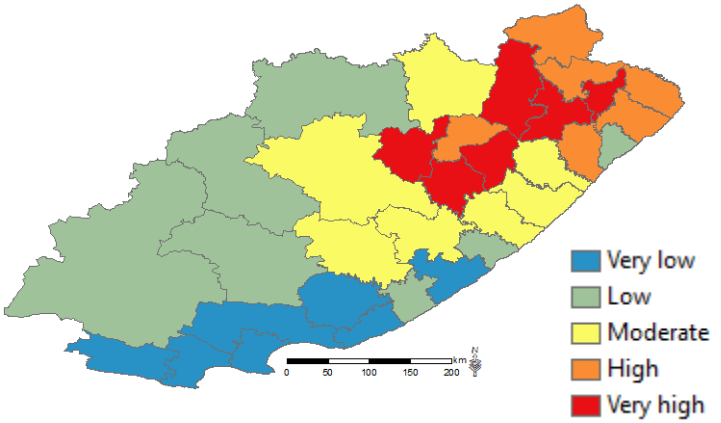
→ Counting of reported impacts per spatial unit
→ Relating impacts to drought hazard severity classification from SA

Results of media analysis in 2015/2016

Number of reported impacts

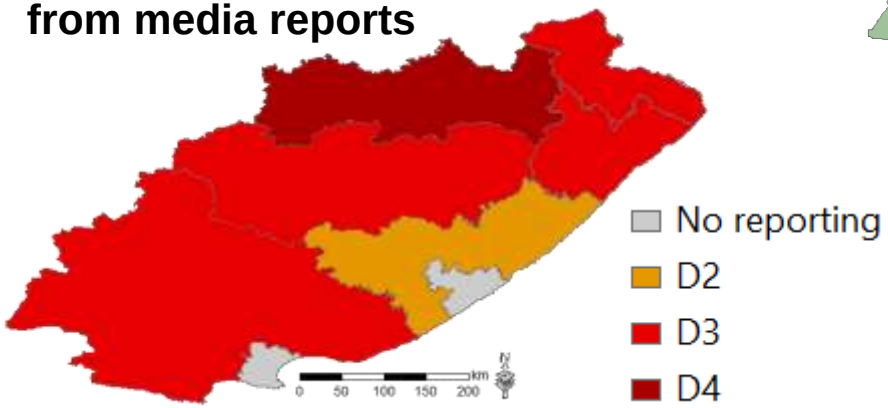


Agricultural drought risk



Cat	Description	Possible Impacts & actions
D 0	Dry	Dry period. Short-term dryness slowing plant growth of crops and pastures; fire risk above average; some lingering water deficiencies; pastures and crops not fully recovered
D 1	Moderate drought	Some damage to crops & pastures; fire risk is high; Levels of streams, reservoirs or wells are low; Some water shortages are imminent and developing; voluntary water restrictions requested; Early warning
D 2	Severe drought	Crop and pasture losses likely; Fire risk very high; Water shortages common; Water restrictions imposed; drought warning messages; Institutions to prepare for response mechanisms.
D 3	Extreme drought	Major crop and pasture losses; Extreme fire danger; Widespread water shortages and restrictions compulsory; Extended duration with critical impacts; Warning messages must be adhered to; disaster drought declaration; Institutions to implement wider response actions
D 4	Exceptional drought	Exceptional and widespread crop & pasture losses; Exceptional high fire risk; shortages of water in reservoirs, streams and wells; creating water emergencies; Potential food insecurity; Water restrictions compulsory; Warning messages must be adhered to; Active response mechanisms; Impacts critical to larger economy

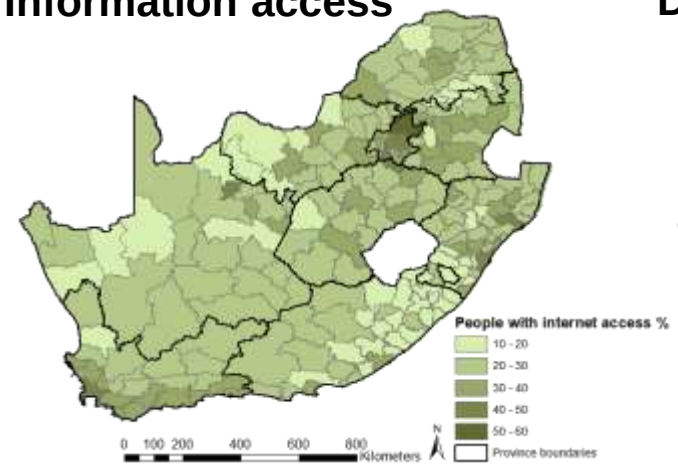
Mean impact value derived from media reports



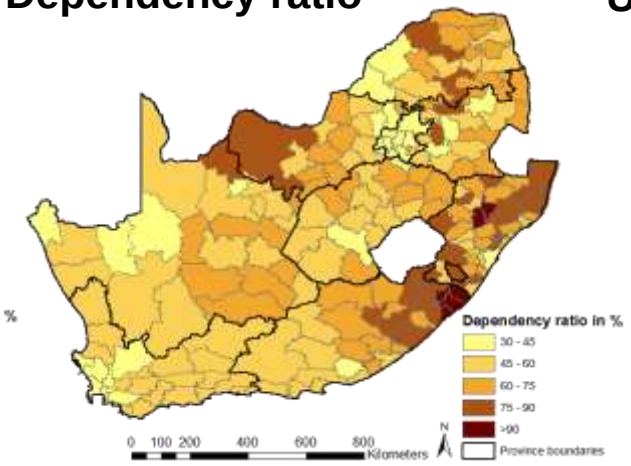
Remaining challenges and next steps

- Refinement of selected vulnerability indicators → stakeholder consultation
- Upscaling vulnerability assessment on the national level
- How can vulnerability information be designed to allow its integration in the decision-making process in line with the existing drought classification scheme for SA?

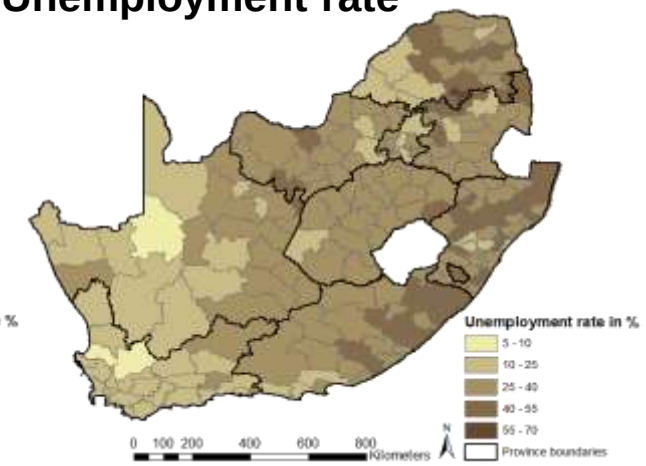
Information access



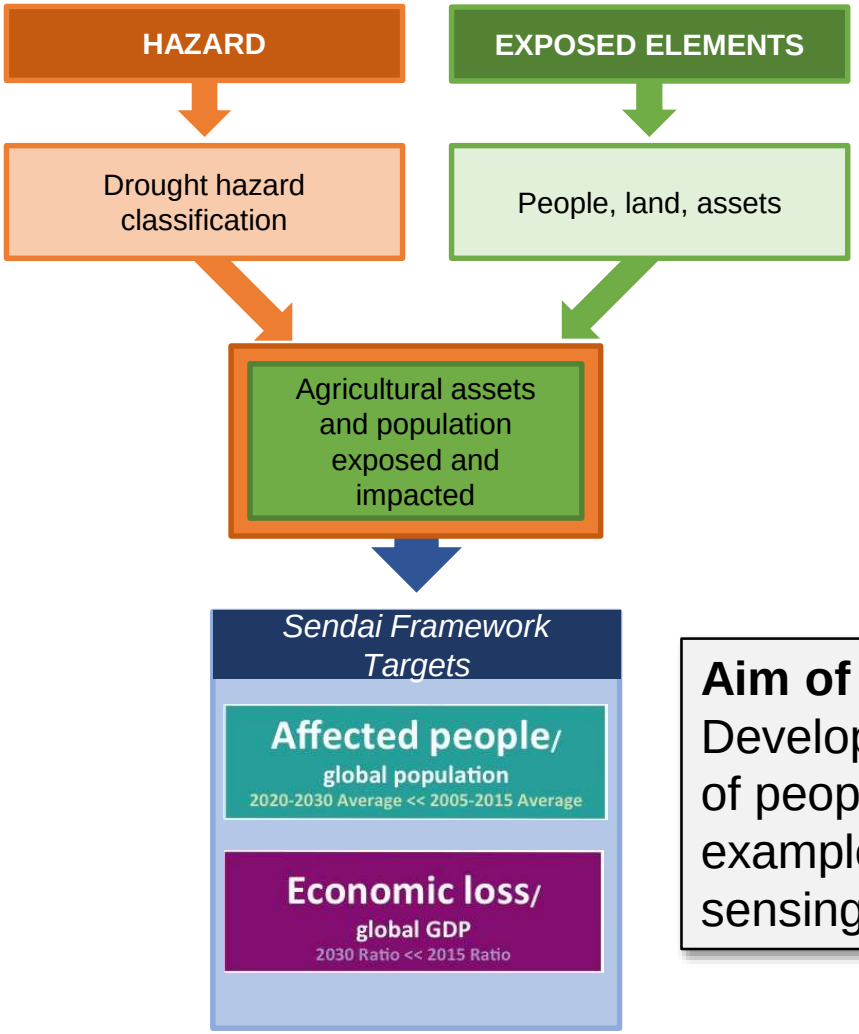
Dependency ratio



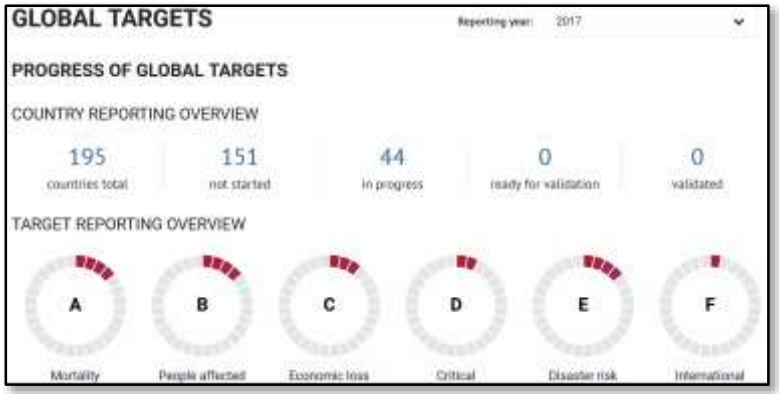
Unemployment rate

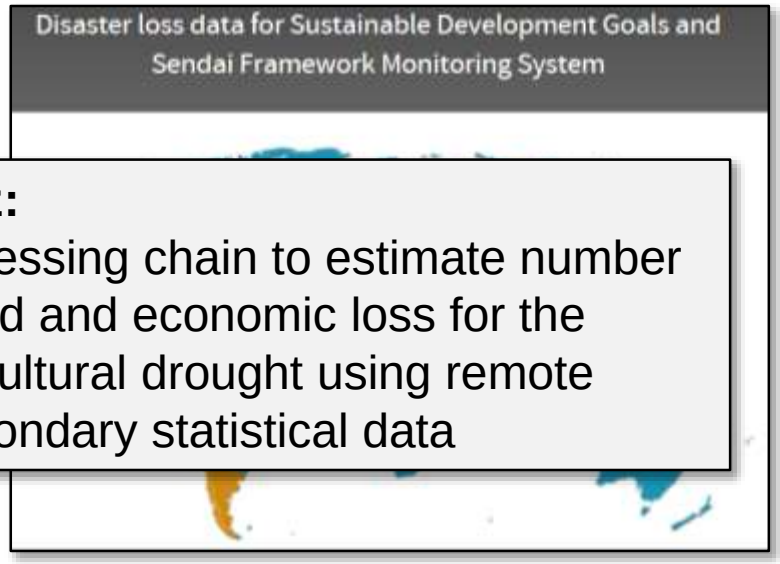


Assessment of Sendai targets



Need for assessment of indicators





Aim of EvIDENz:
Developing processing chain to estimate number of people affected and economic loss for the example of agricultural drought using remote sensing and secondary statistical data

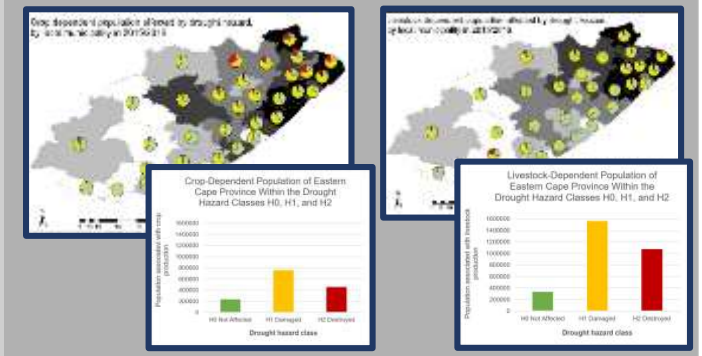
Sendai Framework Indicators

South Africa

Eastern Cape Province

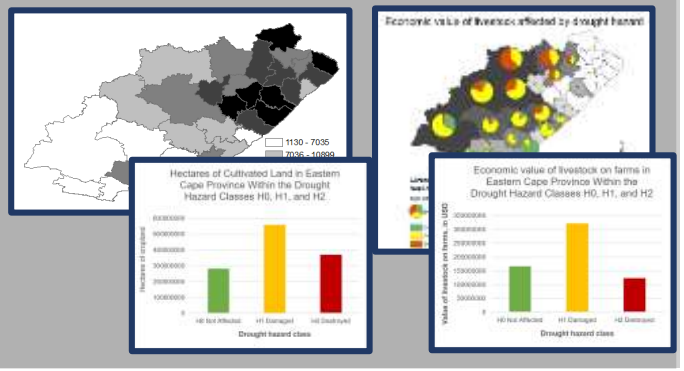
Affected people/
global population
2020-2030 Average << 2005-2015 Average

Indicator B-5: Number of people whose livelihoods were disrupted or destroyed, attributed to agricultural drought



Economic loss/
global GDP
2030 Ratio << 2015 Ratio

Indicator C-2: Direct agricultural loss attributed to agricultural drought



Methodological basis for indicator calculations

Affected people/
global population
2020-2030 Average << 2005-2015 Average

No.	Indicator
B-1	Number of directly affected people attributed to disasters, per 100,000 population.
B-2	Number of injured or ill people attributed to disasters, per 100,000 population.
B-3	Number of people whose damaged dwellings were attributed to disasters.
B-4	Number of people whose destroyed dwellings were attributed to disasters.
B-5	Number of people whose livelihoods were disrupted or destroyed, attributed to disasters.

Economic loss/
global GDP
2030 Ratio << 2015 Ratio

No.	Indicator
C-1	Direct economic loss attributed to disasters in relation to global gross domestic product. (compound indicator)
C-2	Direct agricultural loss attributed to disasters *Agriculture is understood to include the crops, livestock, fisheries, apiculture, aquaculture and forest sectors as well as associated facilities and infrastructure.*
C-3	Direct economic loss to all other damaged or destroyed productive assets attributed to disasters. *Productive assets would be disaggregated by economic sector, including services, according to standard international classifications. Countries would report against those economic sectors relevant to their economies. This would be described in the associated metadata.*
C-4	Direct economic loss in the housing sector attributed to disasters. *Data would be disaggregated according to damaged and destroyed dwellings.*
C-5	Direct economic loss resulting from damaged or destroyed critical infrastructure attributed to disasters. *The decision regarding those elements of critical infrastructure to be included in the calculation will be left to the Member States and described in the accompanying metadata. Protective infrastructure and green infrastructure should be included where relevant*
C-6	Direct economic loss to cultural heritage damaged or destroyed attributed to disasters.

http://www.unisdr.org/files/54970_techguidancefdigitalhr.pdf (22.02.2018).

Indicator relationships and workflow

Eastern Cape, South Africa

B5

Affected people/ global population
2020-2030 Average << 2005-2015 Average

- B-5a: Number of workers in agriculture with crops damaged or destroyed
- B-5b: Number of workers responsible for, and owners of livestock lost affected by drought

C2

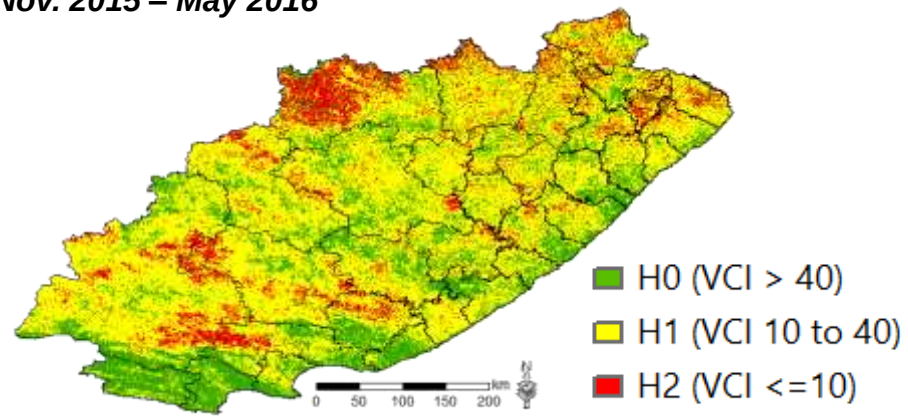
Economic loss/ global GDP
2030 Ratio << 2015 Ratio

- C-2Ca: Number of hectares of crops damaged or destroyed by agricultural drought
- C-2L: Direct livestock loss due to agricultural drought

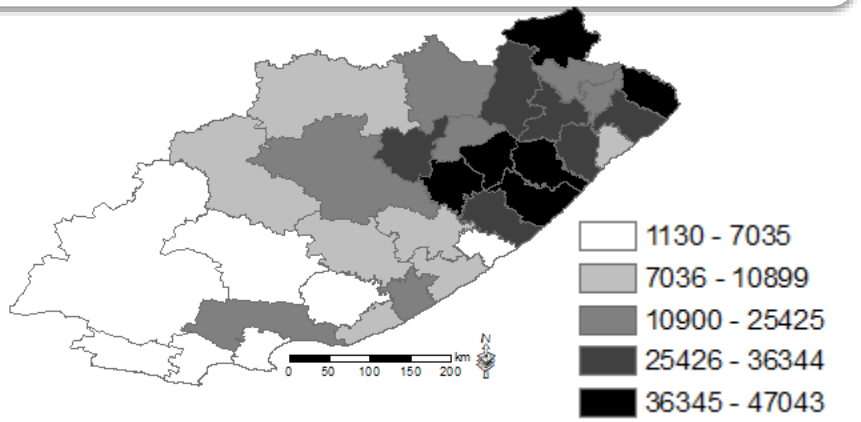
- C-2Ca: Number of hectares of crops damaged or destroyed by agricultural drought
- B-5a: Number of workers in agriculture with crops damaged or destroyed
- Number of hectares of grassland affected
- B-5b: Number of workers (population) responsible for livestock lost
- C-2L: Direct livestock loss due to agricultural drought

Hectars of crops damaged or destroyed (C-2Ca)

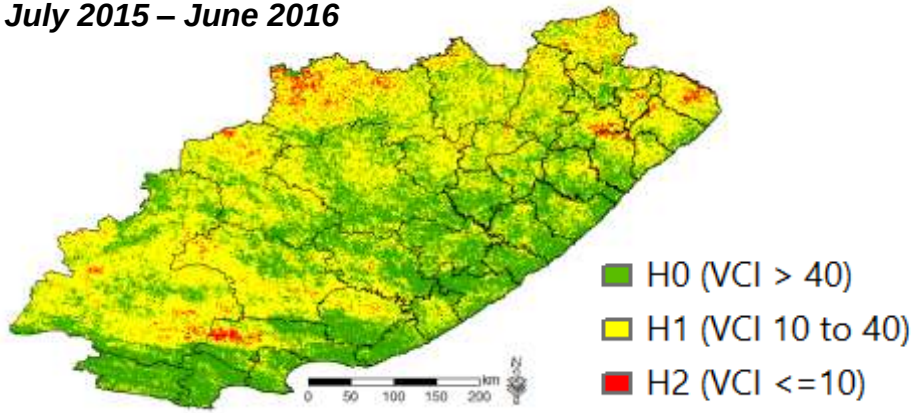
Median VCI
Nov. 2015 – May 2016



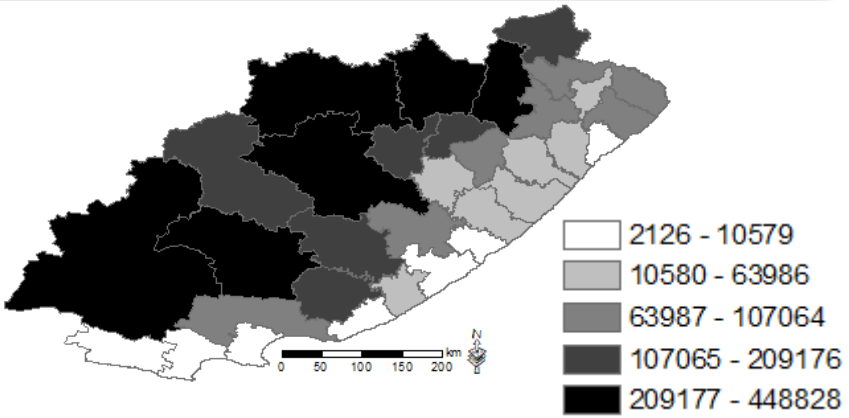
C-2Ca: Number of hectares of crops damaged or destroyed by agricultural drought



Median VCI
July 2015 – June 2016



Number of hectares of grassland affected



Crop-dependent population affected (B-5a)

B-5a: Number of workers in agriculture with crops damaged or destroyed

Households involved in crop production **X** Number of people per household **=** Number of crop-dependent people

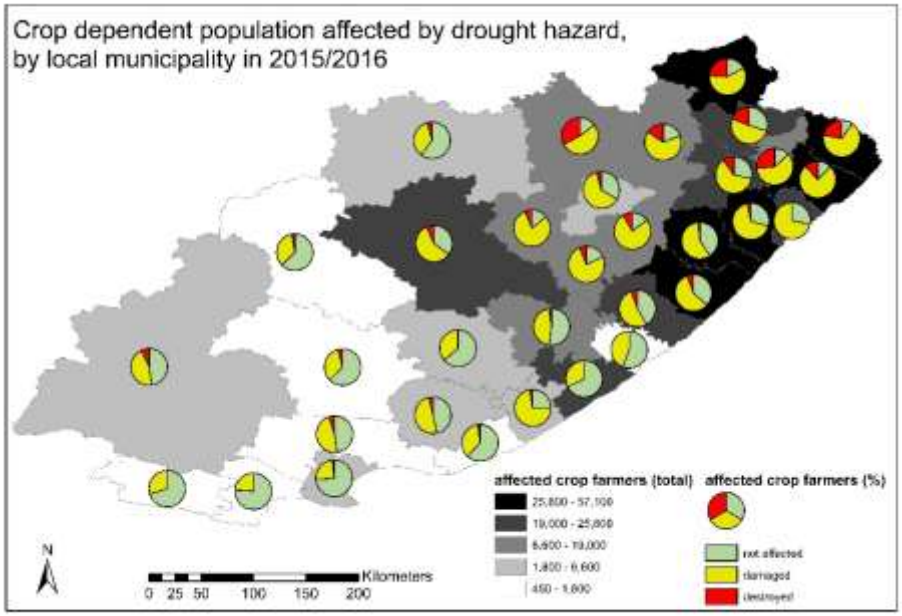
Number of crop-dependent people **÷** Hectares of cropland **=** Density of crop-dependent population per hectare of cropland

Density of crop-dependent population per hectare of cropland **X** Hectares of cropland in hazard classes (from C2-2a) **=**

Data from Statistics South Africa

Data from EvIDENz

Data from environmental affairs, GEOTERRA



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Livestock-dependent population affected (B-5b)

B-5b: Number of workers responsible for, and owners of livestock lost affected by drought

Households in livestock production **X** Number of people per household **=** Number of livestock-dependent people

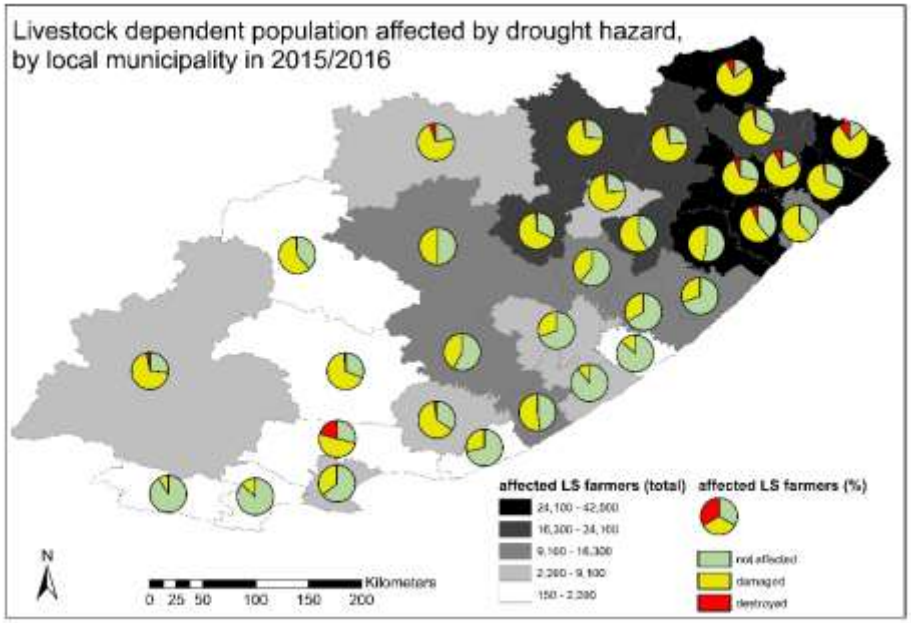
Number of livestock-dependent people **÷** Hectares of grassland **=** Density of livestock-dependent population per hectare of grassland

Density of livestock-dependent population per hectare of grassland **X** Hectares of grassland in hazard classes **=**

Data from Statistics South Africa

Data from EvIDENz

Data from environmental affairs, GEOTERRA



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Economic value of livestock affected (C-2L)

C-2L: Economic loss from number of livestock lost

Per local municipality

Gross farming income from cattle sold	÷	Number of cattle sold	=	Gross farming income per head of cattle
R000 (in thousands of rand)				**R000** /

Gross farming income per head of cattle	x	Total number of cattle on farms	=	Total monetary value of cattle on farms
R000 /				**R000**

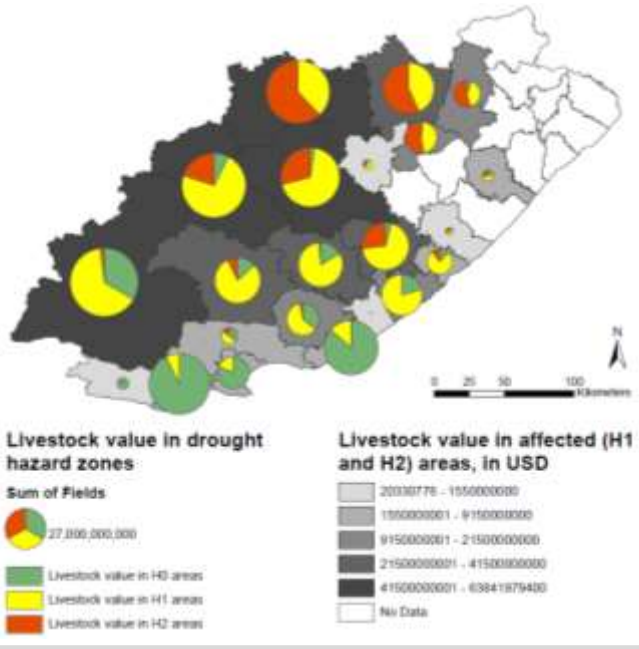
Repeat for all livestock categories

Account for inflation and convert to USD

Total value of livestock on farms	x	*Per local municipality* Proportion of grassland in hazard classes	=	Economic value of livestock exposed to drought hazard (grassland)
USD				

Data from EVIDENz

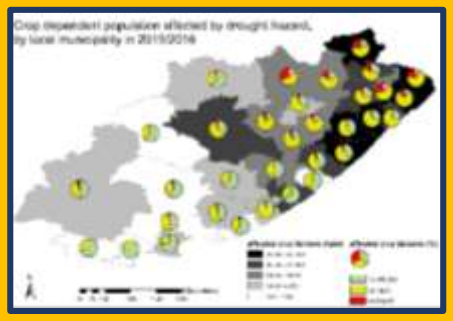
Data from Statistics South Africa – Agriculture

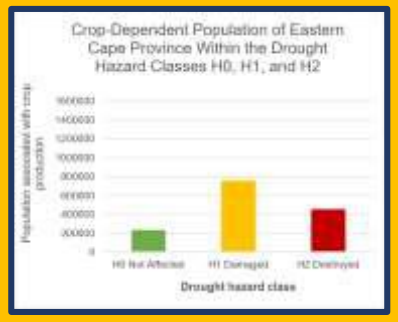


Contributions to SFDRR Targets
Example 2015/2016

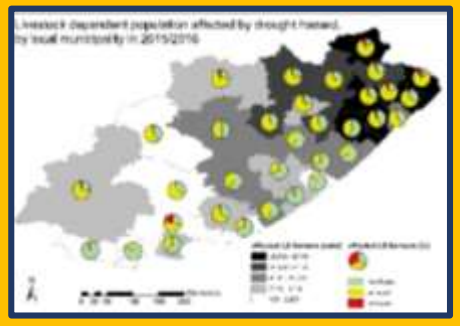
Eastern Cape, South Africa

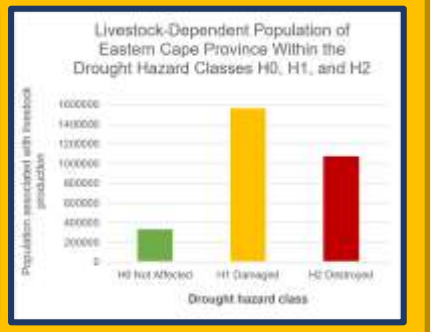
B-5a: Number of workers in agriculture with crops damaged or destroyed



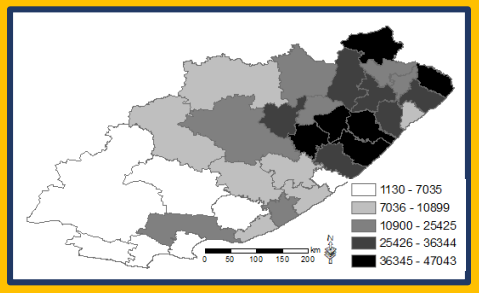


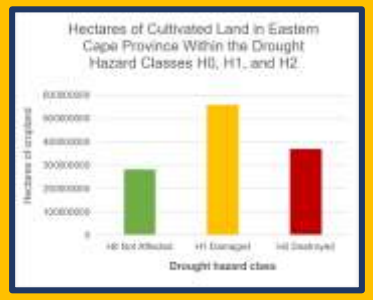
B-5b: Number of workers responsible for livestock lost



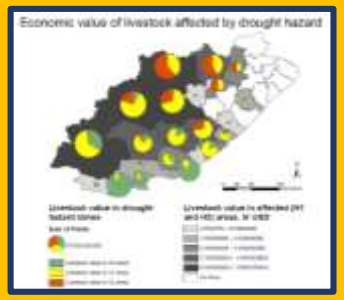


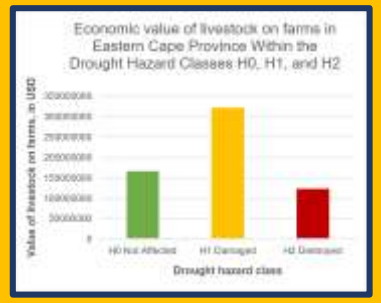
C-2Ca: Number of hectares of crops affected



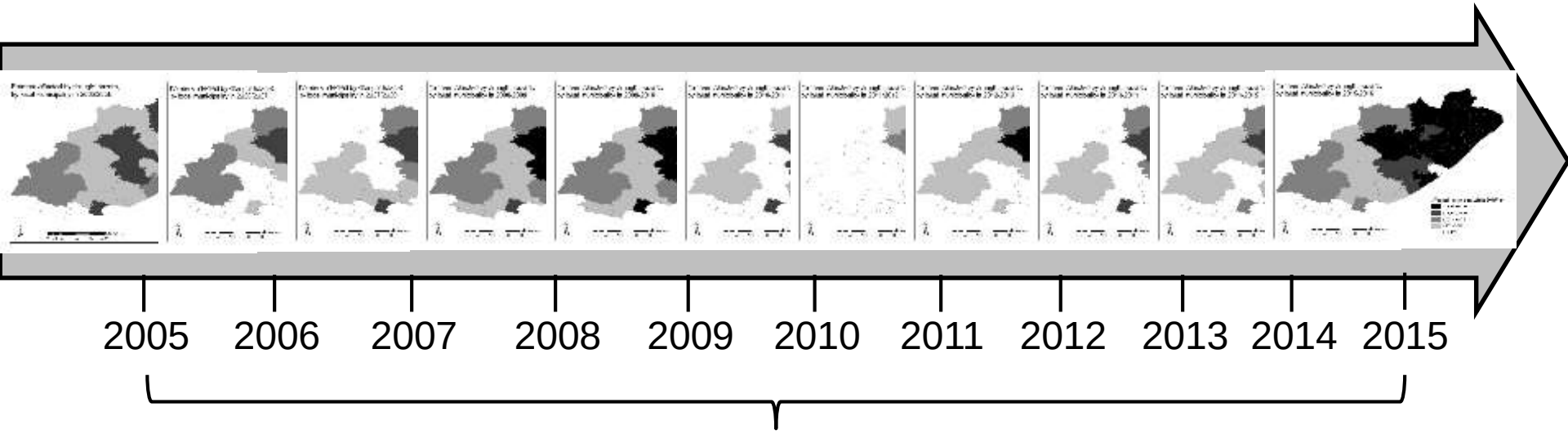


C-2L: Direct agricultural loss due to livestock lost





Sendai baseline



2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015

Affected people/
global population
2020-2030 Average << 2005-2015 Average

Estimated number of people affected due to agricultural drought in Eastern Cape

7,035 / 100,000

Remaining challenges and next steps

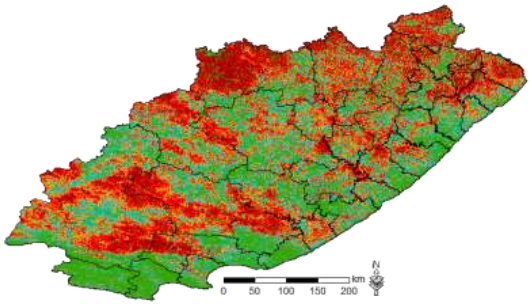
Need to discuss **assumptions** made:

- Relation between livestock-related measure(s) and grassland,
- Setting thresholds between damaged and destroyed / crops not fully or fully affected by droughts,
- How to differentiate between drought-related attribution of estimated „number of people affected by agricultural drought“ (see impact of vulnerability).

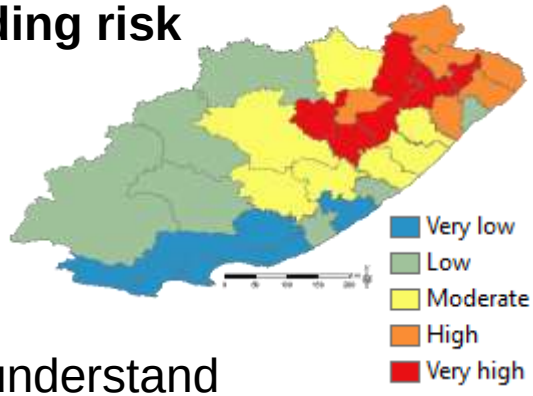
Calculation of economic loss for cropland: Need for crop map and yield data

Summary

Cat	Description	Possible impacts & actions
D0	Dry	Dry period: Short-term dryness slowing plant growth of crops and pastures; fire risk above average; some lingering water deficiencies: pastures and crops not fully recovered
D1	Moderate drought	Some damage to crops & pastures; fire risk is high; Levels of streams, reservoirs or wells are low; Some water shortages are imminent and developing; voluntary water restrictions requested; Early warning
D2	Severe drought	Crop and pasture losses likely; Fire risk very high; Water shortages common; Water restrictions imposed; drought warning messages; Institutions to prepare for response mechanisms.
D3	Extreme drought	Major crop and pasture losses; Extreme fire danger; Widespread water shortages and restrictions compulsory; Extended dry/hot with critical impacts; Warning messages must be adhered to; drastic drought mechanism institutions to implement water response actions
D4	Exceptional drought	Exceptional and widespread crop & pasture losses; Exceptional high fire risk; shortages of water in reservoirs, streams and wells; creating water emergencies. Potential food insecurity. Water restrictions compulsory; Warning messages must be adhered to; Active response mechanisms; Impacts critical to larger economy



Objective I: Understanding risk

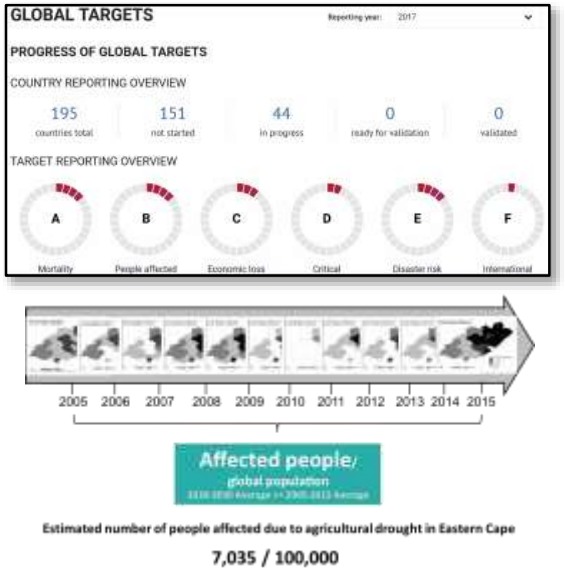


Integration of exposure and vulnerability to understand drought risk and its manifestation in impacts

Objective II: Assessment of Sendai targets

Processing chain provides an estimate of Sendai indicators (EvIDENz example):

- Overcome data scarcity
- Monitor plausibility of existing loss and damage data
- Retrospective measure of Sendai baseline



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Thank you very much for your attention

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