Drought risk assessment for agricultural systems at the regional scale

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Background and Methodology

Summary

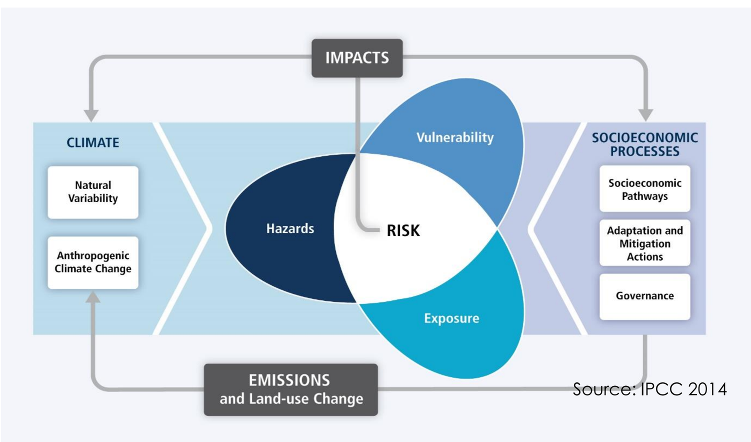
The devastating impacts of drought are fast becoming a global concern.

Zimbabwe and **South Africa** are highly at risk towards drought impacts, where drought impacts have led to **water shortages**, **declining yields**, and periods of **food insecurity**, accompanied by **economic downturns**. In particular, the countries' agricultural sector, mostly comprised of smallholder growing crops under rainfed conditions are highly susceptible to drought impacts, and are likely to be disproportionally affected due to their high dependency on climate-sensitive resources.

Our findings shows the **heterogeneity** of drought risk in both countries and how assessing its components can support the identification of tailored measures to reduce drought risk and increase the resilience of agricultural systems.

Data and methods

Drought Risk function of: Drought **hazard**, **exposure** and **vulnerability**



Source: IPCC 2014

Zimbabwe

Hazard: Vegetation Health Index (VHI) Data Collection (1989 – 2019)

Exposure: Land use/land cover (LULC) dataset differentiating between rainfed and irrigated agriculture in Zimbabwe, derived from NDVI (2013–2018 by Landmann et al. (2019))

Vulnerability: Selection and classification through literature review and experts weighting survey of 32 vulnerability indicators by socioecological susceptibility (SOC-ENV_SUS) and lack of coping capacity (COP).

South Africa

Hazard: Deviation of the situation in a specific year or month from long-term mean (1986–2015). WaterGAP and the Global Crop Water Model (GCWM) models daily, 30 arcmin (WaterGAP) & 5 arcmin (GCWM)

Exposure: LULC dataset differentiating between rainfed and irrigated agriculture, and population

Vulnerability: Selection and classification through literature review and experts weighting survey of 22 vulnerability indicators by socioecological susceptibility (SOC-ENV_SUS) and lack of coping capacity (COP).

Results

Results drought risk Zimbabwe

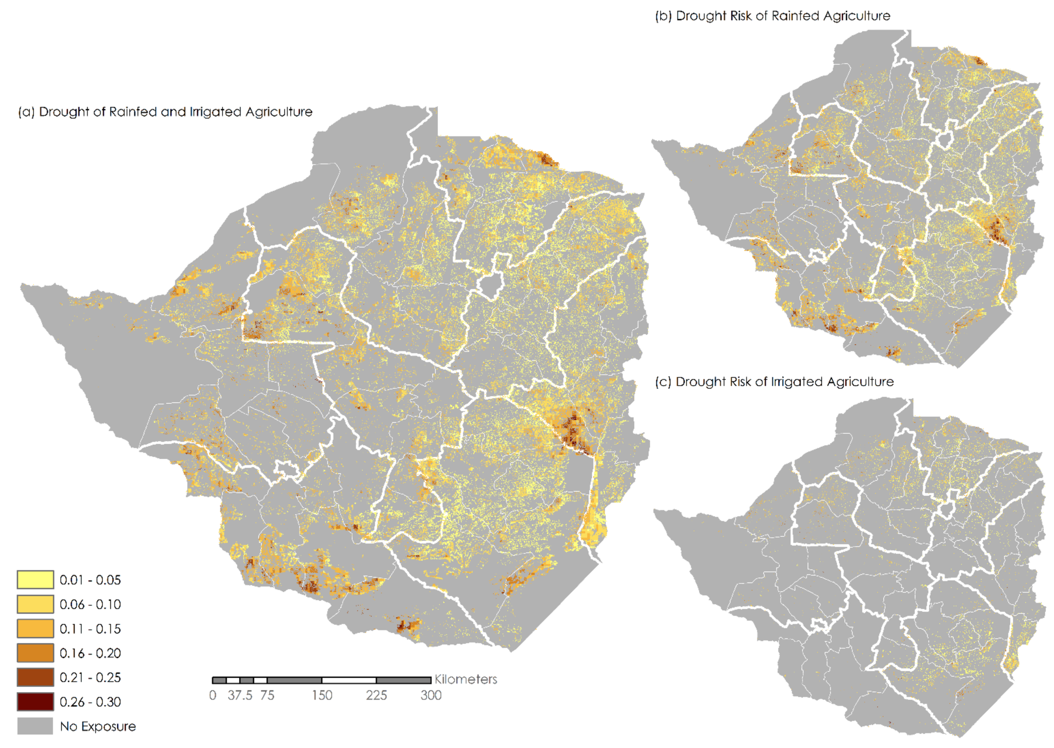


Figure 1. Drought risk to rainfed and irrigated agriculture considering drought frequency. Classification scheme: equal intervals between 0.01 and 0.3. Source: Frischet et al. 2020

- Every district has been **affected by drought during the last thirty years**
- Severity and magnitude vary substantially
- Results must be seen in the context of **the disaster risk management (DRM)** structure in Zimbabwe
- Findings can help to prioritise suitable adaptation measures:
  District affected by a high frequency, but low severity: **drought-resistant crops, conservation agriculture, water saving-techniques**
  Districts affected by a low frequency, but high severity: **risk transfer schemes, climate risk insurance**

Results Drought Risk South Africa

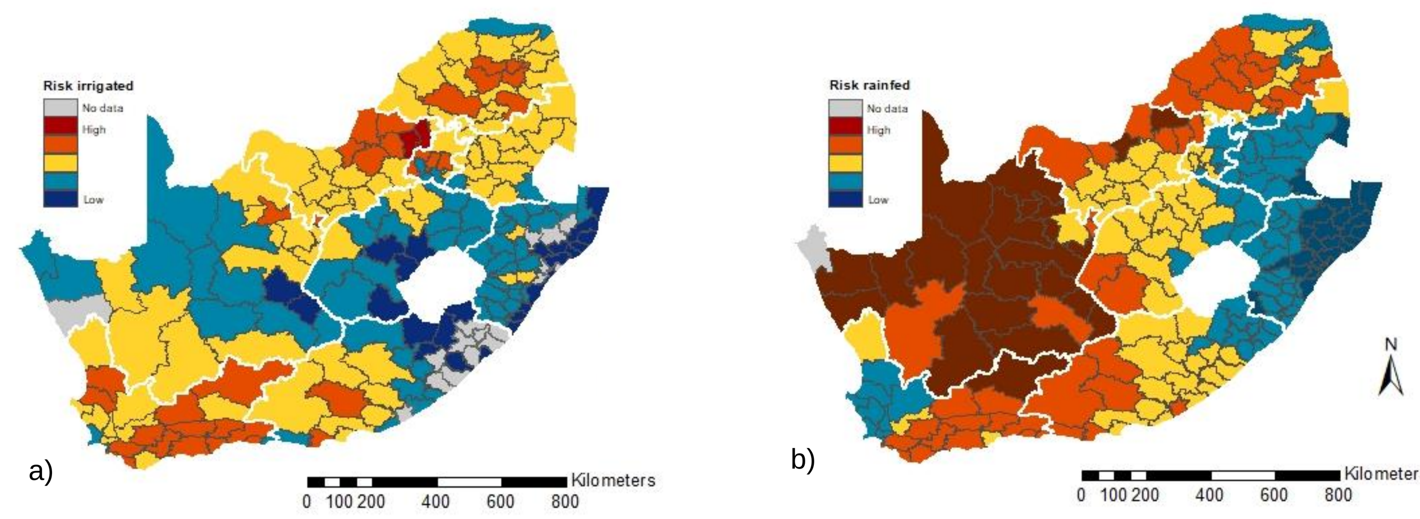


Figure 2. Drought risk for irrigated (a) and rainfed (b) agricultural systems at local municipality level in South Africa. Source: UNU (unpublished, paper under preparation)
- The drought risk index for irrigated varied from 0.023 (no drought, dark blue) to -1.22 (extreme drought, dark red); grey shows no data
- The drought risk index for rainfed varied from 0.0122 (no drought, dark blue) to 0.197 (extreme drought, dark red); grey shows no data

- Visualization of risk can be used by policy makers and explains why people are disproportionally affected, even though they are affected by the same hazard, therefore gives entry points for **vulnerability reduction**
- **Heterogeneous pattern** of drought risk within the country. This spatial variability in drought risk might help to identify leverage points for reducing impacts and properly anticipate, adapt and move towards resilient agricultural systems (e.g. risk transfer through crop/climate risk insurance)
- Drought risk assessments need to be crop-specific. Notable information gets lost by aggregating drought effects on different crops (irrigated, rainfed)

Correlation between modelled and remotely sensed ratio

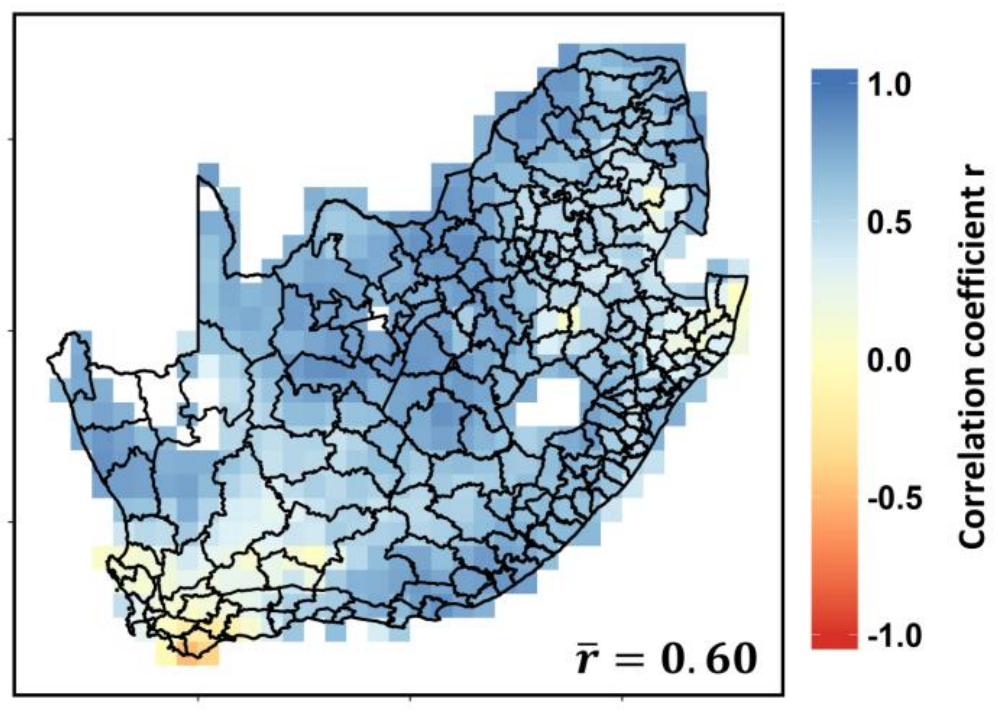


Figure 3. Correlation between modelled and remotely sensed ratio between actual and potential evapotranspiration for rainfed crops in South Africa and period 2001-2018 Source: Uni-Göttingen (unpublished, paper under preparation).

Conclusion and outlook

- Local assessments (e.g. district, local municipality) are fundamentally important to understand root causes of vulnerability and provide detailed information about people's livelihoods, perceptions and challenges.
- **A multi-method approach** is highly useful to determine root causes and drivers of drought risk.
- Enhancement of the analysis would be a **temporally dynamic exposure and vulnerability analysis**, complementing the hazard data.

References

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