



# CEPHaS

Capacity for Conservation Agriculture Research

## Capacity building in multi-disciplinary scientific methods for improved understanding of the impact of conservation agriculture on groundwater resources in Africa

Daina Mudimbu<sup>1\*</sup>, Kawawa Banda<sup>2</sup>, Bentje Brauns<sup>3</sup>, Dan J. Lapworth<sup>4</sup>, Alan M. MacDonald<sup>5</sup>, Willy Namaona<sup>6</sup>, Richard Owen<sup>7</sup>, and Mabvuso Sinda<sup>8</sup>

<sup>1</sup>Department of Chemistry and Earth Sciences, Faculty of Science, University of Zimbabwe, Harare, Zimbabwe

<sup>2</sup>Department of Geology, School of Mines, University of Zambia, P.O. Box 32379, Lusaka, Zambia

<sup>3</sup>British Geological Survey, Keyworth, NG12 5GG, UK

<sup>4</sup>British Geological Survey, Wallingford, OX10 8BB, UK

<sup>5</sup> British Geological Survey, Edinburgh, EH14 4AP, UK

<sup>6</sup>Lilongwe University of Agriculture and Natural Resources, Malawi

<sup>7</sup>Department of Civil Engineering, School of Engineering, University of Zimbabwe, Harare, Zimbabwe

<sup>8</sup>Department of Soil Science, School of Agricultural Sciences, University of Zambia, P.O. Box 32379, Lusaka, Zambia



# Background

- With up to 70% of the populations in the sub-Saharan countries rely on groundwater resources, the development of groundwater systems is instrumental in food security and access to safe water.
- Our ever-changing climate further threatens this security... **“In coming decades, the Southern African Development Community (SADC) region is expected to experience higher land and ocean surface temperatures than in the past”**
- 2015/16 farming season, SADC Early Warning and Vulnerability Assessment Systems, reported – at least 27 million people, in the SADC region were left food insecure as a result of the poor harvest.



SOUTHERN AFRICAN DEVELOPMENT COMMUNITY  
TOWARDS A COMMON FUTURE

Information 5

About SADC | SADC Secretariat | Member States | News & Events | Opportunities

Home > SADC Secretariat > Directorates & Units > Deputy Executive Secretary Regional Integration > Food Agriculture  
Adaptation and Mitigation in Eastern and Southern Africa (COMESA-EAC-SADC)

VISION, MISSION & MANDATE

SADC EXECUTIVES PROFILES

DIRECTORATES & UNITS

Executive Secretary

PROGRAMME ON CLIMATE CHANGE  
EASTERN AND SOUTHERN AFRICA (C)



# Coping Mechanisms

- **Governments promoting policies on Conservation agriculture (CA), among other 'climate-smart' agronomic systems.**
- Conservation agriculture (CA) has been promoted as a tool to obtain reliable crop yields through adopting three main principles of **minimum soil disturbance** or no tillage, **crop or surface residue retention**, and **crop diversification** or rotation.



## Key Questions



What is the impact of climate smart agriculture in particular CA practices on soil-water dynamics, agricultural resilience and **groundwater recharge**?

**Limiting factor:** Research capacity in the relevant physical sciences.



CEPHaS

Capacity for Conservation Agriculture Research

Strengthening Capacity in Environmental Physics,  
Hydrology and Statistics for Conservation Agriculture  
Research

The CEPHaS project is a joint undertaking between colleagues in Zambia, Zimbabwe, Malawi and the UK to strengthen our shared capacity among **statisticians, soil scientists, geophysicists, hydrogeologist, agriculturalists and social scientists.**



A GCRF RCUK Collective Fund project





## Strengthening capacity in environmental physics, hydrogeology & statistics for conservation agriculture research

What is the impact of conservation agriculture practices, advocated as a “climate smart” agronomic strategy, on soil-water dynamics and so on agricultural resilience and groundwater recharge?

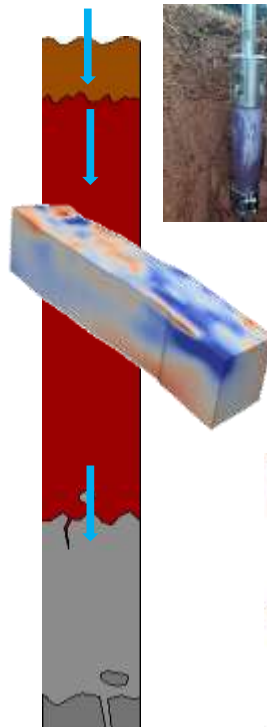
### Processes

Available water for crop growth

Profile water recharge — resilience for next season

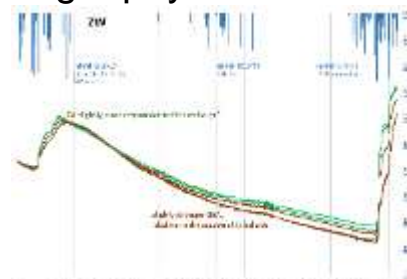
Groundwater recharge sustaining a key resource

### Measurement & modelling



Soil water properties: field and lab measurements

Dynamics and transport between surface and deeper profile: shallow geophysics



Recharge processes

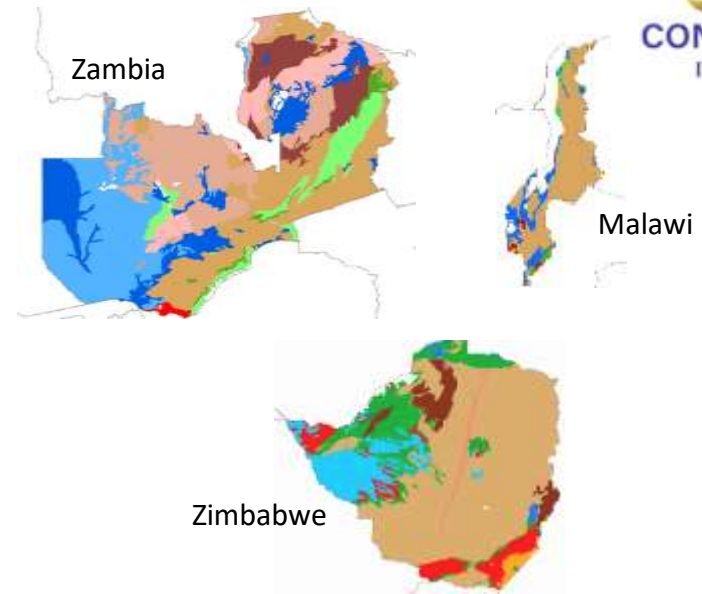
### Integration



Statistical and process modelling: prediction and upscaling.



Socio-economic assessment



## The Project Design

- Experimental field sites established with
  - Soil moisture monitoring probes,
  - Monitoring boreholes with automated pressure transducers to log groundwater level fluctuations
  - and electrical-resistivity tomography (ERT) equipment



# Capacity building

- Training workshops (physical and virtual) - for capacity building, network meetings, practical in-field and laboratory exchanges.
- On the job, university students, project partners





# Key issues & lessons

- Building genuinely equitable partnerships
- Training
  - Capturing learning and experience in useful formats.
  - Value of on-the-job training across sites
  - “Training the trainer” builds a legacy
- Gender balance
  - Has to be proactive (mentoring, stakeholders)
- The need to provide opportunities for ECRs to participate in WG leadership and outward-facing project activities



# Cross pollination, Innovation Collaboration

- Capacity research is purposefully included as a workstream.
- CEPHaS activities have resulted in a **cross-pollination of ideas** and the generation of **innovative** methods and solutions that can **better inform policies**.
- The CEPHaS international network lends itself to use not only in the current project but **future collaborations** of national and regional significance.




# Acknowledgements

**IWRA for the opportunity to share some of our work**  
**A GCRF RCUK Collective Fund for funding this research**



**My CEPHaS colleagues in the hydrogeology working group**  
**The greater CEPHaS network with members from the following institutions**



**All of you for listening to this presentation**  
Contact us at [cephas@bgs.ac.uk](mailto:cephas@bgs.ac.uk) |  us  
**@CEPHaS\_Soil**