Climate Research for Development (CR4D)

WISER Pan Africa Closing Workshop
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Venue: Nairobi, Kenya

Building adaptive capacity to cope with effects of climate change on riparian based ecosystems and livelihoods in semi-arid areas of Zimbabwe

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Presentation Outline

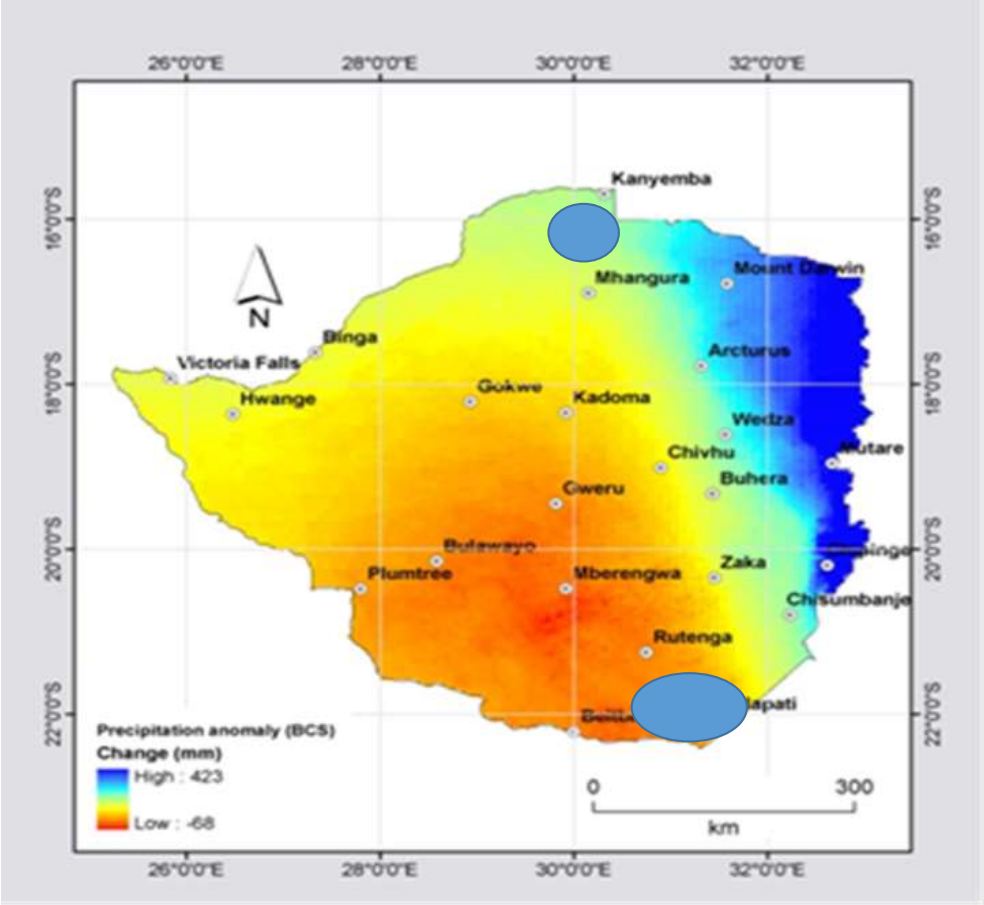
- Introduction and Background
- The Problem
- Objectives and Outputs
- Significance of the study
- Methodology
- Results
- Conclusions
- Outputs and Outcomes
- Challenges
- Policy Implications and Way Forward
- Acknowledgements

Introduction and Background

- Climate change and other anthropogenic stressors pose a threat to riparian areas due to altered hydrologic regimes **(Dirwe et al 2019; Stella and Bendix, 2019).**
- Climate related risks to livelihoods, food security and water resources with projected global warming of 1.5˚C **(IPCC, 2018).**
- Recurrent climate change-mediated reduction in river flow regimes compromise the ecological integrity of rivers and the resultant goods and services relied upon by the local communities
- 70% of the population of Zimbabwe (8.4 million people) lives in rural areas and relies on rain-fed agriculture and natural resources for food security and livelihoods **(Brown et al, 2012).**
- Inadequate surface water and groundwater for rural communities due to prolonged drought periods.
- Rivers account for 90% of the Zimbabwe's water supply **(Chigwada, 2005).**

What is the problem?

- Rainfall has been erratic in the south eastern Lowveld
- Projected it to be more erratic in the near future with most models projecting a reduction in rainfall in the near-future.
- Water scarcity pose a challenge for dry land agriculture
- Affects change in phenology and hence productivity of the riparian ecosystems.
- Interacts with other multiple stressors across different land uses (e.g. communal, resettlement, protected areas, commercial farms)



Projected precipitation anomalies over Zimbabwe based on the difference between CSIROMK3 projections for the year 2080 and the current precipitation for the best case scenario (Zimbabwe's Second National Communication to the UNFCCC, 2014).

Aim and Objectives of the Study

Aim of the study

To explore the impact of climate change on river flow regime and riparian based ecosystems and livelihoods dependent on selected rivers in semi-arid parts, Zimbabwe.

Specific objectives

a. To establish the current and model future climatic trends (temperature and rainfall) in Chiredzi, Mbire and Mwenezi District.

b. To determine the relationship between rainfall and river flow

c. To explore local knowledge on the impacts of climate change on riparian based ecosystem goods & services and livelihoods in semi-arid parts of Zimbabwe.

d. To identify livelihood coping strategies for river dependent livelihoods located along the Angwa, Manyame, Runde and Mwenezi Rivers.

e. To determine the adaptive capacity of riparian based communities in located along the Angwa, Manyame, Runde and Mwenezi Rivers.

f. Use a community-based approach to build capacity for management and restoration of ecosystems and livelihoods based on rivers.

g. Build capacity for global environmental change research by training the next generation of researchers

Significance/Outputs/Outcomes

Vulnerability assessment and mapping of adaptive capacities for riparian based rural communities

Documentation of local knowledge on strategies used by riparian based communities to cope with changes in the flow regime of perennial river systems

Documentation on how livelihoods and riparian ecosystems goods and services have been impacted by climate change

Capacity building of institutions and practitioners (hydrologists, fisheries unit, environmentalists, climate change managers, local NGOs) involved in water resources management

Post Doc
Dissertation
2 Master of Science dissertations, 2 Female MPhil, 1 Book Chapter, 3 manuscripts in progress, 3 Technical reports and
1 Policy Brief

SDGs (1, 2 , 13 and 15), Agenda 2063, IPBEs, COP26 priorities (Adaptation & Resilience; Nature), National and Sub-national Policies and Development Plans (NDS1) IPCC Reports; Nationally Determined Contributions under Paris Agreement

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Methodology

- Combination of qualitative and quantitative data collection methods for the collection of bio-physical and socio-economic data.
- **Secondary data**
  - Rainfall and temperature (station and satellite)
  - River discharge
- **Climate projections**
- **Primary Data Collection (Participatory Rural Appraisal Techniques)**
  - household surveys using mobile data collection (Android Phones loaded with Kobo collect software) - respondents randomly selected from purposively sampled from villages within riparian zone)
  - key informant interviews (purposively sampled)
  - 9 focus group discussions (one per ward) – Ranking Exercises, Trend Analysis, Brainstorming, Community Mapping, Problem Tree Analysis

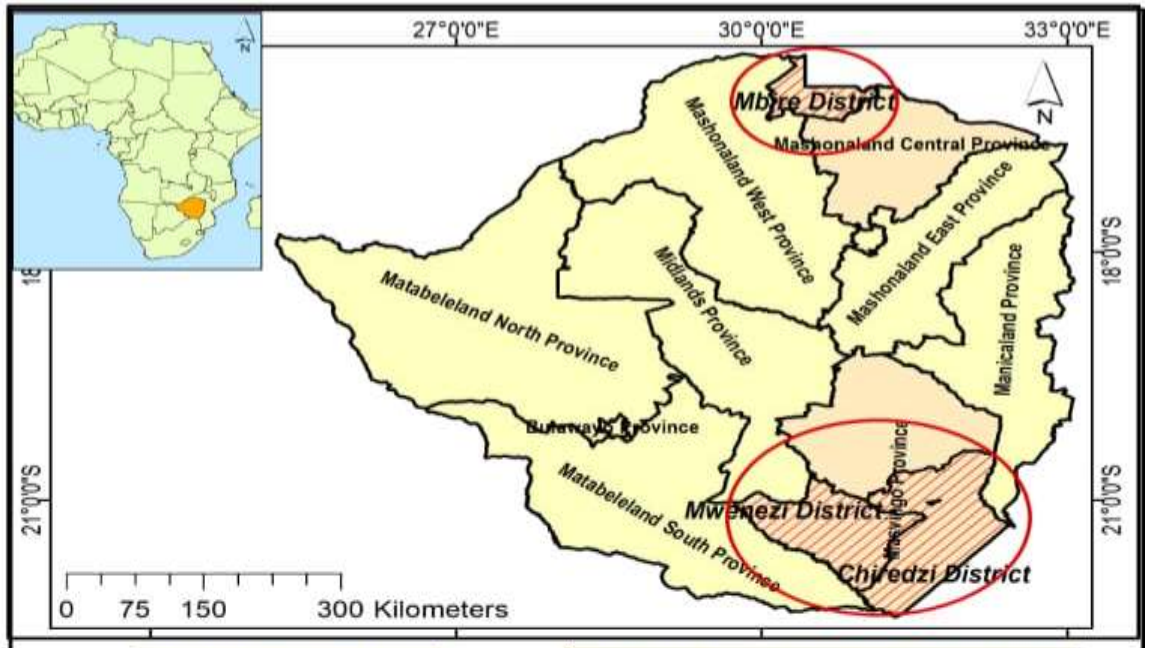
- The **Ecosystem Millennium Assessment framework** was be adopted for the categories of ecosystems goods and services.

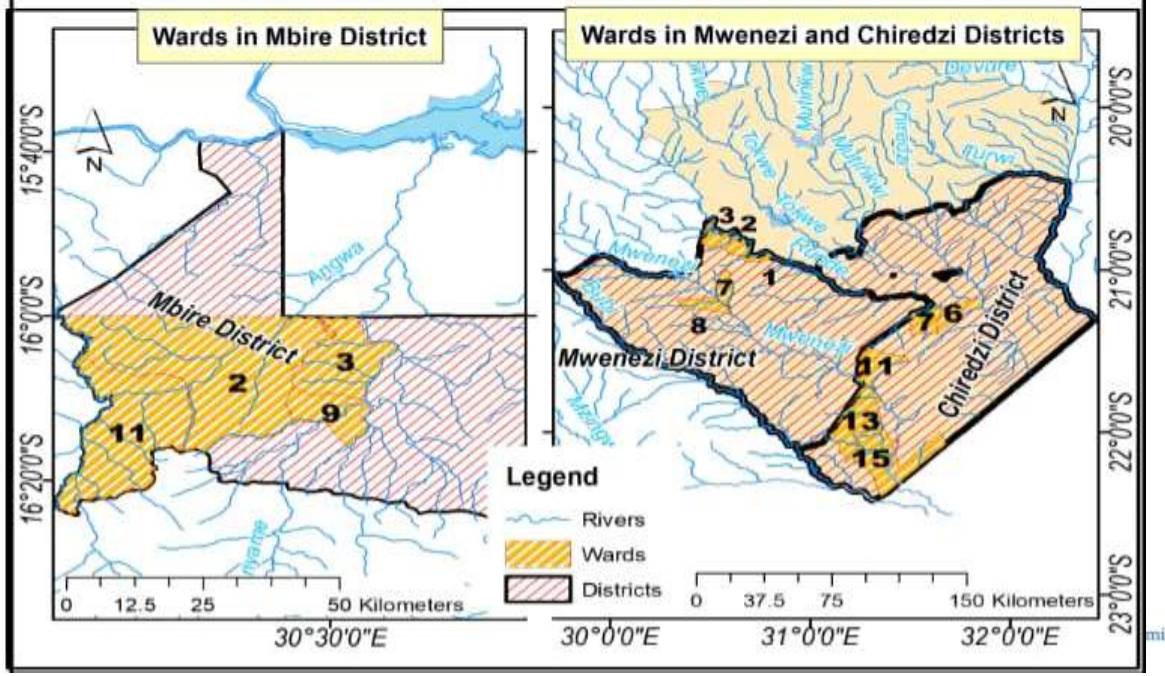
- The **Sustainable Livelihoods Framework (SLF)** was adopted to identify the livelihoods assets for the riparian based communities

- **Field observations** were done on various aspects including observations of riparian resources, socio economic status, crops grown and ground truthing for image classification.

- **GIS and Satellite imagery** were used to place the project beneficiary communities into a geographical landscape context.

Study sites





- Three rural communities, Chiredzi and Mwenezi (Indigenous Shangani People) and Mbire (Indigenous VaDoma people)
- located along the four major rivers i.e Runde River and Mwenezi River & Angwa and Manyame River respectively
- South East Lowveld covers part of the Mwenezi and Lower Runde sub catchment.
- Mbire District is located in the Mid Zambezi Valley in Mashonaland Central Province northern Zimbabwe
- altitude between 300 and 600m above sea level.
- The average annual rainfall in this region ranges between 500mm and 700mm
- mean annual temperatures that range between 25 C and 37 C.

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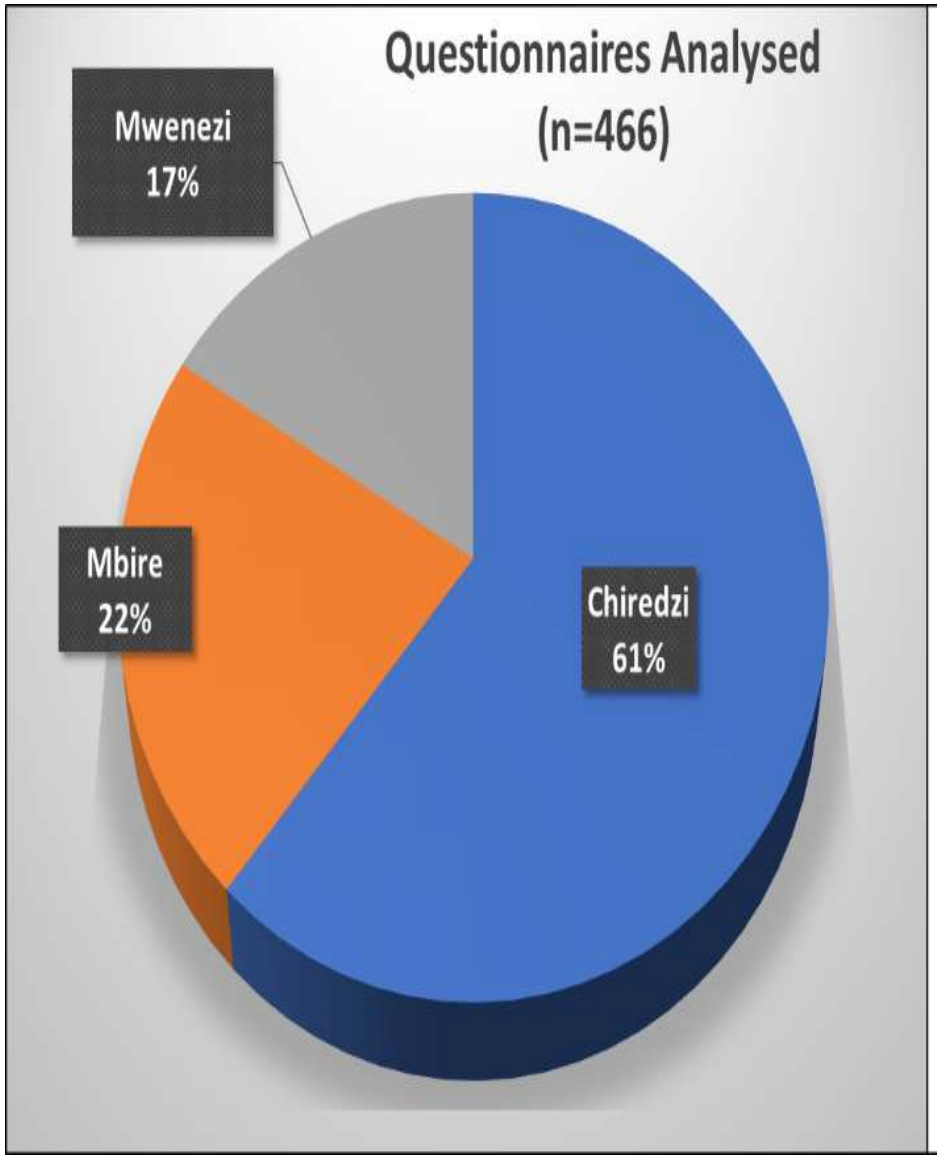
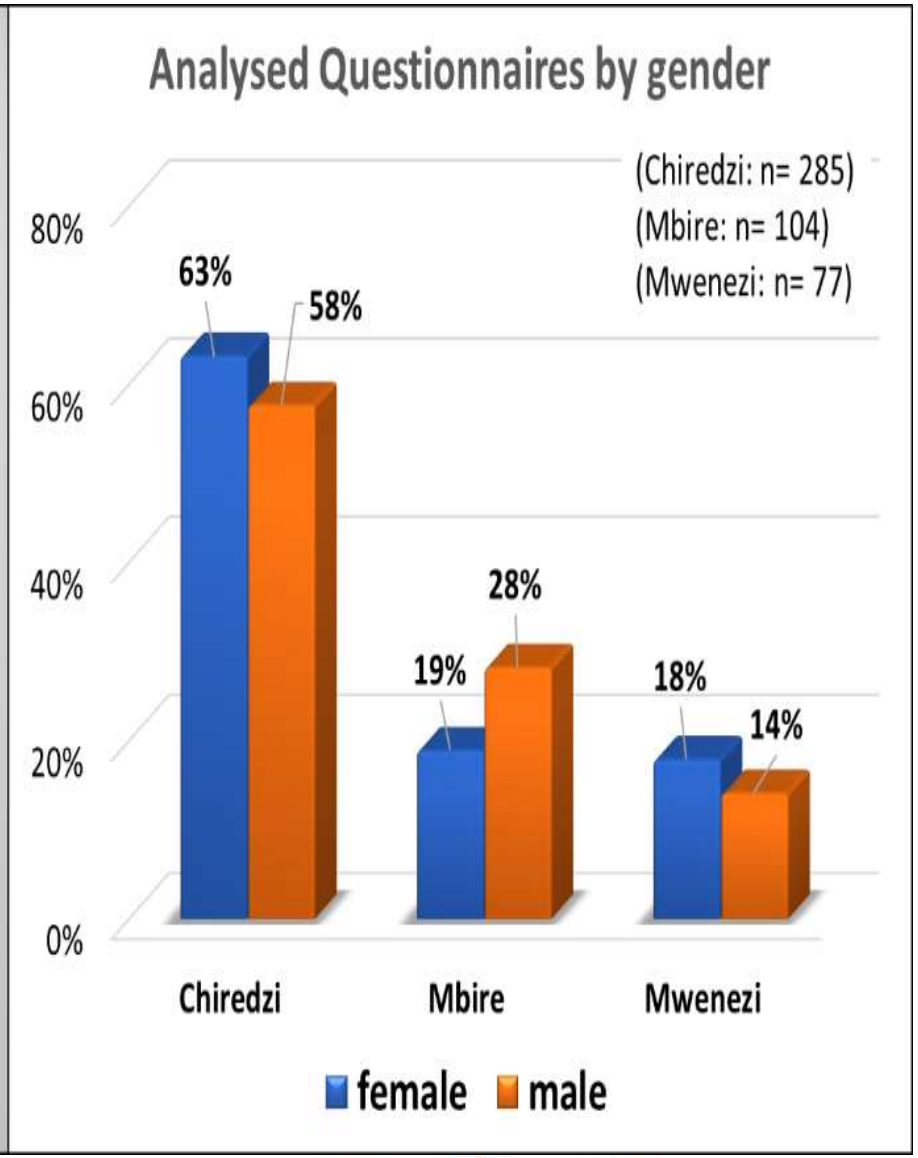
Summary of key informants across the three districts

	Chiredzi District	Mwenezi District	Gonarezhou Conservation Trust	Mbire District
Category of key informants	**Number of informants**	**Number of informants**		**Number of informants**
RDC Official	1	1	N/A	1
Councilors	4	2	N/A	2
Local chiefs	2	3	N/A	0
Headman	1	2	N/A	1
Village Heads	4	5	N/A	3
Local elders	2	1	N/A	2
Local Irrigation Schemes Committee representatives	2	4	N/A	0
Technical officers (AGRITEX, HEADTEACHERS, ZINWA, CAMPFIRE OFFICERS)	4	3	3	3
Local NGOs	0	1	N/A	1
Total	20	22	3	13

Summary demographic profile of respondents





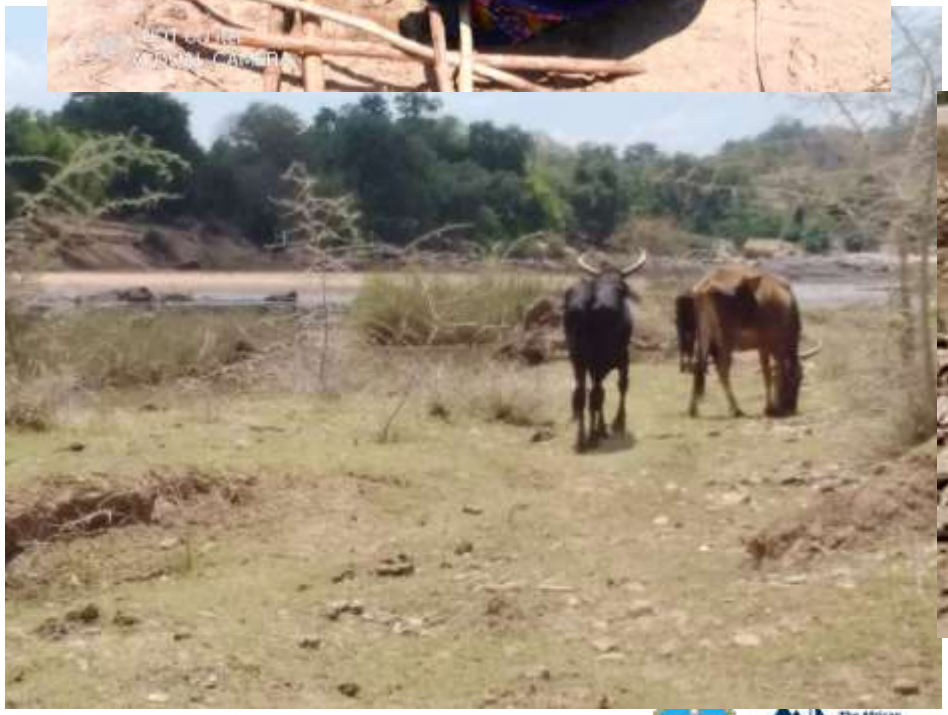
Data Collection in Pictures

Participatory mapping

Focus Group Discussion

Key Informant interviews

Field observations



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Climate data analysis

- A total of six downscaled Global Climate Models (GCMs) from the Coupled Model Intercomparison Project Phase 6 (CMIP6) data sets were used in assessing the likely impacts of climate change in the three districts.

- CMIP6 is a project coordinated by the Working Group on Coupled Modelling (WGCM) as part of the World Climate Research Programme (WCRP).

- The downscaled GCM data were downloaded from the following website: https://www.worldclim.org/data/cmip6/cmip6_clim10m.html.

- Temperature and precipitation data for the immediate future (2021-2040) were processed for six downscaled global climate models as in the Firth Assessment Report (AR5).

- Compared to the total set of Representative Concentration Pathways (RCPs), RCP8.5 thus corresponds to the pathway with the highest greenhouse gas emissions.

- Results for the vulnerability analysis are mostly based on the RCP8.5 representing the possible worst-case scenario.

Data Analysis

- The Mann Kendall trend test was performed to detect trends in mean monthly rainfall for the period 1972-2018 for both Lower Runde and Mwenezi sub-catchment

- The Mann–Kendall trend test (a non-parametric rank-based method) was used to test for monotonic trends in the streamflow records and long-term rainfall data

- Association between mean annual stream flow and precipitation was tested using the Spearman's correlation

- Data collected through the household questionnaire survey was coded by assigning numerical codes to text and then entered into Statistical Package for Social Sciences (SPSS software IBM Version 20, Chicago, USA) for analysis.
  - Descriptive statistics (frequencies) was used to summarize demographic and socio-economic data from the questionnaire response data set.

- Transcripts from KIIs and FGDs were translated to English and analysed through deductive thematic analysis was done based on themes which were predetermined by the researcher's theoretical or analytic interest in the research area and more explicitly driven.

- Maxent Modelling - Habitat Suitability Analysis in ArcGIS10.2

Vulnerability Assessment

- Vulnerability assessments (VAs help to define the nature and extent of the climate change threat that may harm a given system, providing a basis for devising measures that will minimize or avoid this harm – i.e., adaptation.

- VA - central to shaping climate change adaptation decisions as they help to define the nature and extent of the threat that may harm a given human or ecological system, providing a basis for devising measures that will minimise or avoid this harm.

- In this context, clarifying the 'what' in vulnerability assessments is key.

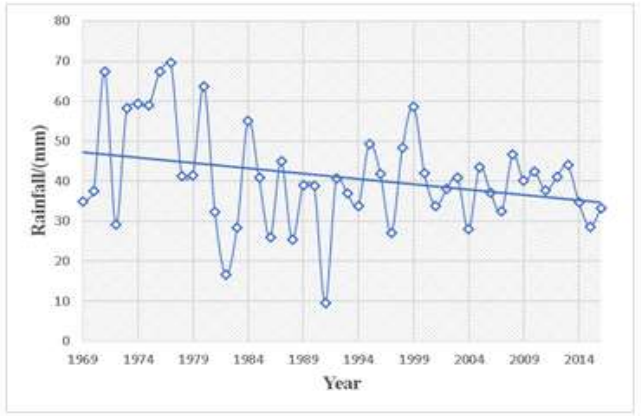
- Vulnerability of what? (e.g., people, regions, ecosystems, economic sectors) and vulnerability to what (e.g., storms, sea level rise, temperature extremes etc) – is a good first step to framing an assessment.

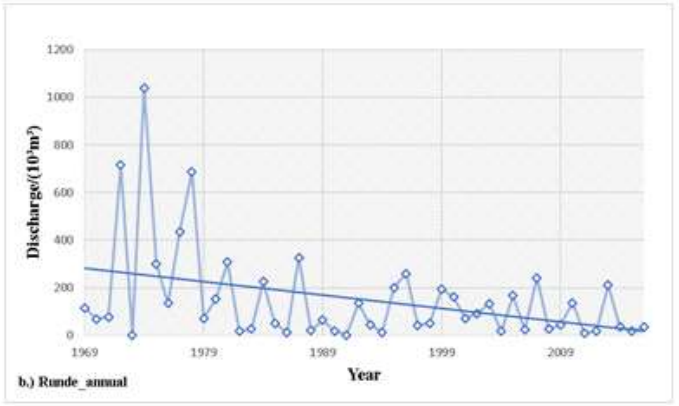
- Analysis done in ArcGIS10.2

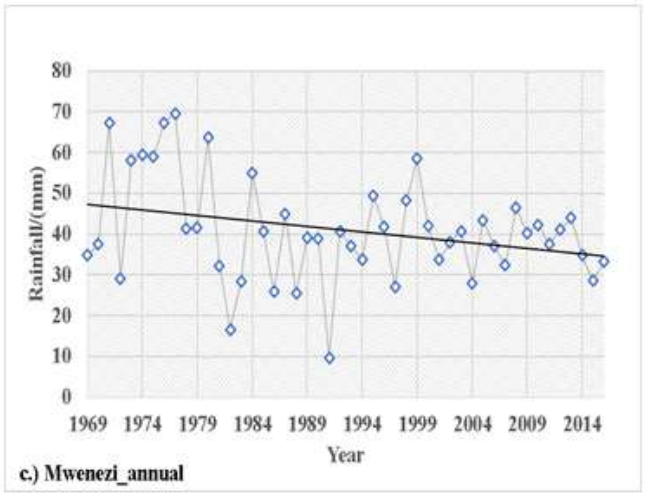
Key results

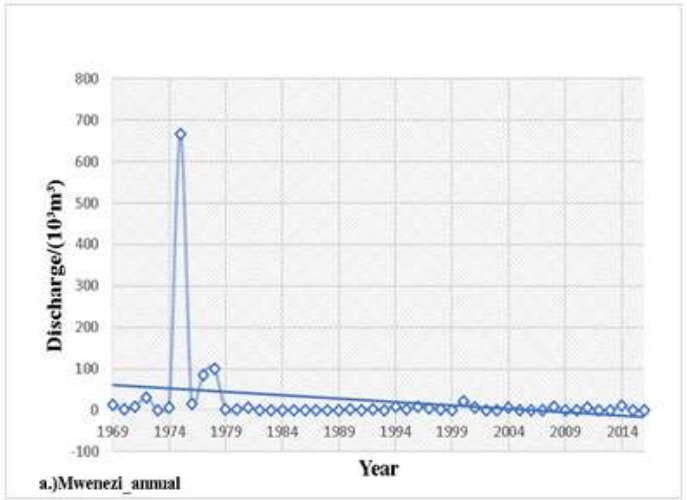
- Findings from the study indicate significant changes in rainfall for the wet season months October, November, January and February for the period 1972-2018 across the three districts.

Annual mean precipitation and stream flow trends on Lower Runde and Mwenezi sub catchments

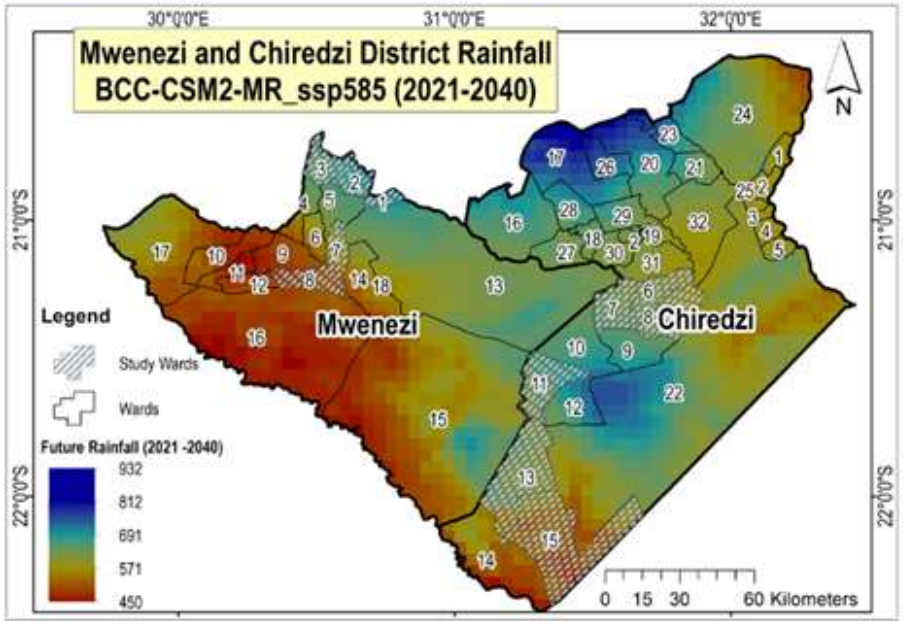


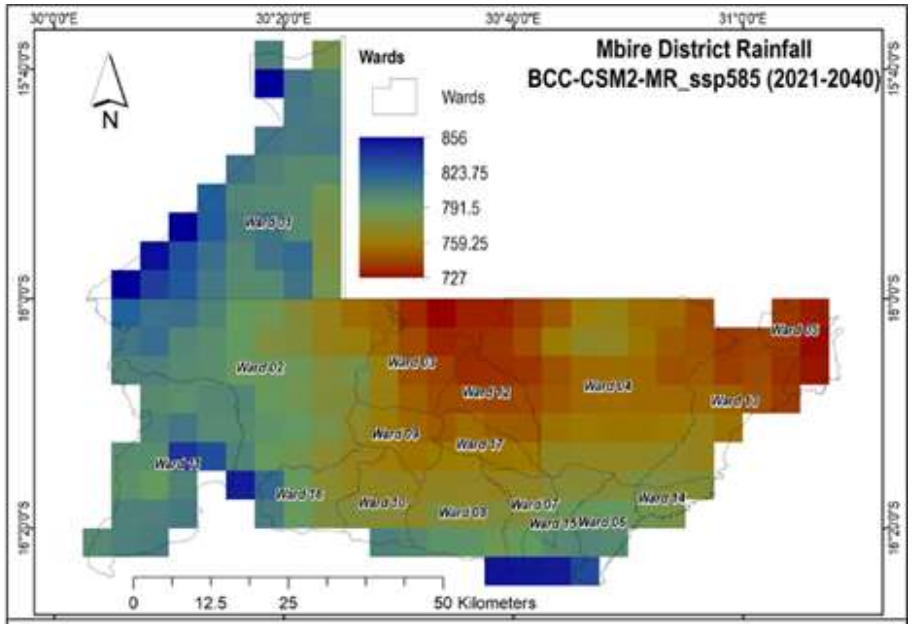


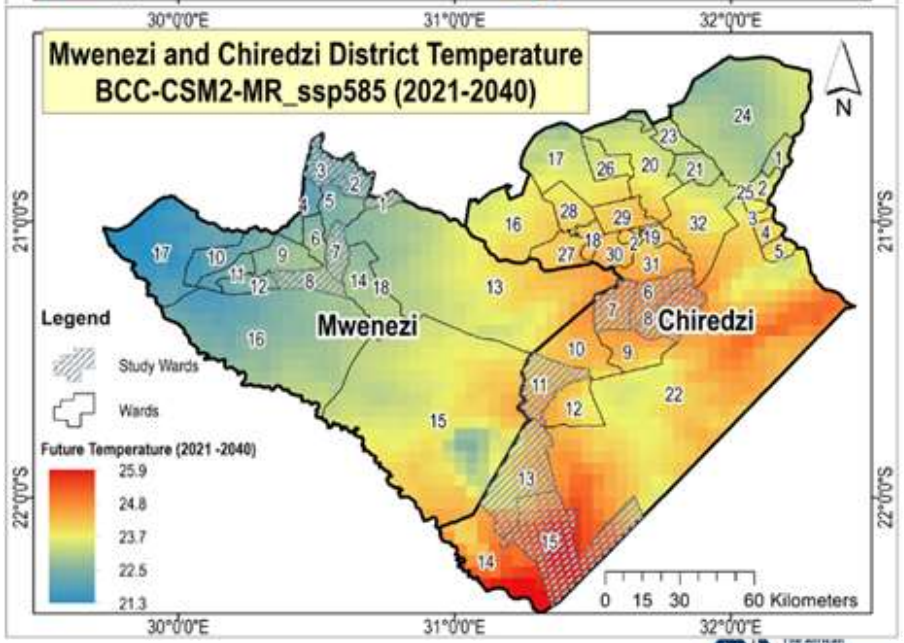


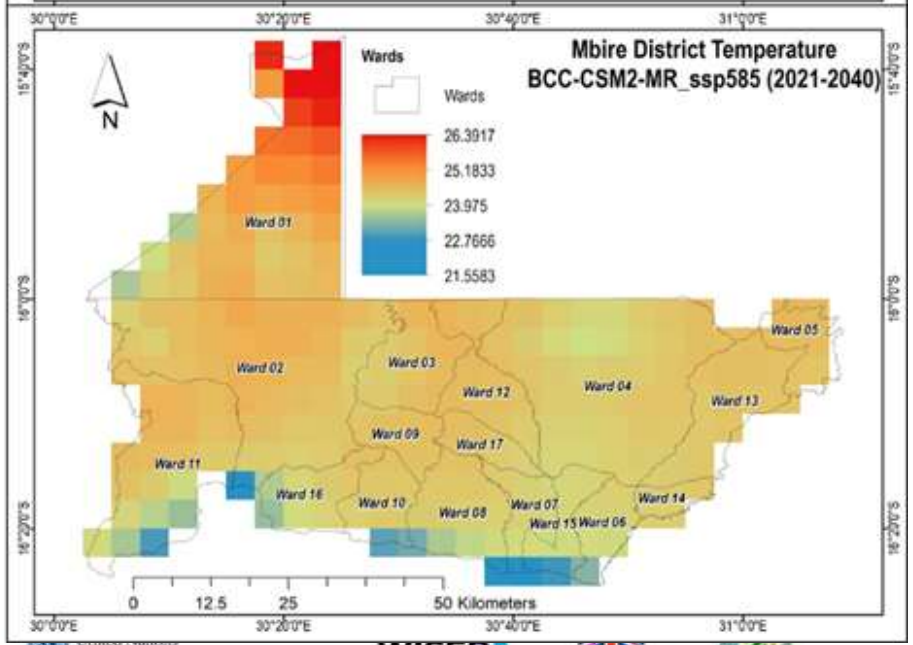


- The low rainfall in 1972 and the early 1990s and post 2000 had a major impact on stream on Runde river recording zero flows for the year.
- A rise in the stream flow graphs for both rivers is observed in the year 2000 (Cyclone Eline) and this also coincides with high rainfall.
- Mann Kendall trend test results for E83 gauge station on Lower Runde sub catchment for mean annual discharge shows a significant decreasing trend in annual flows by 1743.110m³ .





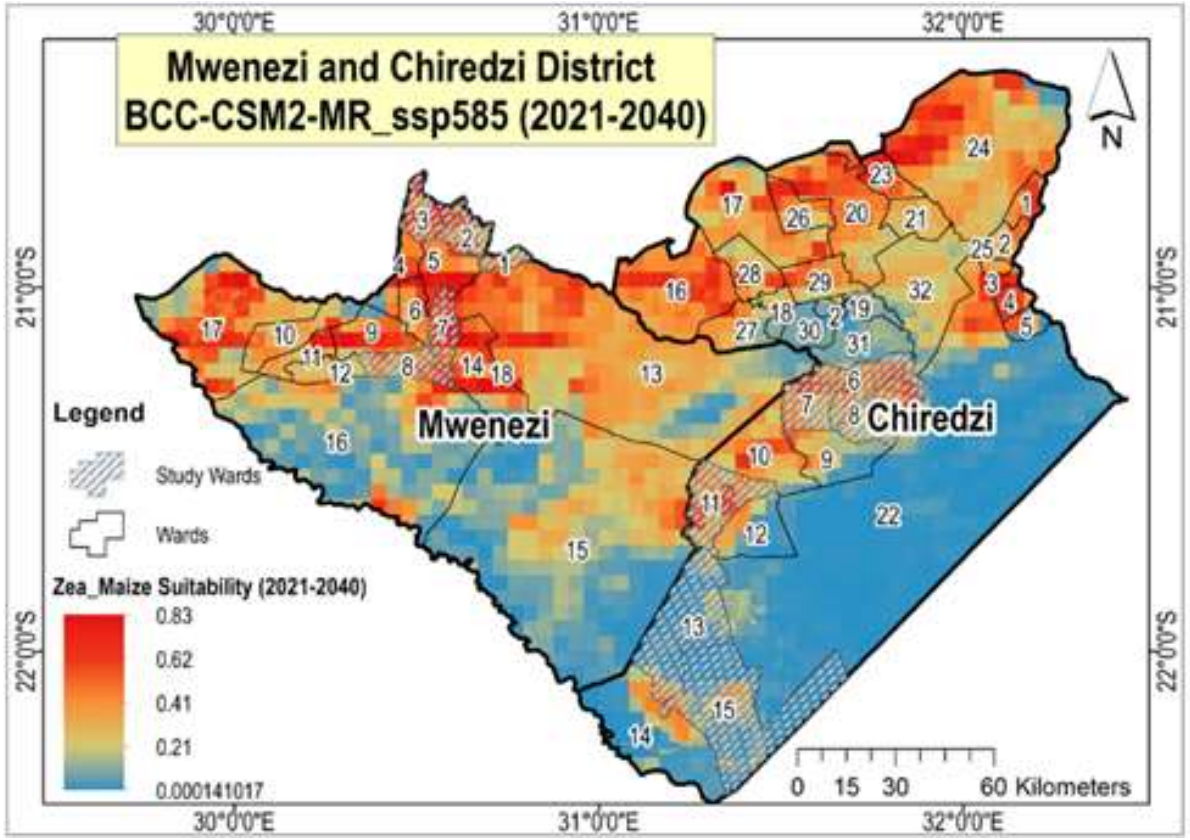


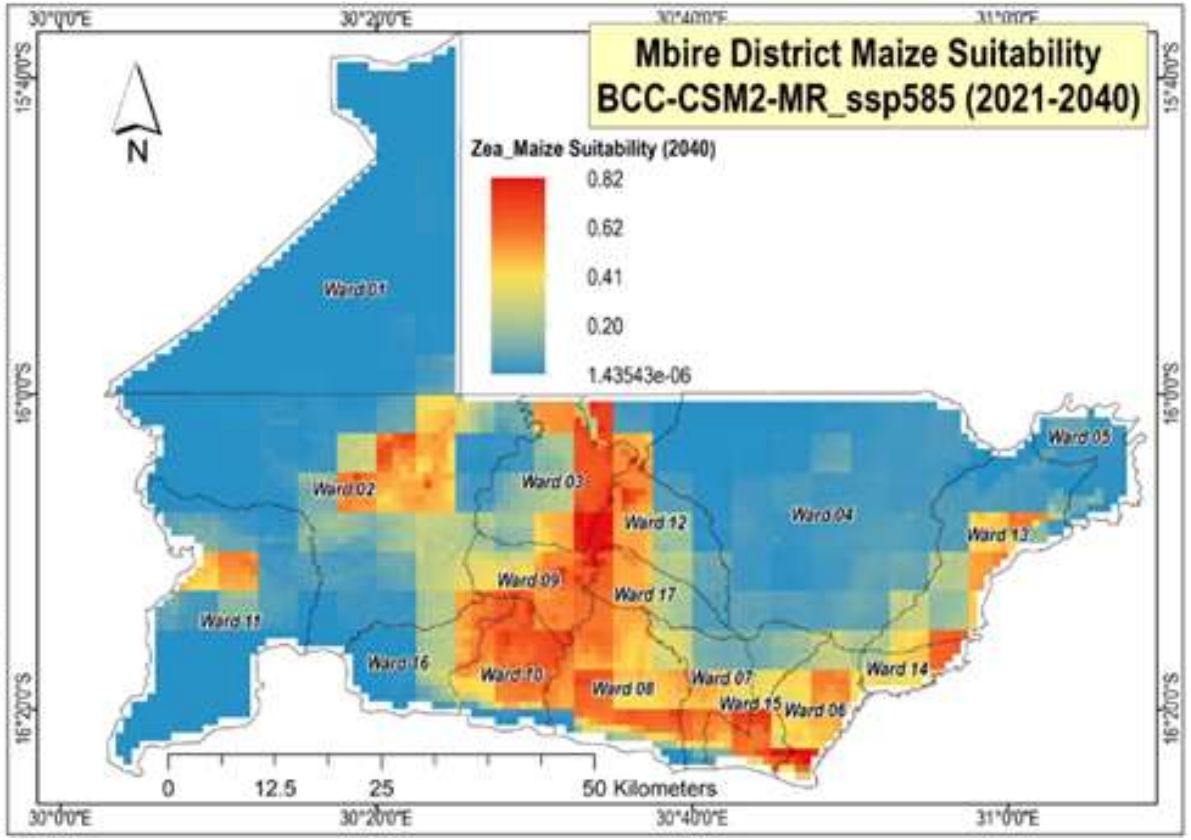


- The average of models for both RPC2.6 and RPC8.5 for the immediate future period (2021-2040) showed a likelihood of reduced rainfall for all the models across the three districts.
- Projections indicate an increase in temperatures across the 3 districts

Crop and Rangeland distribution and suitability under the future climate (2040)

- Given the projected less rainfall and higher temperatures (above), it was then necessary to model the potential future suitability for maize, millet and sorghum in Mwenezi District.
- 19 bioclimatic variables including soils, slope, cattle density, soil nutrient levels (nitrogen, phosphorus, potassium) and elevation.
- Overall, for the three crops, suitability ranges decreased
- Compared to the current climate, there was a decrease in areas with maximum rangeland suitability across the three districts with Chiredzi now having a maximum grassland suitability of 93%, Mwenezi – 92%
- Chiredzi District had 6 out of 32 districts with rangeland suitability above 70%
- Overall, for the future climate (2021-2040) maximum millet suitability for Mwenezi district is 83%; and Chiredzi district 75%.
- Generally, for Mwenezi and Chiredzi districts the wards in the northern areas are more suitable for millet production than the wards in the southern regions
- The maximum suitability for maize decreased from 88% for the current climate to as low as 60% in future using the BCC-CSM2 climate model under the RPC8.5 scenario.





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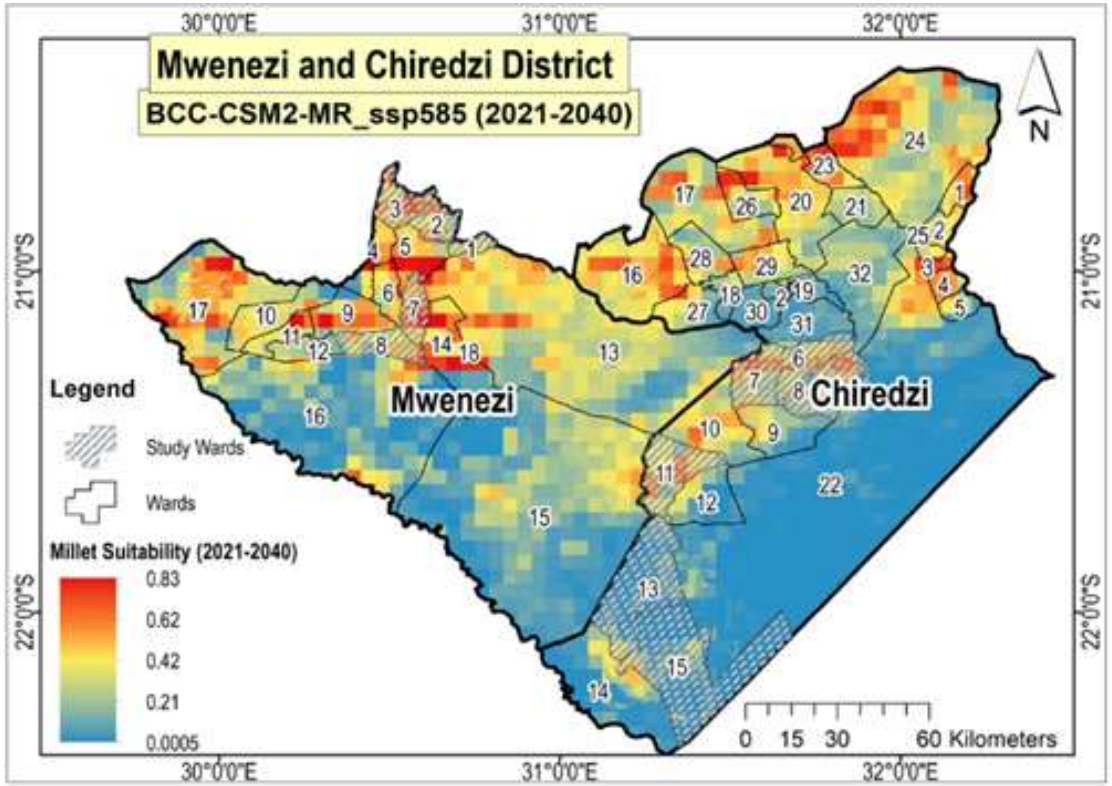

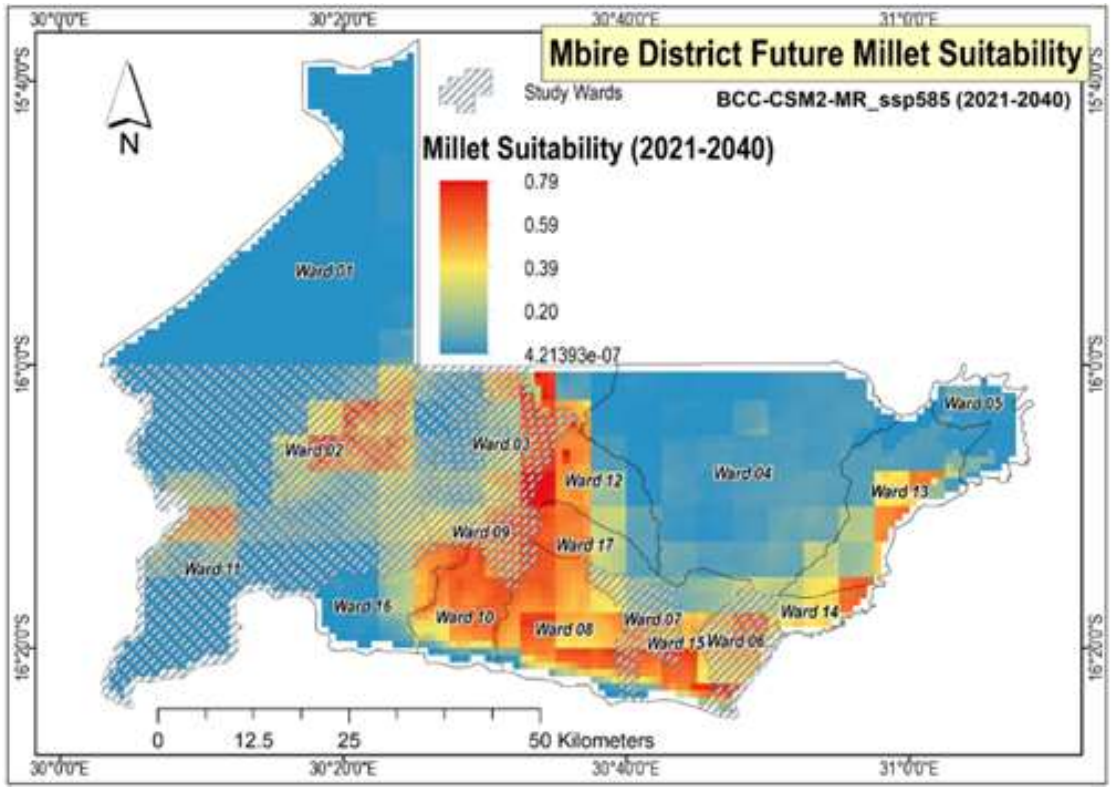

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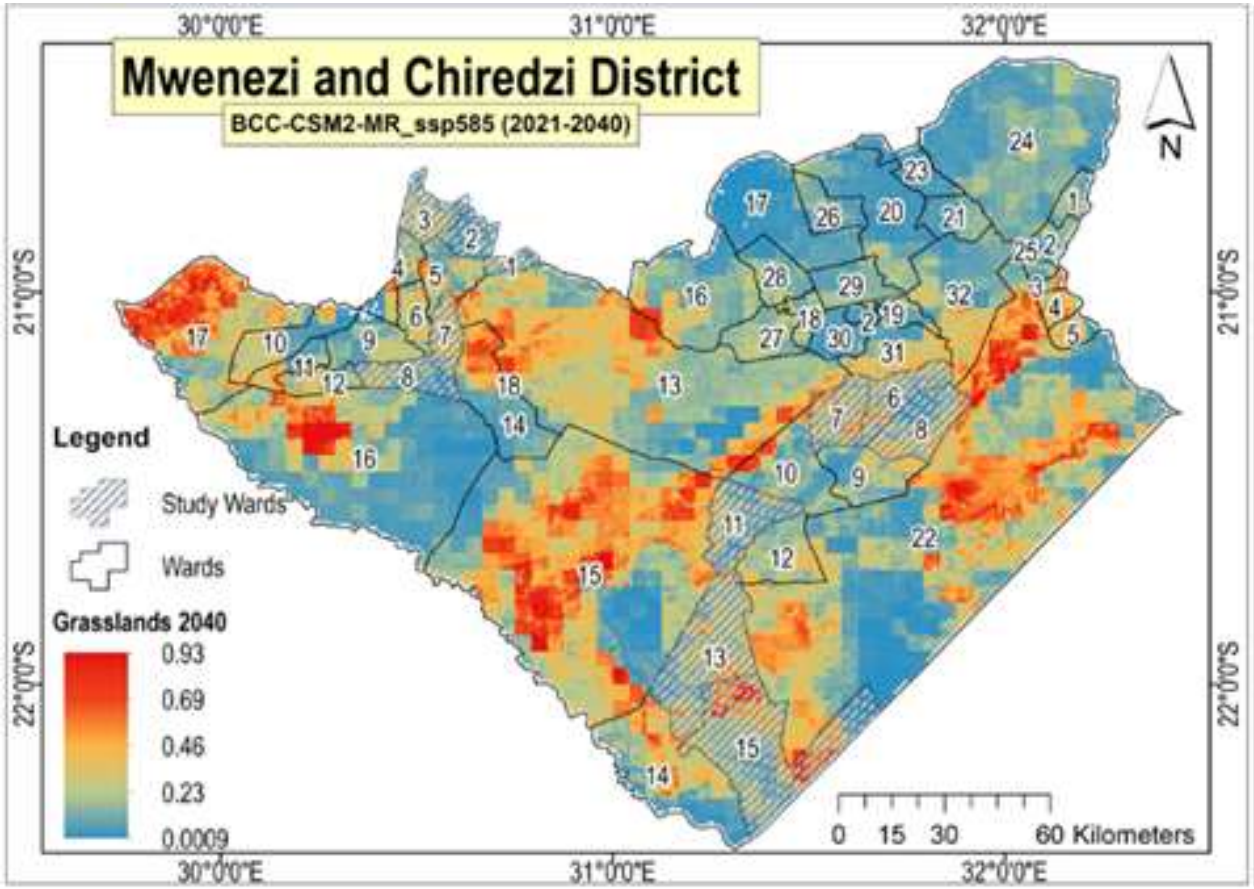
Mwenezi and Chiredzi District
BCC-CSM2-MR_ssp585 (2021-2040)
30°0'0"E
31°0'0"E
32°0'0"E
21°0'0"S
22°0'0"S
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Study Wards
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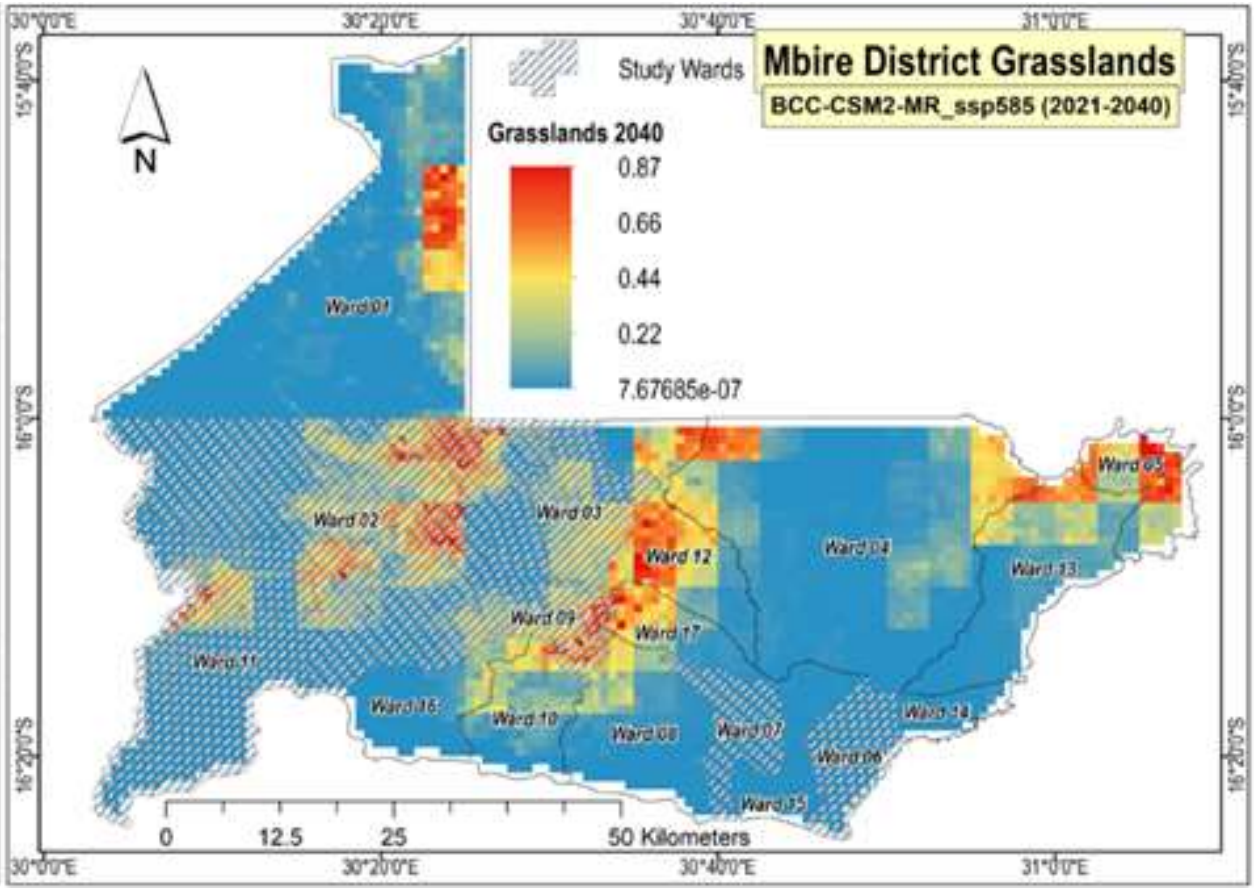
0.46
0.23
0.0009
0 15 30 60 Kilometers


Mbire District Grasslands
BCC-CSM2-MR_ssp585 (2021-2040)
Study Wards
Grasslands 2040
0.87
0.66
0.44
0.22
7.67685e-07
N
Ward 01
Ward 02
Ward 03
Ward 04
Ward 05
Ward 06
Ward 07
Ward 08
Ward 09
Ward 10
Ward 11
Ward 12
Ward 13
Ward 14
Ward 15
Ward 16
Ward 17
0 12.5 25 50 Kilometers

Local Knowledge on river flow trends and riparian goods and services

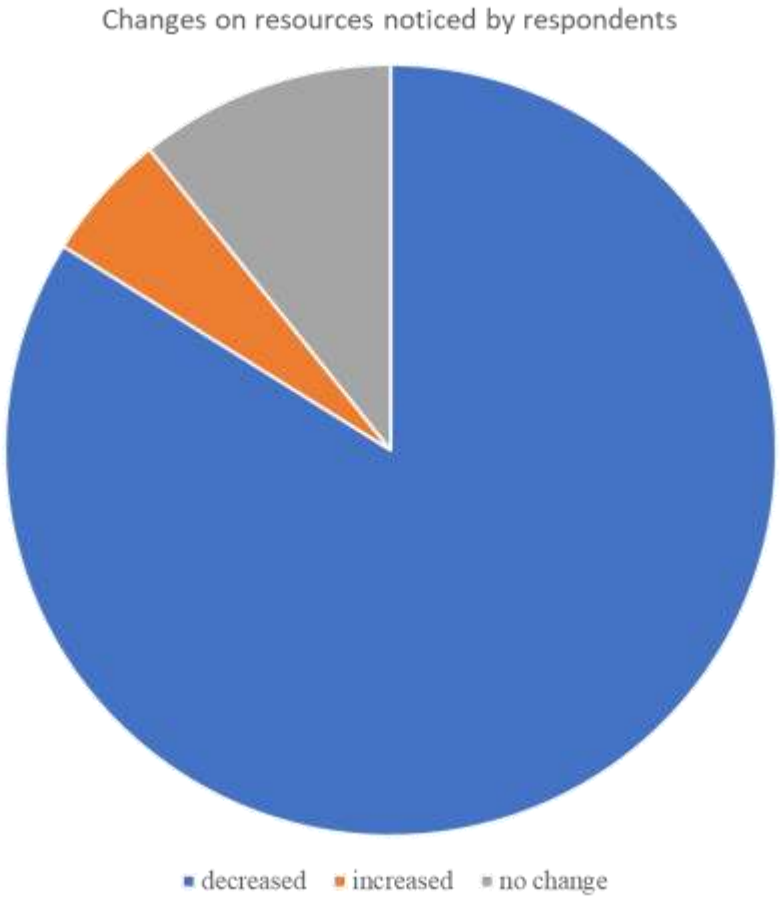
- Local community participants reported that persistent droughts, long dry spells, floods, late rains and shorter rain seasons have some impacts on the availability of provisioning ecosystem goods and services.

- Persistent droughts and dry spells are the major extreme events which impact on river flow regimes, phenology of aquatic flora and fauna as well as the major livelihood strategies (crop production).

- The Shangani Indigenous women can narrate how the changing climate had impacted the flow regime of the Mwenezi River and phenology and availability of flora and fauna from their vicinity.

- The key species used included Adansonia digitata, Tamarindus indica and the Strychnos species (S. cocculoides and S. madagascariensis).

Local Knowledge on changes in riparian based resources



- Riparian zone has seen a remarkable decrease in resources over the past 5 years due to climate change.
- provisioning services no longer available, for instance fish from the river have decreased.
- Because of the changes in seasons, people have now resorted to nature for a living, for instance cutting firewood for sell, sand mining and brick moulding.
  - all these coping strategies have resulted in heavy damage to the riparian ecosystems hence facilitated in the general depletion of resources
- From the respondents it is very clear that the dry spells are increasing and this has posed high risk on the natural resources on which people depend on.

LEK on Nature Based Solutions Nature based solutions

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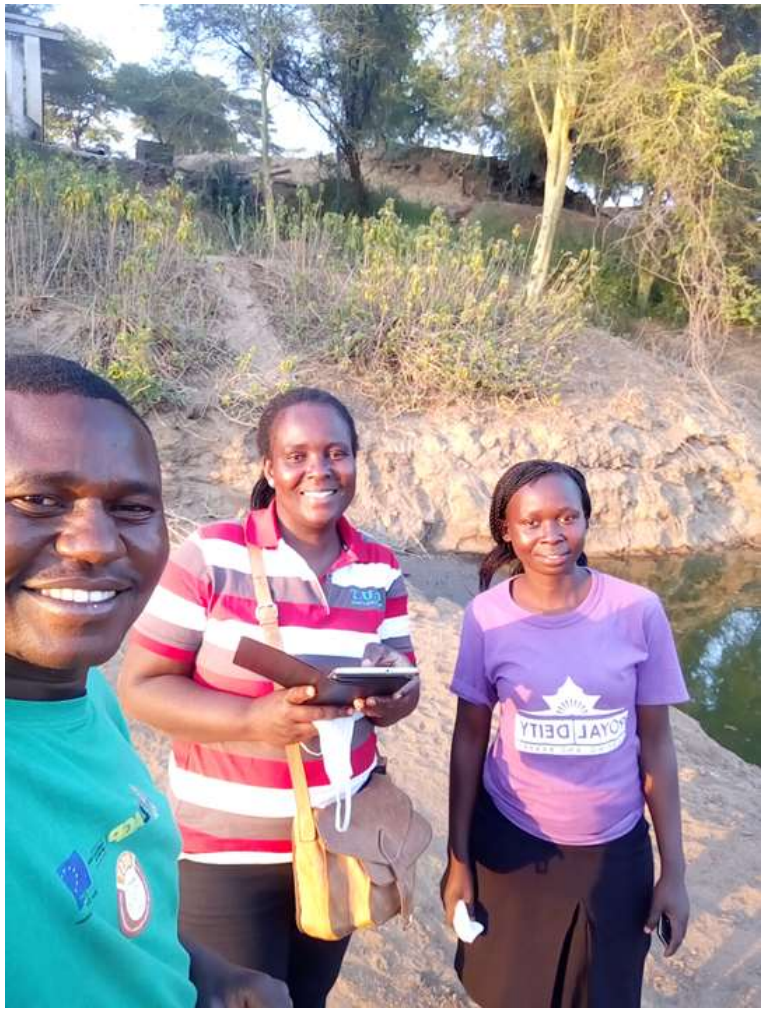
Safeguarding Activities…….

Engine site for the Chilonga irrigation Scheme



Dredging of the heavily silted Runde River


Malipati Community Orchard & Nursery
THE CARBON PROJECT
SAFIRE


HUAWEI P20
LEICA DUAL CAMERA | AI

Conclusions

- The future will be characterized with higher temperatures and less rainfall
- Riparian resources are declining in abundance and quality due to both climatic and no-climatic factors
- LEK vital in promoting resilience to climate impacts
- Most wards will become unsuitable for pasture / rangeland hence rearing livestock will be more difficult in future
- The three study districts are vulnerable regions owing in part to:
  - lack of financial, institutional and technological capacity, low adaptive capacity, endemic poverty, low technology uptake, and dependence on rain fed agriculture.
- This was evident from the demographic profile of respondents (e.g., high population, lack of significant tertiary qualifications, dependence on rainfed agriculture) as is the case for most wards in most districts.

Policy Recommendations

- Mainstreaming local knowledge of climate change and community-based strategies for resilience are important in the face of a changing and unpredictable climate.

- Embrace sustainable solutions to climate change impacts in light of the current scietifc evidence and LEK on riparian ecosystems and livelihoods e.g community based livestock value chains

- Ecosystem restoration (e.g grasslands) vital to promote healthy riparian ecosystems for resilience building

- Promote cultivation of small grains as an adaptation measure to climate change.

- Instead of livestock production, people should also consider wildlife-based livelihoods e.g wildlife tourism

Outputs/Outcomes

- 6 Symposium Presentations e.g COMA, UKCDR (4 Virtual and 2 Physical) and 1 Project showcase
- Technical reports (3)
- Training manuals and Field Reports
- Community Engagement – Inception, Feedback and Validation Meetings
- Capacity building through Mentoring and Skills building

SUPPORTING COP26 PRIORITIES THROUGH RESEARCH ON INTERNATIONAL DEVELOPMENT & CLIMATE CHANGE

UKCDR WEBINAR
THURSDAY 12TH NOVEMBER
14:00-15:30 (GMT)

Showcasing impacts resulting from UK-funded research on climate change + global development, sharing learning and providing networking opportunities.

- Modern Energy Cooking Services *(Prof Ed Brown, UK Low Carbon Energy for Development Network)*

14:50 – 15:15 PANEL 2: SHOWCASE PRESENTATIONS AND Q&A

- Improving how knowledge on forests and trees is understood and used to tackle the climate crisis *(Dr Robert Nasi, Centre for International Forestry Research (CIFOR))*
- Safeguarding riparian ecosystems and livelihoods as safety nets and in the face of a changing climate change: insights from a semi-arid savannah, Zimbabwe *(Dr Olga Kupika, Chinhoyi University of Technology)*
- Development of Coastal Bangladesh Under Climate Change Scenarios *(Prof Robert Nicholls, Tyndall Centre for Climate Change Research, University of East Anglia)*

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Publications

Non-journal

- Kupika O.L (2020) Building adaptive capacity to cope with effects of climate change on riparian based ecosystems and livelihoods in semi-arid areas of Zimbabwe. In UKCDR's webinar, "Supporting the COP26 priorities through research on international development and climate change" UK-Funded Research Project Showcase Booklet.

Book Chapter

- Mwera P, **Kupika O. L.** and Moyo E.N. (2021) Perceived Impacts of Climate Change on Riparian Ecosystem Goods and Services: A Case Study of Rural Communities Living along Mwenezi River, Southeast Zimbabwe, In Nyikahadzoi K and Mhlanga L (eds) Climate Change Impact, Adaptation and Mitigation in Zimbabwe Case Studies From Zimbabwe's Urban and Rural Areas. Published by KAS & UZ.

MSc Projects

1. Chipere Ronald (C108833A) Investigating the interactive effects of land-use land-cover changes on stream flow and vegetation productivity on Mwenezi and Lower Runde sub catchments (2020)
2. Mwera Petros (C19135858B) Local community perceptions of riparian based ecosystem goods and services in the face of climate change: a case study of rural communities living on the edge of Mwenezi River southeast, Zimbabwe

MPhil Project

Ruth Chinomona : Ethnobotanical Survey And Conservation Status Of **Riparian Indigenous Woody Plants Used To Promote Drought Resilience**: Case Study Of Sengwe Communal Area,Zimbabwe.

Publications

- **OPeD**

Indigenous people are using nature based Non-Timber Forest Products (NTFPs) solution to mitigate against climate change: insights from the Shangani people in Zimbabwe (Under Review)

- **Podcasts**

Africa Climate Conservations:

https://anchor.fm/sophie-mbugua/episodes/Community-Driven-Climate-Solutions-eia3na/a-a2vn2fn

- **Dissemination Videos**

International Women Day Video by CUT Marketing and Publication Department
https://www.facebook.com/hue.mutema/videos/1021559475266229 2

Chipere R, Olga Laiza Kupika, Tongai Mwedzi and Webster Gumindoga (2020) Interactive effects of land-use and climate change on streamflow and riparian forest productivity: Lower Runde and Mwenezi Catchments, Zimbabwe, 21st WaterNet/WARFSA/GWPSA Symposium, Integrated Water Resources Management for Sustainable Development in Eastern and Southern Africa, 28 October 2020.

Training And Capacity Building in pictures

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Lessons learned (new insights?)

- A high proportion of women in this community possess knowledge on utilisation and conservation of local riparian ecosystems but have limited opportunity to play a lead role in providing local development solutions to the fight against climate change

Recommendations for action or for improving existing conditions

- Design green technology sustainable solutions to harvest clean river water for livestock, irrigation and domestic purposes

- Develop a Model for transboundary riparian ecosystems assessment and restoration projects e.g. afforestation and reforestation (mitigation) in the TFCAs.

- Develop a toolkit (adopt the SES Model) for community based real time/ digital monitoring of riparian ecosystems goods and services.

- Access and Benefit Sharing Mechanisms - Motivate for Payments for Ecosystem Services (PES) schemes as an innovative approach to nature conservation in TFCAs.

- Enforcement of laws to halt river bed cultivation and degradation & restore ecological infrastructure

Recommendations for action or for improving existing conditions

- Designing a gender mainstreaming strategy that takes into account gender and biodiversity by strengthening conservation activities and the adaptive capacity of vulnerable groups for effective adaptation to climate change impacts

- Women Indigenous Peoples (IPs) engagement and empowerment for improved river health and NTFPs value chains (for neglected riparian indigenous wild plants) and food production systems (Gender Inclusion)

- Promote women and youth through providing support for diversification of livelihoods to improve food security through integrating sustainable riparian based enterprises.

- Sustainability of climate action can be ensured through:
  - Conservation education (climate change and implications on biodiversity conservation and nature based livelihoods) and awareness campaigns at local level (include young person, youth and women);
  - Education and awareness to promote sustainable land use and water management systems (ESD)

Challenges and Opportunities

- Covid 19 Pandemic Lockdown
  - Health risks
  - Delays in data collection
  - Postponement of planned engagements e.g. Adaptation Futures Conference
  - Travel ban restrictions (visit to external host institution cancelled)

- Climate Data availability - station data (most stations not working) – rely on satellite data

- River discharge data not available - gauging stations not working

Achievements

- University Focal Point and Facilitator for National Climate Change Mainstreaming Programme – Provincial Development Plans- Collaboration between University and the Ministry of Environment, Climate, Tourism and Hospitality Industry
- Improved networking and international and regional collaborations (e.g. Partner in OVERCOME Project and KAZA Livelihoods Monitoring Project)
- Committee Member Climate Change Learning Strategy (launched in April 2021).
- Participated in Workshops on National Climate Policy Issues eg NAP
- Nominated to the Gonarezhou Conservation Trust In Country Working Groups in the Great Limpopo TFCA (Community Livelihoods, Health, Water & Food Security ; Conservation, Wildlife Management and Veterinary)
- Secured Funding for CIRCLE ISP and Research Uptake.
- Appointed member of the University Research Committee
- Promoted to Associate Professorship grade
- Education 5.0 Champion Representative

Acknowledgements

THANK YOU

HLAKHESILE

NDATENDA

MERCI!

ASANTE