BOOK OF ABSTRACTS

Rwanda Climate Science Symposium (Edition 1)

Theme: Advancing Research and Networking

Kigali, Rwanda

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ORGANIZERS

Foreword

With the theme: *"Advancing Research and Networking,"* the First Ever Rwanda Climate Science Symposium provides an interdisciplinary platform for advancing evidence-based understanding of climate variability, climate change impacts, and resilience pathways across Rwanda and the wider region. This Book of Abstracts brings together contributions from researchers, practitioners, and institutions working at the interface of climate science, agriculture, water resources, ecosystems, urban systems, energy, health, and policy. The studies compiled herein reflect the breadth of contemporary climate research in Rwanda, ranging from high-resolution climate projections and environmental modeling to community-driven adaptation strategies, vulnerability assessments, and sector-specific mitigation solutions. Collectively, they demonstrate the increasing integration of data science, earth observation, field experimentation, and social inquiry in generating actionable knowledge to support sustainable development and national climate commitments. The diversity of methodologies and perspectives highlights both the complexity of climate risks and the value of collaborative, cross-sectoral approaches in addressing them.

Many of the abstracts represent ongoing or preliminary investigations, consistent with the purpose of a scientific symposium to foster knowledge exchange, stimulate dialogue, and refine research directions through peer engagement. As such, this volume should be understood as a record of work presented at the symposium rather than a collection of finalized or peer-reviewed publications. By documenting emerging findings, innovative tools, and practical experiences, the Book of Abstracts serves as an important repository of current climate science efforts in Rwanda and contributes to strengthening the national community of practice. We hope that these contributions will inspire collaboration, inform policy and investment decisions, and accelerate the translation of research into effective adaptation and mitigation actions that enhance resilience for present and future generations.

The organizers thank all authors, reviewers, and members of the Scientific Committee for their scholarly contributions and dedication to advancing climate research through this symposium. We also acknowledge the support of partner institutions and organizing teams whose collaboration and commitment made both the event and this abstract volume possible.

Contents

High-resolution climate projection data for climate risk assessments in Rwanda

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Abstract

Global climate models (GCMs) often struggle to accurately assess future climate impacts due to their coarse spatial resolution. In this study, we evaluate changing climate risks relevant to Rwanda using high-resolution downscaled climate projections. These projections are derived from the global climate simulations featured in the latest Intergovernmental Panel on Climate Change (IPCC) report. Specifically, we utilize a bias-corrected and spatially downscaled subset of models from the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP), which are further refined using a published algorithm that incorporates the effects of topography on local climate. The resulting high-resolution climate data are compared against similarly downscaled observational reanalysis datasets and a Rwandan observational climate dataset, which integrates weather station data, satellite observations, and reanalysis products. Future projections are assessed under selected Shared Socioeconomic Pathways (SSPs), including SSP1-2.6 and SSP3-7.0. Results indicate substantial increases in daily mean temperatures annually and during both growing seasons across all scenarios, including the low emission SSP1-2.6. Even greater increases are projected for annual and seasonal maximum daily temperatures, aligning with current physical understanding. Precipitation is projected to rise on an annual basis, with the most pronounced increases occurring from September to January, rather than during the February to June period. Although precipitation projections show greater variability than temperature, a consistent increase in the number of heavy rainfall days is observed, particularly under SSP3-7.0 and SSP5-8.5 scenarios. It is important to note that, as with all predefined climate scenarios, these projections do not encompass the full range of possible future climates.

Rwanda Climate Science Symposium
ADVANCING RESEARCH AND NETWORKING

Understanding Farmers' Knowledge, Perceptions, and Adaptation Strategies to Climate Change in Eastern Rwanda

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Abstract

This study investigates farmers' knowledge, perceptions, and adaptation strategies to climate change in Rwanda's Eastern Province, integrating social and physical science approaches. Analyzing meteorological data (1981–2021) and surveys from 204 farmers across five districts, we assessed climate trends and adaptation behaviors using statistical methods (descriptive statistics, Chi-square, logistic regression, Regional Kendall test, dynamic linear state-space model). Results show that 85% of farmers acknowledge climate change, with 54% observing temperature increases and 37% noting rainfall declines. Climate data confirm significant rises in annual minimum (+0.76 °C/decade) and mean temperatures (+0.48 °C/decade), with the largest seasonal increase (+0.86 °C/decade) in June–August. Rainfall trends indicate a non-significant decrease in March–May and a slight increase in September–December. Farmers report crop failures, yield reductions, and food shortages as major climate impacts. Common adaptations include agroforestry, crop diversification, and fertilizer use, though financial limitations, information gaps, and input scarcity impede adoption. Despite limited formal education (53.9% primary, 22.3% no formal education), indigenous knowledge aids seasonal prediction. Farm location, group membership, and farming goal are key adaptation enablers. These findings emphasize the need for targeted policies and climate communication to enhance rural resilience by strengthening smallholder farmer support systems for effective climate adaptation.

Keywords: *climate change; climate trends; farmer perception; adaptation strategies; small holder farmers; Eastern Rwanda*

Evaluating Land Degradation for Sustainable Silvopastoralism in Savanna Region: A Case Study in Matimba and Rwimiyaga sectors in Eastern Province of Rwanda

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Abstract

In savanna ecosystem, drought induced by climate change impacts plant growth and consequently animal growth as well. To address these challenges, silvopastoralism as an adaptation strategy has been implemented as a solution. This is particularly evident in the savannas of the Nyagatare District, specifically in the Matimba and Rwimiyaga sectors, where a combination of droughts, deforestation, overgrazing, and wind erosion has led to severe land degradation. This study assesses land degradation in the study areas, seeks to provide insights into the effectiveness of silvopastoralism and their potential applicability in degraded areas. Specifically, this research aimed to map and estimate the extent of land degradation from 2000 to 2022, assess the impact of silvopastoral practices on land improvement, identify opportunities for scaling silvopastoral systems in degraded regions, and propose strategies for enhancing climate change resilience. This study applied the Good Practice Guidance (GPG) methodology designed to support countries in tracking progress toward Sustainable Development Goal (SDG) 15.3 on land degradation neutrality (LDN). This method was used to assess land degradation and focused on three key indicators: land cover, land productivity, and Soil Organic Carbon (SOC). Overall, from 2000 to 2022, Matimba and Rwimiyaga sectors experienced land degradation of 7,347.4 hectares due to drought, deforestation and increase in built up areas. The study discussed sustainability of silvopastoralism and found that 46.7% of paddocks with this practice are in areas experiencing land improvement, 48.9% in stable areas, and only 4% in degraded areas. This implies that silvopastoralism is a promising strategy for improving land health, hence increasing the climate change resilience. Therefore, the study recommends expanding silvopastoralism to other pastures with land degradation status and integrating this practice into Rwanda's National Adaptation Plan (NAP) for sustainability.

Evaluation of the Role of Green Infrastructure in Mitigating Stormwater Runoff: A Case Study of Kinamba Catchment, Kigali City

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Abstract

Floods are the most common natural disaster worldwide, and failing to evacuate flooded areas or entering flood waters can lead to injury or death. Kinamba catchment faces severe flood events that have led to loss of lives, crop destruction, and infrastructure damage. This study evaluated the impact of Green Infrastructure (GI) on stormwater runoff in the Kinamba Catchment, Kigali City, addressing the escalating challenges of urban flooding and water pollution exacerbated by rapid urbanization and climate change. The research aimed to assess the presence and coverage of GI, determine key factors contributing to stormwater runoff and analyze the effectiveness of GI in managing stormwater, ultimately reducing sewer overflows. Employing a mixed-methods approach, including cross-sectional, descriptive, and scenario-based modelling, the study integrated quantitative data from rainfall-runoff monitoring, GIS mapping, and hydrological modelling using the Rational methods, with qualitative insights from field observations and documentary reviews. The findings revealed a consistently low mean infiltration rate (0.38831) and high discharge variability, indicating catchment prone to high runoff volumes and extreme events. The key findings from the Kinamba catchment showed the relationship between infiltration and discharge highlighted the complexity of hydrological interactions, while rainfall data from Gitega station underscored the importance of accurate spatial data for modelling. Land use analyses demonstrated a significant loss of green spaces, exacerbating runoff and compromising urban well-being. The study concluded that GI plays a critical role in mitigating stormwater runoff, enhancing infiltration, and reducing peak discharges, but its effectiveness is contingent upon soil properties, rainfall intensity, and maintenance. Therefore, the study recommends a comprehensive GI strategy tailored to high-risk zones, robust data collection and hydrological modelling using Gitega rainfall data, the integration of GI principles into urban planning and policy frameworks, community engagement, and sustainable funding mechanisms to enhance the resilience and sustainability of the Kinamba Catchment.

Keywords: *Flooding, Stormwater Runoff, Sustainable Green Infrastructure, Catchment Area, Kinamba*

Spatial and Temporal Analysis of Rainfall Variability and Trends over Amayaga region, Rwanda

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Abstract

This study investigates the spatial and temporal patterns of rainfall variability and trends in the Amayaga area using rainfall records from 1983 to 2021, sourced from the Rwanda Meteorology Agency. Rainfall variability was quantified using the coefficient of variation, while trend analyses were conducted using the Modified Mann-Kendall test and Sen's slope estimator. The K-means clustering algorithm was employed to delineate Amayaga region into near homogeneous climate zone. In this study, Amayaga region is defined as the region comprising of Kamonyi, Ruhango, Nyanza, Gisagara and Bugesera districts. Results reveal that amayaga region is delineated into three climatologically homogeneous zones: Region_1 (R1), Region_2 (R2), and Region_3 (R3). During January-February (JF), most parts of regions R1, R2, and R3 exhibit moderate variability (30-45%), with localized areas within R1 and R3 showing slightly high variation (45-60%). In March-May (MAM), low variability (15-30%) is observed in R2, the southeastern and northeastern parts of R1, and a small southern section of R3, while the central areas of R2 and R3 display moderate variability (30-45%). For the June-August (JJA), the northwestern and central portions of R3 show relatively high variability (105-120%), whereas R1, the eastern part of R3, and the northern part of R2 demonstrate higher variability (120-135%). During September-December (SOND), low variability (15-30%) is noted in the eastern part of R1, R3, and the northern part of R2, while the eastern section of R3 and central R1 exhibit moderate variation (30-45%). On an annual scale, all three regions demonstrate consistently low rainfall variability (15-30%). No statistically significant trends in rainfall were detected at either seasonal or annual timescales in any of the three regions.The study's findings provide critical insights for developing climate-resilient agricultural strategies and supporting broader socio-economic planning in the Amayaga region, thereby strengthening adaptation efforts to ongoing climate variability.

Keywords: *Amayaga, Climate zone, Rainfall, Trend and Variability*

Assessment of maize suitability under climate change for sustainable agriculture: Evidence from Sub-Saharan African countries

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Abstract

Climate variability and change pose significant threats to agricultural productivity in Sub-Saharan Africa, particularly for staple crops such as maize. Increasing temperatures, erratic rainfall, and prolonged droughts are transforming agroecological systems, placing food security at risk. Maize is especially vulnerable to climate fluctuations due to its sensitivity to both precipitation and temperature extremes. With most maize production being rainfed, there is an urgent need to spatially evaluate how future climate scenarios may affect their suitability across the region. This study aimed to assess the spatial and temporal shifts in maize suitability across eleven Sub-Saharan African countries Rwanda, Burundi, Tanzania, Malawi, Zambia, Zimbabwe, Mozambique, Botswana, South Africa, Lesotho, and Eswatini under future climate scenarios. The goal was to identify vulnerable areas and potential zones for maize expansion by analyzing how climatic factors, especially temperature and precipitation, influence maize viability under projected emissions scenarios. The researcher employed the Maximum Entropy (Maxent) model alongside Environmental Information Systems (EIS) to model current and future maize suitability. Presence-only maize occurrence data were combined with nineteen bioclimatic variables obtained from WorldClim. Suitability was assessed across three Shared Socioeconomic Pathways (SSP2-4.5, SSP3-7.0, SSP5-8.5) and four projection years (2030, 2050, 2070, and 2090). Model performance was robust across scenarios (AUC > 0.85), and Bio1 (annual mean temperature), Bio12 (annual precipitation), and Bio5 (max temperature of warmest month) were the most influential predictors. The results show increasing suitability in Rwanda, Tanzania, and Burundi under moderate scenarios, while southern countries like Botswana and South Africa face substantial reductions under SSP5-8.5. These findings suggest a shift in maize-favorable zones, with implications for future agricultural planning. The research is completed and supports the need for spatially informed adaptation strategies, including drought-tolerant maize varieties, localized planning, and improved irrigation systems.

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Observed Variability and Trends of Rainfall and Climate Extreme Indices in Kirehe District, Eastern Rwanda: Implications for Climate-Sensitive Planning

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Abstract

This study analyzes rainfall variability and trends in extreme rainfall indices using 1983-2021 data from the Rwanda Meteorology Agency. Variability is assessed using the coefficient of variation (CV); trends through the Mann-Kendall test and Sen's slope. Results indicate that the central to western parts show high variability: 46-54% in January-February (JF), 33-41% in March-May (MAM), 73-103% in June-August (JJA), 37-47% in September-December (SOND), and 28-36% annually; other areas show lower variability. No significant seasonal or annual rainfall trends are detected. Extreme rainfall indices show marked spatial variation across Kirehe District. Consecutive Dry Days (CDD) vary highly in southern and central areas (37-43%), and Consecutive Wet Days (CWD) in the southeast, southwest, and north (39-51%). The southeast shows high variability in Heavy Precipitation Days (R10mm: 30-40%), Very Heavy Precipitation Days (R20mm: 53-67%), Precipitation on Very Wet Days (R95PTOT: 95-121%), One-Day Maximum Precipitation (RX1day: 41-51%), and Simple Daily Intensity Index (SDII: 42-58%). Five-Day Maximum Precipitation (RX5day) varies highly in central, eastern, and northern parts (50-58%); other areas show lower variation. Significant positive trends appear in the north for CWD (0.5-1 days/decade), PRCPTOT (45-90 mm/decade), and R10mm (1.5-3.0 days/decade). Declines are noted in central to southern areas for PRCPTOT (-90 to -45 mm/decade), R10mm (-4.5 to -1.5 days/decade), R20mm (-3.0 to -1.5 days/decade), R95PTOT (-60 to -20 mm/decade), RX1day (-12 to -6 mm/decade), RX5day (-10 to -5 mm/decade), and SDII (-2.0 to -1.0 mm/decade), while CDD shows negative trends in the north (-10 to -5 days/decade). The spatial disparities and trends in rainfall and extreme rainfall indices highlight critical risks to agricultural productivity, public health, infrastructure, and disaster risk reduction, underscoring the urgency for policymakers to mainstream localized climate adaptation measures, such as promoting climate-resilient crops, strengthening water resource management, and reinforcing infrastructure, into district-level development and resilience planning to reduce sectoral vulnerabilities.

Keywords: *Climate extreme indices, Kirehe District, Variability, Trends*

Rwanda Climate Science Symposium
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Spatial Variability and Trends of Temperature and related Extreme Indices in Kirehe District, Eastern Rwanda

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Abstract

This study examines the variability and trends of temperatures and related extreme indices in Kirehe District, using observational data (1983-2021) provided by the Rwanda Meteorology Agency. The coefficient of variation is used to assess variability, while trends are evaluated using Mann-Kendall test and Sen's slope estimator. Extreme temperature indices, namely diurnal temperature range (DTR), highest maximum temperature (TXx), highest minimum temperature (TNx), lowest maximum temperature (TXn), lowest minimum temperature (TNn), cold nights (TN10p), warm nights (TN90p), cold days (TX10p), and warm days (TX90p) are analyzed following the Expert Team on Climate Change Detection and Indices methodology. Results show relatively low variations of temperatures in most areas of Kirehe District. For maximum temperature, notable increase is observed in the central areas for January-February (JF, 0.3-0.9°C/decade), for March-May (MAM, 0.0-0.6°C/decade), for June-August (JJA, 0.19-0.38°C/decade), for September-December (SOND, 0.0-0.44°C/decade) and for annual (0.0-0.45°C/decade) while a decline is indicated in the northern areas for JF and MAM (-0.6-0.3°C), for SOND (-0.64-0.42°C/decade) and for annual (-0.45-0.15°C/decade). For minimum temperature, significant positive trends are indicated in the northern, southern and southeastern areas for JF (0.0-0.05°C/decade), for MAM (0.18-0.36°C/decade), for JJA (0.3-0.5°C/decade), for SOND (0.1-0.4°C/decade) and for annual (0.02-0.04°C/decade) while negative trends are observed in the central parts for MAM (-0.09-0.0°C/decade), for SOND (-0.2-0.0°C/decade) and for annual (-0.01-0.00°C/decade). More variation is observed in the northern areas for TN10p (60-80%), TX10p (60-80%), and in the central areas for TX90p (90-100%). A general increasing trend is observed in most areas for TNn and TXn while a general decrease is indicated for TN10p. The DTR, TX90p and TXx show a general decrease in northern and an increase in the central areas while a reversal pattern is shown for TNx and Tx10p. These findings are valuable for informing adaptation measures across socio-economic sectors in Kirehe District.

Keywords: *Climate extreme indices, Kirehe District, Variability, Trends*

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Effects of growth temperature and drought on net photosynthesis and stomatal conductance in Rwanda native tree species

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Abstract

Effects of growth temperature and drought on net photosynthesis and stomatal conductance in Rwanda native tree species

Brigitte Uwajeneza

Rwanda TREE Project

Introduction

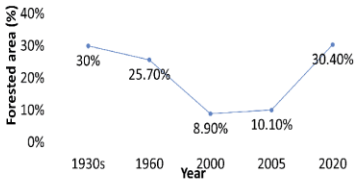

Figure 1: Decline of forested area in Rwanda from 1930s to 2020

- The dominance of exotic monoculture specifically Eucalyptus *spp* (89%) enhance soil erosion, allopathic effects, pests and diseases attraction and depleting soil nutrients
- Rwanda new Forest Policy (2018) focus on native tree species to increase tree diversity in forest restoration
- However, there is a lack of information about the adaptation of native tree species in different Agro-ecological zones in Rwanda
- This study aims to assess the impact of growth temperature and drought on net photosynthesis in native tree species along an elevation gradient in Rwanda

Methodology

This study was conducted within the Rwanda Tropical Elevation Experiment (Rwanda-TREE) project) established a multispecies forest plantations with 20 native species (grouped into Late Successional, LS and Early Successional, ES groups) along an elevation gradient.

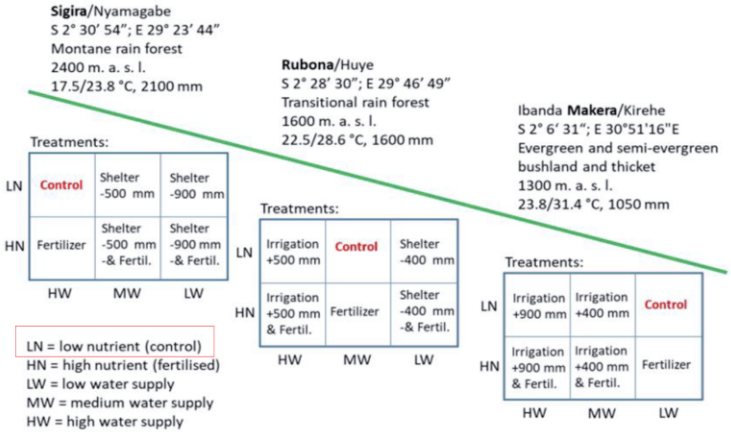

Figure 2: Sites and treatments description in the experiment

- Leaf gas exchange measurement was made to assess the effect of temperature change and drought on stomata conductance (g_s) and net photosynthesis (A_n) of trees under study

Results

- Photosynthesis and stomatal conductance are lower in LS than ES and the difference got smaller under drought (**Figure 3a,b**)
- The A_n and g_s declined at LE (warmer) site were lower at warmer site and the strong decline is observed LS species (**Figure 3a,b**)
- A_n and g_s declined under drought conditions (low water treatment) (**Figure 3c,d**)

Discussion

- The decline of A_n at LE site is a result of the reduction in the availability of CO_2 due to the decline in g_s observed at this site. As temperature increase leaf stomata closes partially to reduce water loss
- The high A_n and stomatal conductance observed in ES is proposed to be the result of their higher metabolism and ability to acquire resources and lower photoinhibition than do shade-adapted (LS) species
- Drought negatively affects An at both sites due to stomatal limitation which increase as soil water content declines. Negative water potential also increase the vulnerability of vessels to embolism.

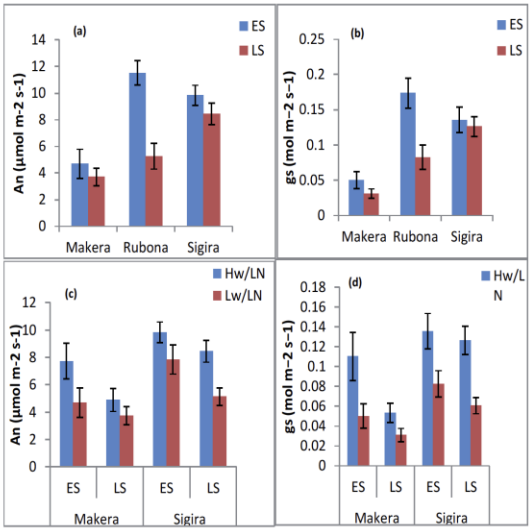

Figure 3: Growth temperature effect on net photosynthesis, A_n (a); stomatal conductance, g_s (b). Dought effect on A_n (c) and g_s (d) at high and low elevation sites

Conclusion

- The response of photosynthesis to high temperature and drought will affect the growth of trees suggesting a higher risk to some species, particularly LS and montane tree species in a changing climate.
- **Recommendation:** Further research on other growth factors' effects to those species to confirm their adaptability to different climatic conditions.

References

1. Bazzaz, F. A. (1979). The physiological ecology of plant succession. *Annual review of Ecology and Systematics*, *10*(1), 351-371.
2. Cheesman, A. W., & Winter, K. (2013). Growth response and acclimation of CO2 exchange characteristics to elevated temperatures in tropical tree seedlings. Journal of Experimental
3. Slot, M., & Winter, K. (2018). High tolerance of tropical sapling growth and gas exchange to moderate warming. Functional Ecology, 32(3), 599-611.
4. Stelstra, R. E. (2021). Implementation of native tree species in Rwandan forest plantations.

Rwanda's Greenhouse Gas Inventory Report

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Abstract

Despite the growing urgency to address climate change, many countries face significant challenges in accurately understanding the sources and trends of their greenhouse gas emissions due to data gaps. Rwanda as a non-Annex I Party to the UNFCCC has submitted its National greenhouse gas inventory report as part of the Biennial Transparency Report to better inform climate change policy and planning. The inventory covered the period from 2006 to 2022. It indicates the country's emissions and removals of GHG across different sectors (e.g., energy, agriculture, waste, industry, and land use). The inventory specifically has the objective to present the emissions and removals by clearly understanding which sectors and activities contribute most to national emissions, and how these have changed over time. The methodology used in a National GHG Inventory is primarily based on the 2006 Intergovernmental Panel on Climate Change (IPCC) Guideline and its 2019 refinement, which provide standardized approaches for estimating emissions and removals from various sectors. The process involves identifying key categories of emissions, collecting activity data, and applying appropriate emission factors or country-specific data to calculate emissions. In 2022, total emissions (with land use) reached about 7.8 million tons of CO2 equivalent (MtCO2e), marking a significant increase from the baseline year 2006. In 2022, the highest emissions were from the agriculture sector (39% of emissions), followed by land use and land use change and forestry (LULUCF (-28%), Energy (18%), Waste (9%), and lastly the Industrial process and Product Use (PPU) sector (2%). The main key gas emitted is Methane, which has a share of 69% in 2022, mainly sourced from enteric fermentation. The results indicate that Rwanda is not a high-emitting country, however, the emissions from energy and waste showed a high increasing rate, indicating the need to invest more in the activities that can reduce emissions.

Impact of climate variability on agricultural productivity: Case study Bugesera district, Rwanda

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Abstract

Rainfall variability, intensity, and distribution have attracted global concern, especially in regions reliant on rain-fed agriculture. This study analyzes rainfall patterns and trends in Bugesera District, Rwanda, using meteorological records from the Rwanda Meteorology Agency covering the period from 1981 to 2021. The coefficient of variation was applied to assess rainfall variability, while the Mann-Kendall test and Sen's slope estimator were used to detect and quantify rainfall trends. Complementary survey data from local farmers provided insights into perceived climate impacts and adaptive responses. Results show that rainfall during the March-May (MAM) season is highly variable in the northern parts of the district, with moderate to low variability in the central and southern areas. During the September-December (SOND) season, variability is generally lower across the district, though some high-variability zones persist in the southwest. Annual rainfall variability is highest in northern Bugesera (24-28%), moderate in the central regions (18-24%), and lowest in the south (14-18%).Trend analysis revealed slight, non-significant increases in rainfall during January-February (+2.475 mm/decade) and SOND (+1.300 mm/decade), while March-May, June-August, and annual rainfall showed non-significant decreasing trends. Temperature variability remains low (3-5°C) in most areas but is moderate to high (5-8°C) in the southeast, especially during JJA and SOND. Significant warming trends were observed for all seasons, particularly in JJA, where maximum, minimum, and average temperatures increased by +0.338°C, +0.310°C, and +0.255°C per decade, respectively. Farmers have responded to climate changes by adopting strategies such as crop diversification and irrigation. However, 71% face financial barriers, and 54% report limited infrastructure as a constraint. Despite these challenges, 97% believe that adaptation measures improve agricultural productivity. The study supports efforts to enhance resilience and guide climate related interventions.

Keywords: *Bugesera District, Famers, Rainfall, Variability, Trends*

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Future Climate Scenarios and Their Impacts on Rwanda: Projections, Risks, and Adaptation Strategies (2002-2022)

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Abstract

Climate change presents significant challenges to Rwanda, particularly in the areas of agriculture, water resources, and public health. The country's reliance on rain-fed agriculture, mountainous terrain, and rapid population growth heightens its vulnerability to temperature shifts, rainfall variability, and extreme weather events. This has led to environmental degradation, threatened food security, and increased pressure on infrastructure, necessitating comprehensive and sustainable climate action. This study examines the impacts of climate change on Rwanda from 2002 to 2022, focusing on the effects of climate variability, population growth, and urban expansion. It explores the influence of these factors on key sectors such as agriculture, health, and infrastructure while assessing Rwanda's vulnerability to climate-related risks. The research also investigates climate adaptation strategies aimed at mitigating these impacts. Time-series data from the Rwanda Meteorology Agency, the National Institute of Statistics of Rwanda, and other sources were analyzed using satellite remote sensing, climate modeling, and risk assessment tools. A key method used for predicting future scenarios is the Coupled Model Intercomparison Project (CMIP6), which models temperature and precipitation trends under different greenhouse gas emission pathways. Additionally, the study employs the Community Climate System Model (CCSM4) for high-resolution projections of climate variables. Findings from the past 20 years show that Rwanda's average temperature has risen by 0.5°C, and rainfall during dry seasons has decreased by up to 20%. These changes have resulted in a 10-15% reduction in agricultural yields, particularly in maize and beans. Rwanda's population grew by 25%, from 9 million in 2002 to 13 million in 2022, contributing to increased pressure on resources. Urban areas expanded by 10-12% in the last decade. Future scenarios predict a continued rise in average temperatures by 1.2°C to 2.4°C by 2050, with erratic rainfall patterns leading to a 15-25% decrease in dry-season rainfall, exacerbating food insecurity and water scarcity.

Estimating the Effects of Climate Fluctuations on Precipitation and Temperature in East Africa

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Abstract

East African (EA) countries including Rwanda, Kenya, Uganda, Tanzania, and Burundi face increasing climatic risks due to their high exposure and low adaptive capacity, especially in arid and semi-arid regions. Climate extremes have already led to the loss of life, infrastructure damage, and socio-economic disruption across EA. Reliable climate projections are essential to support effective regional adaptation and planning strategies. The study aimed to: (1) evaluate the performance of NEX-GDDP-CMIP6 models in simulating historical precipitation and temperature from 1981 to 2014, and (2) project future climate changes under three emission-driven scenarios SSP1-2.6 (low), SSP2-4.5 (medium), and SSP5-8.5 (high) to guide regional planning and adaptation efforts. To achieve these objectives, the study applied robust statistical metrics, Taylor diagrams, and Interannual Variability Skill (IVS) scores to assess model accuracy. Future trends in precipitation and temperature were analyzed using the non-parametric Mann-Kendall test and Sen's slope estimator to determine the direction and magnitude of projected changes over time. The findings revealed that IPSL-CM6A-LR, EC-Earth3, CanESM5, and INM-CM4-8 were the most reliable models for simulating precipitation and temperature patterns. Under the high-emission SSP5-8.5 scenario, March-May (MAM) precipitation is projected to increase by 40% and temperature by 4.5°C by the century's end. In contrast, MAM precipitation and temperature could decline under SSP2-4.5 and SSP1-2.6. Notably, under SSP5-8.5, temperature increases of over 6°C are expected in several regions. The results underscored the urgency of GHG mitigation, as continued high emissions could lead to severe climatic shifts in EA.

Rwanda Climate Science Symposium
ADVANCING RESEARCH AND NETWORKING

Rooftop Solar Potential in Rwanda: A Pathway to Achieve 2030 Greenhouse Gas Reduction Targets

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Abstract

Rwanda's energy sector faces critical challenges, with 70% of its 14 million population residing in rural areas where limited electricity access perpetuates reliance on carbon-intensive fuels. This energy poverty undermines both development goals and climate commitments, particularly the nation's 2030 targets for 60% renewable energy adoption and 38% emission reductions. The study addresses this dual challenge by quantifying how strategically deployed rooftop solar systems can simultaneously expand energy access and mitigate greenhouse gas emissions across Urban and Rural communities. The research establishes three key objectives: (1) to measure the solar generation potential across income-stratified households (Urban: 336,000 Poor to 157,500 Rich; Rural: 940,800 Poor to 284,200 Rich), (2) to calculate corresponding CO_2 saving and (3) to evaluate the socio-economic impacts through job creation and carbon saving revenue. These assessments directly align with Rwanda's policy priorities for sustainable energy transition. Methodologically, the study employs a spatial-energy model incorporating household- level rooftop areas estimated (18-140m²), Rwanda's solar irradiance data (4.5 kWh/m²/day), and standardized emission factors (1.1 kg CO_2/kWh displaced). Financial analysis includes Levelized Cost of Electricity calculations and carbon credit valuation at $ 30/ton, while employment potential is derived using Rwanda-specific job creation coefficients (41 jobs/MW). Key findings reveal Urban areas can generate 5-15 MW of solar capacity (9.93×10^9- 4×10^{10}kWh annually), while Rural regions show 15-30 MW potential (3.26 - 7×10^{10} kWh). This translates to annual CO_2 reductions of 1.1-7.7×10^{10} kg across income groups. The economic analysis demonstrates strong viability, with LCOE ranging from 0.000068−0.0006/kWh and carbon credit revenues reaching 2.31 billion/year. The research is completed and provides policymakers with actionable insights for achieving Rwanda's 2030 energy and climate targets through decentralized solar solutions.

Concluding Application of DISA: Weather guided potato production management reduces pesticide application

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Abstract

Global warming results in significant regional climatic changes, creating uncertainty in the seasonal weather patterns. In Rwanda's topography with site-specific microclimates, this necessitates improved local weather observation networks and integration into regionalized forecast models. Potato late blight disease, caused by Phytophthora infestans, presents a growing challenge for potato farmers due to these climatic shifts. Currently, fungicides are applied on a calendar-based schedule without considering actual infection risk, leading to overuse of fungicides, creating economic and environmental concerns. This study aimed to evaluate the effectiveness of real-time weather-guided late blight management based on calculated risk levels and variety tolerance. Building network of automated weather stations and LoRaWAN sensors, a digital Decision Support System that uses hourly weather data to calculate late blight disease index was developed, designed to provide timely fungicide application recommendations based on actual disease pressure, with the goal of reducing fungicide use while maintaining yields. Field trials were conducted over two growing seasons along an altitude transect from Kinigi (~2400 masl) to Nyange (2000 masl). Four potato varieties with varying late blight resistance levels (susceptible Ndamira, tolerant Twihaze, and moderately resistant Kirundo and Cyerekezo) were tested under either DSS-guided spray regimes or conventional weekly spraying. Weather data was processed through the late blight model, and recommendations were delivered to farmers. Results demonstrated that the weather-guided DSS substantially reduced fungicide applications while maintaining comparable yields. Fungicide use reductions ranged from 10-90% depending on cultivar and location, with the most significant reductions in the tolerant variety. Even the susceptible variety achieved 50% spray reductions in some locations. These reductions were achieved with minimal yield impacts, with some varieties showing yield increases under DSS management. This research demonstrates that weather-based disease management, when implemented with appropriate weather data and models, offers a practical adaptation strategy for potato farmers facing climate change.

Rwanda National Climate Change Vulnerability Index Assessment (CCVIA)

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Abstract

The overall objective of the National CC Vulnerability Index Assessment-CCVIA is to collect data and assess social-economic and spatial vulnerability to climate change in Rwanda, develop an index-based ranking of vulnerabilities in districts to use for future change investigations, generate climate-related vulnerability maps, and provide policy and strategy recommendations to reduce vulnerability to climate change. CCVIA has involved a national household survey that targeted 2,568 respondents selected in 30 districts across the country. The survey is the 3rd tracking of household responses. Earlier CCVIA were done in 2015 and 2018. This assessment uses an 'index' methodology based on the national HH survey data, correlating that data to several Vulnerability Indicators in a national framework, and presenting a picture of vulnerability - with an Index number for each Indicator in each District. These numbers are rolled up to provide an Index for Exposure, Sensitivity, Adaptive Capacity and overall Vulnerability for each District. The use of the Index methodology allows for comparison of the indices between Districts, and with the 2019 CCVIA. The CCVIA included a panel of 8 sector experts who prepared a National Situation Analysis reports – one for each sector: Water, Health, Energy, Human Settlements, Agriculture and Livestock, Forests, Transportation Infrastructure, and Socio-Economic. The 2025 CCVIA report is not yet completed. The presentation will provide interim results. Maps are available that show relative vulnerability of the Districts.

Complexity of Climate Variables Interdependence and their effects to Agricultural Sector in Rwanda

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Abstract

Rwanda, like many sub-Saharan countries, relies heavily on rainfed agriculture, making it highly sensitive to climate variability. However, there is often a lack of analysis regarding the key drivers behind climate change that impacts agricultural productivity. To improve adaptation and mitigation strategies, it is essential to understand these dynamics and provide accurate seasonal precipitation forecasts to inform farmers and boost preparedness. This study had three primary objectives: (1) to investigate the regional precipitation bias in the Greater Horn of Africa, where Rwanda is situated, and assess the potential of ensemble averaging of global circulation models (GCMs) for simulating total precipitation; (2) to evaluate the response of tea production in Rwanda to rainfall variability; and (3) to identify the climate forcings influencing observed surface temperature, and explore the relationship between rainfall and surface air temperature. In these studies, various methods were employed. Precipitation bias was measured using RMSE and MAE, while ensemble averaging was done via unsupervised machine learning, specifically hierarchical clustering (single linkage, average linkage, and Ward's method). Panel data models, including OLS, random effects, and fixed effects—were used to assess tea output's sensitivity to rainfall. Lastly, multiple linear regression helped evaluate the influence of volcanic, natural, and anthropogenic forcings on temperature. Results showed that multi-model ensembles better-captured precipitation patterns than individual models. Among agricultural variables, only precipitation significantly impacted tea production, particularly in Rwanda's western ("Gisovu", "Nyabihu"), southern ("Kitabi"), and northern ("Mulindi") regions. Furthermore, cross-correlation analysis revealed a notable interdependence: rising surface temperatures tended to precede decreased rainfall, suggesting important implications for forecasting and adaptation planning.

NB: *The research is ongoing in the direction of creating our own machine learning algorithm that can produce a multi-model ensemble of global circulation models before achieving an objective precipitation seasonal forecast in the Greater Horn of Africa.*

Investigating The Relationship Between Urban Landscape Patterns and Non-Chronic Respiratory Diseases over Nyagatare District

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Abstract

Rapid urbanization in Nyagatare District, Rwanda, has transformed the landscape, raising concerns about its impact on respiratory health. The study investigates the relationship between landscape patterns and non-chronic respiratory diseases over Nyagatare from 2018-2021. The research examines how increase in land-use affects respiratory health by using urban indices. The main objective of this research is to Assess the impact of the landscape patterns on non-chronic respiratory, by assessing the spatiotemporal landscape patterns over Nyagatare district and assessing the link between the changes in landscape patterns and the respiratory diseases incidences over Nyagatare district. Data was collected from different institutions. The study employed spatial analysis techniques, such as Spearman correlation to explore relationships between urban indices and disease prevalence. Seasonal variations were also considered to account for temporal dynamics in both urbanization and respiratory health outcomes. The findings reveal a significant correlation between high densely populated areas and increased incidences of respiratory diseases. This underscores the critical impact of landscape patterns on respiratory health. Sectors with high population density show higher prevalence of respiratory disorders. These results highlight the urgent need for urban planning strategies that prioritize health outcomes, emphasizing the importance of improving air quality through better traffic and industrial regulations and monitoring urban expansion to mitigate its health impacts.

NB: *The research is ongoing*

Analyzing Potential Flood Occurrence Under Climate Related Variables in Coastal Areas of Kilifi, Kenya

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Abstract

Climate change related disasters are one of the most persisting challenges confronting the world today. Among all climate related disasters, floods have the greatest economic and social impacts worldwide, and the flood frequency is expected to increase due to climate change impacts. Flood is highly devastating low-lying areas and is the worst in coastal areas. This study aims to analyze the patterns and trends of flood occurrences in Kilifi coastal communities, focusing on the influence of climate-change-related variables, such as temperature, precipitation, and river discharge and sea level rise over 32 years and seeks to forecast potential flood occurrences based on the predicted climate change impacts under RCP4.5. The analysis method for this study was time series model, Autoregressive Integrated Moving Average (ARIMA) which involves analyzing the trends and patterns of a variable over time. The time series analysis is a powerful tool for identifying the relationships between climate variables and hydrological variables. model the relationship between climate change variables with flood frequency and flood magnitude. The result findings quantitatively confirm there is strong positive correlation flood occurrence and of climate related variable with and they are correlated among themselves. Increasing temperatures, increased precipitation, and higher river discharge are significantly associated with the increasing frequency and severity of floods in Magarini. The study will also help the areas to predict future flood risk and the uncertainties for preparation and enhance flood risk Management their adaptation strategies to expected potential flood risk.

NB: *This is the ongoing research and is part of my PhD Thesis, that has topic of Assessment of risk and household vulnerability to Climate Change-related floods in coastal selected wards of kilifi, kenya which is conducted at the university of Cape Coast, Ghana.*

Analyzing Water Loss and Demand Effects on Agricultural Productivity in Eastern Rwanda's Irrigation Schemes

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Abstract

Eastern Rwanda's agricultural sector relies heavily on irrigation schemes, making efficient water management crucial for productivity. This study examines the impact of water losses and demand on agricultural productivity within these schemes, utilizing Geographical Information System (GIS) and remote sensing data. By integrating satellite imagery and spatial data analysis, we evaluate water availability, losses due to evaporation and seepage, and crop yields in the region. Our research identifies key factors contributing to water loss, including infrastructural issues, climatic influences, and management practices. Using high-resolution satellite images, we assess surface water levels, the spatial distribution of irrigation schemes, and crop health indicators. Water demand is modeled based on crop type, growth stages, and seasonal patterns, enhancing our understanding of irrigation efficiency and resource allocation. The findings reveal significant water losses due to inefficiencies in the irrigation infrastructure and unfavorable climatic conditions. Combining GIS analytics with remote sensing enables us to quantify these losses and correlate them with agricultural productivity metrics. Analysis indicates that regions with enhanced irrigation management practices show higher yields, highlighting the need for policy interventions focused on improved water conservation and irrigation technology. This study offers insights into sustainable agricultural practices during water scarcity, providing recommendations for local farmers and policymakers to enhance agricultural resilience and productivity in Eastern Rwanda's irrigation schemes, thereby promoting food security and economic stability.

NB: *This study is ongoing*

Adaptation to the impacts of climate change in Kigali, Rwanda: Challenges and Opportunities

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Abstract

Climate change remains one of the most pressing global challenges, exerting profound impacts on ecosystems, economies, and human well-being. Rising global temperatures, altered weather patterns, and the increased frequency of extreme events threaten critical sectors such as agriculture, water supply, and public health. These impacts are particularly severe in regions with limited adaptive capacity, where they exacerbate existing social and economic vulnerabilities. Developing effective adaptation strategies is essential to building resilient societies and safeguarding future development gains. This study examines various adaptation responses to the impacts of climate change across multiple sectors and geographical settings. It aims to identify successful strategies, evaluate their effectiveness, and design adaptable frameworks suited to local needs. The research also seeks to uncover key barriers to adaptation, including financial, technological, and institutional challenges, and to offer recommendations that enhance community participation and strengthen institutional resilience. At this early phase, the study applies a mixed-methods research design, incorporating both qualitative and quantitative approaches. Initial work involves developing surveys and conducting interviews with community members, decision-makers, and field practitioners, alongside gathering baseline climate data and reviewing case studies of adaptation practices. Geographic Information Systems (GIS) are being introduced to map vulnerable areas and monitor trends over time. Participatory workshops are also being planned to integrate local knowledge and foster collaboration among key stakeholders, ensuring that adaptation measures are practical and sustainable. Preliminary insights highlight the effectiveness of community-led initiatives compared to top-down strategies. Promising practices, including climate-resilient agriculture, decentralized water management, and nature-based solutions, have begun to emerge. However, challenges such as funding shortages, technological gaps, and weak governance structures persist.

NB: *This research is ongoing, therefore, further analysis is necessary to validate these early findings and to develop comprehensive adaptation policies that are equitable, sustainable, and responsive to evolving climate risks.*

The consequences of climate change on mental health in Rwanda: A Narrative Review from Vulnerable communities

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Abstract

UN Climate Change Conference (COP29), alarm the nations to work on Climate change. Climate change every day is leading to worsening effects in various sectors, such as agriculture and health, particularly mental health. These different risks come together and lead to devastating events, which cause either emotional trauma or physical destruction. Africa is among the top continents with highly alarming stories of Climate change due to its geographical location and its economic situation. One of the countries affected by climate change is Rwanda. Rwanda is known as "A Land of thousands of hills", as its name is made of terrain including mountains, Hills, plateaus, Plains, Lakes, rivers and a large area of the Rift Valley in the western part. This all contributes to the country which is affected by climate change and has led to devastating results. This research aims to explore how environmental stressors contribute to mental health issues in the most vulnerable groups, such as women, genocide survivors, farmers and residents in harsh areas in Rwanda. This narrative review aims to explore how Climate change affects the Mental Health of vulnerable communities in Rwanda. Literature was identified using PubMed, Scopus, and Google Scholar with keywords including 'Climate Change', 'Mental Health', and 'Rwanda Community.' While Mental health screening is still neglected in the communities affected by climate change. Government needs to consider this issue for prevention of raising mental problems.

NB: *The research is still ongoing*

Impact of Climate Change on female Participation and Employment Opportunities in Agriculture Sector in Rwanda

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Abstract

Climate changes possess big challenges in the sector of agriculture in Rwanda, which is the most significant source of job opportunities especially for women in rural areas. As climate patterns shift and agriculture yields decreases, the great amount of women participation in agriculture sector are highly effected. Even if women have a large impact in agriculture sector, there a scarcity of research on how climate change has a profound effect on their role and opportunities in Rwanda. This lack of knowledge is hindering the progress of efforts to combat climate change in this sector. This study aims (1) to estimate the effect of climate change on female participation in agriculture sector, (2) to estimate how climate patterns affect employment opportunities for female in agriculture sector, and (3) Suggest gender inclusive climate resilience and participation. A variety of methods combining both Quantitative data and qualitative data will be used, including household's surveys, keynote discussions and group discussions in selected areas in Rwanda. Weather forecasts will also be used to determine weather patterns. The study will expect to show us the relationship between climate change and women participation together with their employment in agriculture sector. It will be able to demonstrate how climate patterns affect agricultural productivity, lack of job opportunities and income opportunities for women in this sector. It is also expected that there will be barriers to the shape of the women's body during the climate crisis. Understanding the impact of climate change on agriculture sector particularly on women is essential for the development of common policies and deep understanding of the matter. The results of this study will support the inclusion of women's interest in national climate change programs and agricultural development strategies, to achieve sustainable development goals in the agriculture sector.

NB: *The research is still ongoing*

Advances in Measurement and Reduction Strategies for Greenhouse Gas Emissions

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Abstract

The global escalation of greenhouse gas (GHG) concentrations continues to drive climate change, posing serious threats to ecosystems, economies, and public health. Despite international agreements targeting emission reductions, challenges remain in accurately quantifying emissions across sectors and implementing effective mitigation strategies. The lack of standardized measurement techniques further complicates efforts to track progress and design evidence-based policies. This research aims to develop and validate improved methodologies for measuring GHG emissions from key sectors, including energy production, agriculture, and transportation. Additionally, it investigates the effectiveness of innovative reduction technologies such as carbon capture and storage (CCS), methane leak detection and repair (LDAR) programs, and the integration of renewable energy systems. The goal is to provide actionable insights for policymakers, industry leaders, and researchers working toward emission targets. The study combines field measurements, remote sensing technologies, and modeling approaches to capture emissions at local and regional scales. Advanced spectroscopic instruments, satellite data analysis, and life-cycle assessment models are employed to ensure a comprehensive evaluation. Pilot projects testing CCS installations and LDAR technologies are analyzed to assess real-world efficacy and scalability. Data harmonization techniques are applied to ensure cross-comparability among different emission sources and sectors. Preliminary findings suggest that integrating remote sensing with ground-based measurements significantly enhances the accuracy of emission inventories. Pilot reductions in methane emissions through LDAR initiatives have shown up to a 45% decrease compared to baseline levels. Ongoing analysis of CCS projects indicates a promising but sector-dependent viability.

NB: *The research is still ongoing*

Community-Driven Adaptation Strategies to Climate Change

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Abstract

Climate change poses significant threats to ecosystems, livelihoods, and economies, particularly in vulnerable regions. Increasing temperatures, unpredictable rainfall patterns, and extreme weather events are intensifying the challenges faced by communities, especially those with limited adaptive capacity. There is an urgent need for effective and sustainable strategies to mitigate these risks and enhance resilience at local, national, and global levels. The objective of this research is to assess the effectiveness of community-driven adaptation strategies in reducing vulnerability to climate change impacts. It seeks to identify practical approaches that communities are implementing, analyze their successes and limitations, and recommend scalable solutions. The goal is also to highlight the role of local knowledge and participatory action in shaping effective climate adaptation policies. This study employed a mixed-methods approach, combining quantitative surveys, qualitative interviews, and participatory workshops across multiple communities highly affected by climate change. Data was collected on agricultural practices, water management, early warning systems, and livelihood diversification. Statistical analysis was conducted to evaluate the effectiveness of each adaptation strategy, while thematic analysis was used to interpret qualitative insights from community narratives. Preliminary findings indicate that community-led initiatives, especially those integrating indigenous knowledge and scientific innovations, show promising results in enhancing resilience. Programs promoting diversified livelihoods and improved water management have led to measurable reductions in vulnerability indicators. However, challenges such as limited funding, lack of institutional support, and political barriers remain.

NB: *The research is still ongoing*

Project 'IKIRERE': Innovation and Knowledge Integration for Resilience in East Africa through Climate Research and Education

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Abstract

Drought and heatwaves are recurrent extreme weather events in East Africa with devastating consequences, especially for food security, livelihoods and human health. With climate change, these extreme events are expected to increase in frequency, severity and extent. Robust climate information is needed to help East African countries implement effective adaptation strategies. However, owing to the complexity of these extreme phenomena and the sparse nature of the region's data, it is not straightforward to characterize and predict them, and large uncertainties remain. In our new UK-Rwanda collaborative project 'IKIRERE' (Innovation and Knowledge Integration for Resilience in East Africa through climate Research and Education) we aim to improve our understanding of the physical drivers and indicators of agricultural drought and heatwaves in East Africa and their future projections, with a focus on Rwanda as a case study. The project will also have strong capacity building component, aiming to inspire and train the next generations of climate scientists in Rwanda. We will use state-of-the-art Earth Observation and reanalysis datasets, models and machine-learning methods. We will use the Joint UK Land Environment Simulator (JULES) to run high-resolution simulations of soil moisture over East Africa, and a novel machine-learning emulator as a fast, lightweight alternative to JULES that can be used by non-experts. In this contribution, we will present our exciting new project, and we will show results from our soil moisture emulator prototype, which can reproduce JULES soil moisture over Africa with remarkable agreement. The project has only just started, so this research is ongoing. 'IKIRERE' is a collaboration between the UK National Centre for Earth Observation (NCEO) at the University of Leicester and the African Institute for Mathematical Sciences (AIMS) in Rwanda. Other project partners include Digital Earth Africa and the UK National STEM Learning Centre.

NB: *The project is ongoing*

Impacts of Climate Change and Risk Assessment

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Abstract

One of the most important issues facing the world today is climate change, which has profound effects on ecosystems, economies, and human welfare. Rising temperatures, changing weather patterns, sea level rise, and an increase in the frequency of extreme weather events are all signs of its effects. Both human and ecological systems are seriously at risk from these changes, especially in areas that are fragile and have limited potential for adaptation. The necessity for thorough risk assessments to direct efficient actions has become more pressing as the urgency to comprehend and confront these risks has increased. This study's main goal is to analyze the complex effects of climate change and the hazards that come with it on a regional and global scale. Determining the probable severity of anticipated climate-related hazards, identifying the most vulnerable communities and industries, and guiding adaptive actions that can lessen long-term vulnerability are some specific objectives. The purpose of this study is to support evidence-based policymaking by identifying important areas that require intervention. The study uses an interdisciplinary method, integrating socioeconomic risk evaluations, geospatial analysis and climate modeling to accomplish these goals. Both quantitative and qualitative techniques were used to assess the data, which came from field surveys, historical documents, and climatic projections. Exposure, sensitivity, and adaptation ability were assessed across various areas and industries using risk assessment frameworks, such as the IPCC's risk-based approach. The results show that low-income and coastal communities are disproportionately impacted by climate change, with higher risks of floods, food insecurity, and health emergencies. The study concludes that to lessen these effects, proactive risk management, early warning systems, and locally specific adaptation plans are crucial. Furthermore, strengthening resilience and guaranteeing sustainable development in the face of climate uncertainty depend on incorporating scientific insights into planning and policy processes.

NB: *The research is ongoing*

Refining Rwanda's Path to Climate Action: Measuring and Reducing Greenhouse Gas Emissions

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Abstract

Rwanda, like many developing nations, faces mounting challenges related to climate change, particularly in managing and reducing greenhouse gas (GHG) emissions. Despite its relatively low contribution to global emissions, the country is committed to implementing robust strategies aligned with international climate agreements. This study addresses the problem of accurately quantifying and curbing GHG emissions across key sectors including agriculture, energy, and transportation. The objective of this research is to support Rwanda's climate ambition by developing tools for effective GHG measurement and mitigation. A major focus is the enhancement of Monitoring, Reporting, and Verification (MRV) frameworks in line with the Enhanced Transparency Framework (ETF) under the UNFCCC and the Paris Agreement. The study also explores targeted mitigation strategies aimed at reducing emissions and strengthening carbon sinks to support Rwanda's climate resilience goals. To achieve these goals, the research applies a combination of satellite imagery, ground-based sensors, and remote sensing technologies to monitor emissions with improved accuracy. Data from different sectors are analyzed to detect trends and inform responsive policy decisions. Consultations with key stakeholders, including technical experts and policymakers, help align the improved MRV framework with national and global expectations. Preliminary findings reveal that while Rwanda has made progress in emissions tracking, there are still data consistency and integration gaps across sectors. The enhanced MRV system developed in this study shows potential to improve transparency and guide evidence-based policy. The mitigation approaches evaluated suggest realistic pathways for emission reductions and increased carbon sequestration.

NB: *The research is ongoing, and its final outcomes are expected to provide actionable insights to further support Rwanda's national climate strategy and its commitments under international climate frameworks.*

Climate Adaptation Knowledge Brokering in Rwanda - What Does it Take to Contextualise, Make Sense of, Visualise or Prepare Climate Information for Usage?

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Abstract

The generation of climate information has rapidly evolved over the last decades. There is an ever-increasing amount of information, with more models, scenarios and outputs produced. The information generated is essential to make smarter and better decisions, to develop effective and inclusive policies and strategies as to how to adapt to the negative climate impacts. All affected sectors (agriculture, forestry, environment, infrastructure, urban planning etc.) are starting to use this type of information but struggle to integrate it into specific strategies, operations, workflows and decision-making processes. Professionals that are tasked to 'use' the climate information have not been systematically trained and up skilled to carry out these tasks and duties within their respective sectors and sub-sectors. How to deal with spatial and temporal scales that diverge between the use cases and the models? How to reduce complexity while still maintaining key information? How to deal with uncertainties in climate information and treat them professionally? How to assess whether adaptation designs and plans need to change and if so, how? Methods and approaches from across the world that "focus on" or "support" the contextualization, visualization and sense-making of complex climate information will be presented. There is a growing professional need for skills and competencies that are summarized as climate adaptation knowledge brokering or sense-making skills. Establishing a professional cadre of climate adaptation knowledge brokers in Rwanda is key to develop, implement and finance meaningful, appropriate and robust adaptation strategies. Achieving this will require educational and professional development processes that go beyond traditional lectures and professional training approaches. Innovative co-creation and sense-making processes and techniques to develop these skills and competencies such as the Climate Co-Adaptation Lab and similar ones will be shared. Potential networking and cohort approaches will be discussed with key actors at the Forum.