GORILLA CONFERENCE PROGRAM AND BOOK OF ABSTRACTS

7TH –10THDECEMBER 2022

Protea Hotel by Marriott Kampala
Kampala, Uganda

https://gorilla.mak.ac.ug

Overview of Conference Events

5th to 7th December 2022: **Pre-conference Training** on Optimizing Emerging Geospatial Technologies in Evaluating Climate Change Impacts on Vegetation

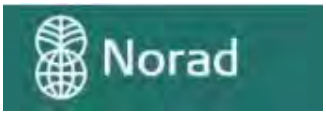
5th to 7th December 2022: **Pre-conference hackathon** on Geospatial Based Cloud Computing for Biodiversity and Ecosystem Resilience

7thDecember 2022: **Special Session** organized by Avoidable Deaths Network (ADN) on Neglected Areas of Disaster Loss and Damage: Virtual Session conducted on zoom

8th to 9th December 2022: **Main GORILLA** Conference at Protea Hotel Kampala

10th to 12th December 2022: **Post GORILLA** Conference excursion to Mountain Elgon in Eastern Uganda

CONFERENCE SPONSORS



CONFERENCE PARTNERS

Conference Program

Wednesday, December 7th, 2022		
8:00 – 17:00	**Pre-Conference Hackathon** **Geospatial Based Cloud Computing for Biodiversity and Ecosystem Resilience** **Makerere University**	**Pre-Conference Training:** **Optimizing Emerging Geospatial Technologies in Evaluating Climate Change Impacts on Vegetation** **Makerere University**
14:30-16:30	**Avoidable Deaths Network(ADN) Special Session: Neglected Areas of Disaster Loss and Damage: Virtual Session** **Registration online at: https://lnkd.in/eN4pVeSX Required**	
16:00 – 18:00	**Conference Registration: Protea Hotel, Kampala**	

	Thursday, December 8th, 2022			
8:00 – 8:45	**Registration Continued**			
8:30 – 9:00	Welcome remarks: **MAIN HALL**			
9:00 – 10:00	**SESSION 2**: Official Opening and Group Photo by Guest of Honor: **MAIN HALL**			
10:00-10:45	**Tea Break**			
10:45 – 12:15	https://zoom.us/j/95748473551?pwd=OWF0ejVaemJ3cnhUL2lFTUZ6SVVSUT09 Meeting ID: 957 4847 3551Passcode: 922358 **SESSION 1:** Keynote Presentations: **MAIN HALL** **Speakers** 1. Prof. TonnyOyana 2. Prof. Joy Obando 3. Prof. Innocent Moyo 4. Prof. Heiko Baltzer			
12:15 – 13:00	High Level Panel Discussions:**MAIN HALL** Panelists: FAO, Parliament, NPA, UNAS and BRAC Uganda			
1:00 – 2:00	**Lunch Break**			
2:00 – 3:45	**Session3 a**: Water resources and water systems in the Anthropocene **MAIN HALL A**	**Session 4a**: The Future of Smart Cities and Urban Systems in SSA **MAIN HALL B**	**Session 5**: Land Degradation Neutrality and Net Zero **BOARD ROOM 3** **Session 7**: Geographies and Contexts of COVID-19 Processes and Sustainable Recovery: **BOARD ROOM 1**	**Session 6**: Migration and Displacement: Socio-ecological Intricacies and Benefits **BOARD ROOM 2**
3:45 – 4:15	**Tea Break**			
4:15 – 6:00	**Session 3b**: Water resources and water systems in the Anthropocene **MAIN HALL A**	**Session 4b**: The Future of Smart Cities and Urban Systems in SSA: **MAIN HALL B**	***UNESCO side Event: Regional level project planning*** **BOARD ROOM 2**	
Friday, December 9th, 2022				
9:00 – 10:30	**Session 8:** Keynote Presentations: **MAIN HALL** https://zoom.us/j/94267559548?pwd=REpyQXpWRU12dTkzdGZIdHN5eGk0dz09 Meeting ID: 942 6755 9548Passcode: 533437 **Speakers:** 1. Prof. Justine Namaalwa 2. Prof. Jan KetilRø d 3. Dr. SamuelPartey			
10:30 – 11:00	**Tea Break**			

11:00 – 1:00	**Session 9a**: Climate Smart Agriculture and Sustainable Resilience **MAIN HALL A**	**Session 10a:** Nature-Based Systems in Mitigating Hydro-meteorological Hazards and Disasters **BOARD ROOM 3**	**Session 11a:** Biogeography, biodiversity, and ecosystem conservation **BOARD ROOM 2**
1:00 – 2:00	**Lunch Break**		
2:00 – 4:30	**Session 9b:**Climate Smart Agriculture and Sustainable Resilience **MAIN HALL A**	**Session 10b:** Nature-Based Systems in Mitigating Hydro-meteorological Hazards and Disasters **BOARD ROOM 3**	**Session 11b:** Biogeography, biodiversity, and ecosystem conservation **BOARD ROOM 2**
	Session 9c: Climate Smart Agriculture and Sustainable Resilience **MAIN HALL B**		
4:30 – 5:00	**CLOSING SESSION WITH COFFEE/TEA: MAIN CONFERENCE HALL**		

Message from the Minister of Science, Technology and Innovation

Hon. Dr. Monica MusenoroMusanza

On behalf of the government of Uganda, I take this opportunity welcome you all to the 2nd International Conference on Geographical Science for Resilient Communities, Ecosystems and Livelihood under Global Environmental Change (GORRILA), which will be held in our beautiful city Kampala. This conference is timely and relevant today, because it will help everyone to contextualize the causes of the many climate-related problems we are facing today, the extent to which we are to blame, and practical ways to minimize the effects and adapt to become more resilient to these perturbations. The Government of Uganda is always ready to listen to new science intended to address livelihood challenges and inspire national development, because science is at the heart of the country's development agenda. We are therefore grateful to host a vibrant community of experts in various areas of science and await to listen, exchange, learn and later apply the original ideas you have, for the good of the environment and humanity at large. Once again, you are most welcome to Uganda.

Message from the Vice Chancellor, Makerere University

Prof. Barnabas Nawangwe

Makerere University is extremely pleased to collaborate with the National Environmental Management Authority (NEMA) to organize the second international conference on Geographical Science for Resilient Communities, Ecosystems and Livelihoods under Global Environmental Change, which will take place in Kampala. The 2nd International GORILLA conference coincides with Makerere University's centenary celebrations of 100 years of existence, in which we have shaped individuals, transformed societies and influenced the global discourse through teaching and education, research and innovations as well as outreach activities.

At Makerere University, we have intentioned ourselves as stipulated in our strategic plan 2020-2030 to transition to research led university, which will also heighten our contribution to solving the sustainability issues as prioritized in the Global development Agenda 2030. The GORILLA conference is one avenue of taking stock of the emerging new knowledge from the scientific community which can be harnessed to improve the society well-being. On behalf of Makerere University, I welcome you to the GORILLA conference and I am confident that it will be a vibrant event.

Message from the Executive Director, National Environment Management Authority (NEMA)

Dr. Barirega Akankwasah

I welcome you all to the international conference on Geographical Science for Resilient Communities, Ecosystems and Livelihoods under Global Environmental Change (GORILLA), to be held in Kampala, from 8th to 10th December, 2022. This is the second edition of the GORILLA, after the first in December 2020, which was well attended, despite the COVID-19 pandemic. As an agency of Government supervising all matters of the environment in Uganda, we are glad to associate ourselves with this conference because of the enormous opportunities to learn and update our knowledge on those areas of science at the core of our activities. We are therefore eager to meet you all and build long-lasting partnerships, for the good of the environment and all of us who depend on it.

Message from Chairperson, Conference Organizing Committee

Dr. Yazidhi Bamutaze, Associate Professor and Deputy Principal,
College of Agricultural and Environmental Sciences, Makerere University

It is a great pleasure that we once again welcome you to Kampala for the second International Conference on Geographical Science for Resilient Communities, Ecosystems and Livelihoods under Global Environmental Change (GORILLA). We are gratified by the nearly 200 abstracts submitted for the conference. As you already know, the interdisciplinary GORILLA conference seeks to make a contribution to the realization of the Global Development Agenda 2030 and the AU Agenda 2063. While the Global Development Agenda was agreed on in 2015, an inspection of the current state, 7 years down the road gives dismal progress on many targets of the SDG targets and priorities of the Sendai Framework for Disaster Risk Reduction, particularly for developing countries. The annual COP meetings and their outcomes have recently given a glimmer of hope in reinvigorating the path to sustainability and thrivability. In order to address the pressing contemporary issues, the 2nd GORILLA conference has been collapsed into eight subthemes i.e. (a)Biogeography, Biodiversity and Ecosystem Conservation(b)Land Degradation Neutrality and Net Zero(c)Water resources and water systems in the Anthropocene(d) Migration and Displacement: Socio-ecological Intricacies and Benefits(e)Climate Smart Agriculture for Sustainable Resilience(f)Nature Based Systems in Mitigating Hydro-meteorological Hazards and Disasters (g)Geographies and Contexts of COVID-19 Processes and Sustainable Recovery(h)The Future of Smart Cities and Urban Systems in SSA. These subthemes, coupled with keynote addresses, the high-level panel discussion, special sessions are expected to elevate the conversations geared at cultivating solutions and strategies for achieving the development goals and aspirations. We have created a platform geared at bridging the science-policy-practice gaps and deriving actionable and policy-oriented measures that can potentially transform societies. For those in academic, we have planned a special issue publication with the African Geographical Review (AGR) Journal, which will also commemorate the MAK@100 celebrations. Lastly, I wish to acknowledge the generosity of the various sponsors and partners whose support has enabled the 2nd international GORILLA conference to be successful.

Message from Co-Chair, Conference Organizing Committee

Dr. Jerome S. Lugumira, Natural Resources Manager
(Soils and Land Use), National Environment Management Authority (NEMA), UGANDA

On behalf of the Local Organizing Committee, I humbly welcome you to the 2nd internationalconference on Geographical Science for Resilient Communities, Ecosystems and Livelihoods under Global Environmental Change (GORILLA). This is indeed a continuation of the first GORILLA conference, held in 2020. Once again, we converge in Kampala to hear and learn about new science that ought to underpin policy decisions intended to increase resilience of ecological systems and societies dependent on them, especially at this time of global environment change. In light of this, the conference has been organized in such a way to allow a science-policy dialogue framed around key issues representative of the conference sub-themes, but also going deeper to tease out those gaps that represent bottlenecks in our quest to meet targets within the frameworks of global, region and national development agendas. This, we believe, should prepare presenters and their audiences for the several sessions ahead, which represent a collection of information across a spectrum of science relevant to the theme of the conference.

I am grateful to have once again co-chaired the organization of this conference. I appreciate the local organizing committee for their time and effort that has seen us this far. I also thank the sponsors who have supported this conference, and the presenters for enriching the conference with your presence.

Local Organizing Committee

Name	Institution
Yazidhi Bamutaze (**Chairperson**)	Makerere University
Jerome S. Lugumira **(Co-chair)**	NEMA
Frank Mugagga	Makerere University
Goretti Nabanoga	Makerere University
Eria Serwajja	Makerere University
Jackie Bonabana	Makerere University
Fredrick Tumwine	Makerere University
Jane Bemigisha	ESIPPS
Edward Mwavu	Makerere University
Patrick Musinguzi	Makerere University
Bob Nakileza	Makerere University
Prossie Nakawuka	Makerere University
Ronald Semyalo	Makerere University
Benita Rumanzi	African Population Institute
Allan Mazimwe	Makerere University
Denis Wamala	Makerere University
Abel Nzabona	Center for Basic Research
Saul Daniel Ddumba	Makerere University
Jacqueline Kibirige	Makerere University
Martin Okwir	BRAC (Uganda)
Daniel Waiswa	Makerere University
Rhoda Nakabugo	Makerere University
Mr. Daniel Kisitu	Makerere University
Milton Kwesiga	ADRREM
Thomas Enuru	Makerere University

International Scientific Committee

1. Mike Meadows: University of Cape Town (South Africa)
2. Odwa Atari: Nipissing University
3. Inocent Moyo: University of Zululand (South Africa).
4. Nibedita Ray-Benetti: University of Leicester (UK)
5. Chris Nshimbi: University of Zululand, South Africa: (South Africa)
6. Udo Schickhoff: Institute of Geography, University of Hamburg, Germany.
7. Suraj Mal: Center for Earth System Research and Sustainability (Germany)
8. Oyama Shuichi: Kyoto University (Japan)
9. Wenwu Zhao: Beijing Normal University (China)
10. Joy Obando: Kenyatta University (Kenya)
11. Mihai Voda: Dimitrie Cantemir University Romania
12. Henry Bulley: City University of New York (USA)
13. Raymond Tutu: Delaware State University (United States)

Rationale for the GORILLA Conference

The interest resilience of ecological and social systems has gained heightened attention globally and are at the center of the United Nations Global Development Agenda 2030 manifesting in; (a) the 17 Sustainable Development Goals and 169 targets, (b) the Sendai Framework for Disaster Risk Reduction, 2015-2030 with its four priorities and 7 targets (c) the Paris Agreement geared at keeping temperature within the 1.5^0-2^0C threshold.

Substantial efforts by the global community have been variously invested in resilience building and sustainable systems in light of multiple exposures and threats. But huge gaps and challenges still remain that compromise realizing the desired goals. The effects of the global financial crisis, existing geo-political tensions and the emergence of COVID-19 altered the resilience trajectory with new dimensions in health, natural resource and poverty. Moreover, recent events exemplified by record temperatures registered in several countries but most notably in the UK, the increasing frequency and magnitude of hydrometeorological hazards as witnessed in Uganda, the increasing loss of biodiversity (>1,000,000 species lost) as recently reported by Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) have heightened the need for urgent actions and interventions that protect vulnerable societies. A consequence of these processes coupled with other factors including but not limited to land use and land cover conversions, rapid urbanization, is that mixed progress has been registered in realizing the sustainability targets for 2030 (https://sdg-tracker.org) with Sub Saharan Africa (SSA) countries posting dismal progress. For example, Uganda's SDG performance currently ranks a dismal 136/163 countries with an SDG Index Score of 53.5 (https://dashboards.sdgindex.org/profiles/uganda). Given the complex and interwoven conditions of underlying processes, this suboptimal performance for Uganda and other African countries is perhaps understandable.

There is broad convergence among scientists, policy makers and practitioners, development actors and governments that contextual knowledge creation and utility coupled with harnessing evolving and emerging technology are critical ingredients in building sustainable and resilience pathways and systems which the Global Sustainability agenda aspired to achieve. The 2ndInternational Conference on Geographical Science for Resilient Communities, Ecosystems and Livelihoods Under Global Environmental Change (Gorilla) is anchored and spurred by the desire to contribute to the realization of this Global Development Agenda 2030.

The conference seeks to address two fundamental questions; (1) "how can science, research and the academia contribute to the expedited achievement of global targets and resolve societal challenges? (2) how can local, regional and international partnerships as well as interactions between science, policy and practice enhance the delivery and achievements of the global development targets? Guided by these fundamental questions, the GORILLA conference will take stock of the emerging technologies, innovations and evolving knowledge streams to make a contribution in resolving the pressing societal problems and challenges to achieve sustainability. The conference is a great opportunity for conceptual, empirical and theoretical conversations on pressing sustainability and resilience issues from several perspectives.

Keynote Speakers

Professor Tonny J. Oyana, Makerere University, Kampala, Uganda

Professor Tonny J. Oyana received his PhD from the University of Buffalo, Buffalo, New York, in 2003. He did his postdoctoral training at the Department of Internal Medicine at the University of Buffalo with Dr. Jameson Lwebuga-Mukasa. He currently serves as the College Principal at the Makerere University College of Computing and Information Sciences, Kampala, Uganda. He is a professor of GIS and Spatial Analysis. He has served for over 25 years in several academic positions including but not limited to Southern Illinois University Carbondale, University of Tennessee Health Science Center, Yonsei University and Kyungpook National University, and Makerere University. His research focuses on establishing whether there is a link between environmental health and exposure; and advancing GIS methods, algorithm design, computational intelligence, analytical reasoning, and spatial analytical methods. He has a significant research interest in interweaving topics and fields and is currently expanding his extensive knowledge of data science to solve complex societal problems. He has mentored over 10 PhD and 38 master's degree students and 4 resident fellows/physicians, and his research has been funded by multiple agencies. He developed four computational algorithms (FES-k-means, MIL-SOM, Flexible Genetic Algorithm, and Reaction-Diffusion Mechanistic Model) and streamlined Diggle's method in Cluster Seer, a disease detection software. And he has taught GIS, data science, and spatial analysis courses for over two decades. He has authored 100 scientific publications including more than 54+ journal articles, 2 books, more than 25 refereed conference proceedings, 10 book chapters, and 10 book reviews; presented over 100 papers at regional, national, and international conferences; and written more than 20 technical reports.

Dr. Oyana earned his Master of Science in GIS at the National University of Ireland, Cork, Ireland, in 1996, and Bachelor of Science in education at the University of Dar-es-Salaam, Tanzania, in 1993. He is an internationally recognized expert in GIS/GPS, spatial data science, algorithm design, and spatial analytical methods and strategies, with over 25 years of proven research and educational leadership with a strong track record of key accomplishments across a wide array of initiatives in North America, South America, Asia, Europe, and Africa.

Professor Oyana's talk is titled "***Optimizing biodiversity data science for societal benefits in developing countries***"

Prof. Joy Apiyo Obando, Kenyatta University, Kenya

Dr. Joy Obando is currently and Associate Professor in the Department of Geography, Kenyatta University. She holds a PhD (Geomorphology), MSc (Geography) and BED (Geography and Mathematics). Her research interests focus on watershed management; food and water security; gender and climate resilience from a physical geography perspective. Joy is a mentor, researcher and is involved in research, training and community outreach. She has more than 30 years of education and research experience in academia at university level. Through the Capacity Building for Integrated Watershed Management, she developed the curriculum for the Masters programme (MSc) in Integrated Watershed Management. She was involved in the Collaborative online international learning (COIL) with Ohio University which involved teaching the students from Kenyatta and Ohio Universities online. The COIL model brings together faculty and students from around the globe to collaborate within and across academic disciplines on a joint virtual project. She continues to mentor early career scientists through training in grant writing as a Pro Grant Regional Expert.

She is currently the Principal Investigator in the project: '*Building gender responsive climate resilient communities in South Suda*n' within the framework of Supporting Pastoralism and Agriculture in Recurrent and Protracted Crises (SPARC) programme. She was a Co-Investigator in the recently completed BRECCIA PROJECT on food and water security in Sub Saharan Africa. She is a member of the steering Committees of 1) Africa Chapter of the International Association for Landscape Ecology (IALE) and is the conference chair IALE2023 World Congress 2023 2) the International Geographical Union (IGU) Geomorphology and Society Commission; 3) the International Advisory Board of Water Resources Research Center (WARREC) and 4) the CRC-TR 228 Future Rural Africa project. She is also a member of the University Research Advisory Board at Kenyatta University. She is involved in research, training and community outreach. She has facilitated and mentored early career scientists through grant writing activities.

Professor Obando's talk is titled "***Building climate resilient communities and ecosystems in Sub Saharan Africa***".

Prof. Innocent Moyo, University of Zululand, South Africa

Innocent Moyo is an Associate Professor in the Department of Geography and Environmental Studies at the University of Zululand, South Africa. He is the founding Chair of the IGU Commission on African Studies. He researches borders, migration, and the political economy of the informal economy in the Southern African region.

Professor Moyo's talk is titled "***On borders, migration and resilient communities***".

Professor Heiko Baltzer, University of Leicester, UK

Heiko Balzter is Director of the Institute for Environmental Futures and Professor of Physical Geography at the University of Leicester. He leads the UKRI Strategic Programme Coordination Team on "Landscape Decisions" (£ 10.5 million) and is a member of the National Centre for Earth Observation. He holds the Royal Society's Wolfson Research Merit Award (2011), Royal Geographical Society's Cuthbert Peek Award 'for advancing geographical knowledge of human impact through earth observation' (2015) and Copernicus Masters 'Sustainable Living Award' (2017) for his work on deforestation monitoring. His 120 journal papers have been cited >7000 times (h-index=45; i10-index=112, Google Scholar).

Prof. Balzter is alternate UK representative on the GEO Programme Board and is leading the Copernicus Land Monitoring Service for the UK. He is involved in collaborative research funded by UK Research and Innovation, BEIS, the European Space Agency, the UK Space Agency and the Natural Environment Research Council. His research interests include Earth observation of the land surface and spatial-temporal patterns and processes. His forest research includes work on above-ground biomass, logging detection in near-real-time, fire monitoring and tree disease detection. Before joining Leicester, he worked at the Centre for Ecology and Hydrology (1998-2006). He was Head of Department of Geography in Leicester from 2008-2011. He graduated with a PhD from Justus-Liebig-University, Giessen, Germany, in 1998.

Professor Heiko's talk is titled "***Satellite Earth Observation for Strengthening Forest Governance and Livelihood Resilience in Africa***"

Professor Justine J. Namaalwa, Makerere University, Kampala, Uganda

A female Uganda trained at PhD level in Forest Economics (Norwegian University of Life Sciences - 2002-2006); MSc. Management of Natural Resources and Sustainable Agriculture (Agricultural University of Norway 1998-2000); BSc. Forestry (Makerere University-Uganda 1993-1997). Currently employed as an Associate Professor in the Department of Environment Management, School of Forestry, Environmental and Geographical Sciences, College of Agricultural and Environmental Sciences, Makerere University; and the Chair of the Department of Environmental Management.

At Makerere University, she engages in Teaching of Graduate and Undergraduate students, Research and community outreach. Some of the taught courses include: Forestry Economics and Valuation; Trade in Ecosystem Services; Forestry and Climate Change; Resource Assessment and GIS; Trade and Environment; and Natural Resource Economics. The Research Interests are in the areas of: Natural Resource Assessment and Valuation; Biophysical and Bio-economic modeling; Markets for Ecosystem Services; Land Access, Land Use and Agribusiness; and gendered access and utilization of natural resources.

Professor. Namaalwa's talk is titled "***Optimizing Green Assets: A pathway to achieving the global development agenda***"

Professor. Jan Ketil Rød, Norwegian University of Science and Technology, Norway

Dr. Jan Ketil Rød is professor in Geographic Information Science at the Department of Geography, at the Norwegian University of Science and Technology (NTNU). He has a master in geomatics and a PhD in geography. Jan Ketil Rød teach and supervise students in application of Geographic Information Systems (GIS). His research is broadly in applying GIS addressing issues related to climate change adaptation, vulnerability, environmental hazards, accessibility of health services, disaggregated studies of armed conflicts, urban planning, literature geographies, and the use of GIS in education.

Professor. Rød's talk is titled "***The geography of disaster risk and participatory risk management: Harnessing sensors and geospatial technology for disaster resilience***".

Dr. Samuel T. Partey, UNESCO Regional Office, Nairobi, Kenya

Dr. Samuel Tetteh Partey is an experienced scientist with a demonstrated history of working in climate policy, biodiversity management, environmental governance, natural resources management, agriculture and science-policy analysis in Africa, Europe and North America. He holds a PhD in Environmental Biology from the University of Manchester, UK and a PhD in Agroforestry from the Kwame Nkrumah University of Science and Technology, Ghana. He is currently a Programme Specialist in Natural Science at the UNESCO Regional Office for Eastern Africa based in Nairobi, Kenya. In his role, he leads the design and implementation of UNESCO's interventions in biodiversity conservation, geology, climate change and disaster risk reduction in 13 Member States within Eastern Africa. Apart from his scientific roles, he represents UNESCO at the UNCT in Madagascar (as focal point) as well as Seychelles and Mauritius (as alternate focal point). He is also the youth focal person for science, and the evaluation focal point for UNESCO's Oversight Unit at the Office in Nairobi.

Before joining UNESCO, he was the West Africa Regional Science Officer for the CGIAR Research Program on Climate Change, Agriculture and Food security (CCAFS) based at the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Bamako, Mali. Other professional experiences include: a lecturer at the Kwame Nkrumah University of Science and Technology in Ghana; Senior Researcher at the International Bamboo and Rattan Organization; Visiting Research Associate at the University of Guelph, Canada; Visiting Scientist at the Manchester Metropolitan University and the University of Manchester, UK; Visiting Scholar at the Africa Rice Center in Benin, an International Consultant for the Center for China-Africa Agriculture and Forestry Research (CAFOR) based in Zhejiang, China and an International Consultant in Gender in climate-smart agriculture for the International Livestock Research Institute (ILRI), Kenya and Women in Global Science and Technology (WISAT), Canada. He is an author and co-author of over 60 publications in reputable journals, books, policy-related documents and advocacy scholarly materials.

Dr. Partey's talk is titled ***"Biosphere reserves as models for resilient ecosystems and societies"***

Pre-Conference Events

PRE-GORILLA CONFERENCE HACKATHON

Geospatial Based Cloud Computing for Biodiversity and Ecosystem Resilience

https://gorilla.mak.ac.ug/preconference

5th to 7th December 2022, Makerere University, Kampala

Introduction: Satellite Earth Observation (EO) provides a wide range of environmental data information which are key to the effective planning and monitoring of the environment. The proposed Hackathon/Datathon activity is to catalyse the development of EO services in a virtual computing and collaborative environment. A three-day pre-GORILLA hackathon is designed to generate scalable solutions to the identified few challenges using EO applications. Participants will Team up to collaborate on viable projects tailored to one of the selected challenges. The hackathon will be conducted at Makerere University.

Challenges to be addressed

1. Earth observation applications in biodiversity and ecosystem resilience
2. Effective monitoring and managing wetlands using earth observation data
3. Improving Agricultural Productivity and performance using earth observation data

Objectives: The aim is to engage early career scientists, researchers and practitioners with diverse backgrounds to foster collaboration in the use of geospatial technology and earth observation to address sustainable development issues especially on biodiversity and ecosystem resilience. Each team includes participants with expertise in EO data processing/GIS, and thematic experts (land use land cover, agriculture, forestry, etc).

Prerequisites: Each participant brings their own computer and other dependents for the Hackathon/Datathon. The hackathon will utilize freely available archived EO data from providers such as ESA, NASA etc. The Gorilla team will also offer technical Support on

1. Access to open-source software (SNAP, QGIS, Python (+ selected packages – GDAL, numpy, scipy, Jupiter Lab etc.), Anaconda, R + RStudio) to allow participants to use preferred SW or coding environment.

2. EO scientific support – 1-2 Person Target participants: This activity targets young and early-career scientists and practitioners with interest in the utility of emerging geospatial technology. Participants are expected to have some skills relevant to software development, e.g. computer programmers, graphic and interface designers, Geographic Information Systems and Earth Observation experts, project managers and thematic experts (e.g. biodiversity, ecosystems, agriculture, climate, energy, environment and natural resources, forestry), data analysts.

3. Learning pattern: The procedure is to admit teams that will work collaboratively to address one of the specific challenges highlighted above. Teams must demonstrate at least technical capabilities in the solutions they seek to provide. This is a hands-on activity that requires concentration and dedication. Prior to the physical Hackathon/Datathon, there will be an orientation to warm up the participants and make them familiar with the computing environment.

4. Expected results: The expected outcome is to provide innovative solutions applicable to each of the thematic areas highlighted in the challenges.

PRE-GORILLA CONFERENCE TRAINING

Optimizing Emerging Geospatial Technologies in Evaluating Climate Change Impacts on Vegetation

5th to 7th December 2022, Makerere University, Kampala, Uganda

Introduction:

The vegetation resources in tropical Africa are under increasing threat both from climate change and a spate of anthropogenic activities. Yet a substantial proportion of livelihoods in Africa is linked to environment and natural resources. Thus, the need for improved monitoring to ensure integrity and resilience of vegetation resources and ecosystems is apparent in line with the goals and tenets of the Global Development Agenda 2030. Geospatial technologies occupy a vintage position in monitoring, analysis and overall resilience building. A three-day pre-GORILLA conference training focussing on enhanced geospatial technology utility in analysing climate change impacts on vegetation resources and ecosystems is planned to be conducted from 5th to 7th December 2022 at Makerere University.

Objectives

1. To equip participants with emerging tools and technologies that can be harnessed in analysing climate change impacts on vegetation and ecosystems
2. To build an ecosystem of champions to propel the utility of geospatial technology
3. To improve the ecosystem and vegetation resilience to climate change

Target group:

The training targets young and early career scientists and practitioners with some basic knowledge of GIS and or remote sensing. They should have keen interest in climate change, biodiversity, biogeography and natural resource management issues. Up to 20 participants will be admitted to the training

Fees and sponsorship:

The training costs catering for training materials, meals and refreshments at the venue will be met with funding from JRS Biodiversity Foundation. Accordingly, there will be no fees charged on the selected participants to the training. Participants are responsible for any other personal costs.

Special Session organized by the Avoidable Deaths Network (ADN)

SPECIAL SESSION | Neglected Areas of Disaster Loss and Damage

Over the past decades, extreme weather events and climate disasters have killed more than 410,000 people and affected 1.7 billion people around the world (IFRC, 2020). The World Meteorological Organization's (WMO, 2021) latest *Atlas of Mortality and Economic Losses 1970-2019* offers some clear trends: the number of disaster deaths is declining despite the increase in the number of disasters in time; losses, especially economic losses, due to disasters are increasing largely in high-income countries; and most disaster-related deaths are occurring in lower-middle and low-income countries.

Disaster 'Loss and Damage' as such, has been one of the most important climate change negotiation discussions right from the Cancún Adaptation Framework of COP16, through to the Paris Agreement's Article 8 on 'Loss and Damage' of COP21, the Warsaw International Mechanism for Loss and Damage of COP19, the Glasgow Climate Pact of COP26 and now for the COP27 in Sharm El Sheikh, Egypt. The disaster 'Loss and Damage' debate is also vital to the UN's Sendai Framework for Disaster Risk Reduction's aim for "The substantial reduction of disaster risk and losses in lives, livelihoods and health" and several Sustainable Development Goals (including 1, 2, 3, 7, 13 and 17). The Glasgow Climate Pact (COP26) has strengthened the commitment to 'Loss and Damage' by recognizing it as the third component of mitigation and adaptation, and by reiterating the: "urgency of scaling up action and support, as appropriate, including finance, technology transfer and capacity-building, for implementing approaches to averting, minimizing and addressing loss and damage associated with the adverse effects of

climate change in developing country Parties that are particularly vulnerable to these effects" (UNFCCC, 2021, p7, section 63).

Although the recognition of 'urgency of scaling up action' is a step forward, the policy debate still concentrates on the physical aspects of the loss and damage with limited focus on the loss of life, effects on human health, loss of livelihoods, damage of the natural environment, change of ecosystem, and loss of social network and cultural heritage (UNISDR, 2015). The impact of climate change and weather extremes is felt and lived empirically by households and communities around the world. The lived experience of losses is indirect, intangible, cascade over time and are difficult to quantify. As such, they are **neglected areas** of public health, disaster risk reduction and sustainable development. They go unnoticed and unaddressed, pushing millions of poor and vulnerable households into poverty ratchets and spirals of vulnerability at local and national levels, especially in low-and middle-income countries.

Typical 'Loss and Damage' debates and studies focus on: existing or potential loss and damage; compensation for loss and damage for the low-and middle-income countries; calculating the link between emissions with specific loss and damage; establishing formal attribution of loss and damage to anthropogenic climate change – among others (Surminski, 2021; Roberts and Pelling, 2016; BBC, 2022; Grantham Research Institute on Climate Change and the Environment, 2022).

This highly topical and timely Special Session organized by the Avoidable Deaths Network (ADN) at the 2nd International Conference on 'Geographical Science for Resilient Communities, Ecosystems and Livelihoods under Global Environmental Change (GORILLA)' in Kampala, Uganda addresses the '**Neglected areas of Loss and Damage**'. Facilitated by the **ADN Uganda Hub** this Special Session will engage with policymakers, policy influencers, politicians, researchers, climate activists and climate scientists to bring the neglected areas to the fore, highlighting the neglected areas of Loss and Damage so that they receive the much-needed attention that they deserve from the UN, World Health Organization, politicians and critical support organizations in the second half of the 21st century. By doing so, it is hoped that these organizations will lead the way to promote **context-specific evidence-based interventions** to tackle poverty ratchets, vulnerability spirals and barriers to human freedom and capabilities for growth and sustainable development. Some of the neglected areas to be explored in the session include;

- Direct and indirect losses as well as their cascading effects on people's health, nutrition, lives and livelihoods
- Limits of coping and adaptation from recurrent loss of livelihoods and depletion of natural resources based on local evidence
- Capacity-building needs for local and national actors for loss and damage
- Strengthening governance for loss and damage
- Understanding loss and damage at the intersection of Sustainable Development Goals, Climate Protocol, the Sendai Framework for Disaster Risk Reduction and the Health Emergency Disaster Risk Management Framework.

References

IFRC (The International Federation of Red Cross and Red Crescent Societies) (2020) *World Disasters Report 2020. Tackling the humanitarian impacts of the climate crisis together*. Available at: https://media.ifrc.org/ifrc/world-disaster-report-IDMC

Roberts, E. and Pelling, M. (2016) 'Climate change-related loss and damage: translating the global policy agenda for national policy processes' in *Climate and Development, 10* (1). Available at: https://www.tandfonline.com/doi/full/10.1080/17565529.2016.1184608
Surminski, S. (2021) *Loss and damage and COP26: Swenja Surminski*. Available at: https://www.youtube.com/watch?v=e-HUCXVWtho

UNISDR (2015) *Making development sustainable: the future of disaster risk management. Global assessment report on disaster risk reduction*. United Nations Office for Disaster Risk Reduction. Geneva.

United Nations Framework Convention for Climate Change (UNFCCC) (2021) *Glasgow Climate Pact*. Available at: https://unfccc.int/sites/default/files/resource/cop26_auv_2f_cover_decision.pdf

United Nations Framework Convention for Climate Change (UNFCCC) (2022) *Report of the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement on its third session, held in Glasgow from 31 October to 13 November 2021*. Available at: https://unfccc.int/sites/default/files/resource/cma2021_10_add1_adv.pdf

WMO (World Meteorological Organisation) (2021) Weather-related disasters increase over past 50 years, causing more damage but fewer deaths. Available at: https://public.wmo.int/en/media/press-release/weather-related-disasters-increase-over-past-50-years-causing-more-damage-fewer

WMO (2021) *WHO Atlas of Mortality and Economic Losses from Weather, Climate and Water Extremes (1970-2019).* WMO

Parallel Sessions: Detailed Schedule with titles and presenters

DAY 1: THURSDAY 8th DECEMBER 2022

Session 3a: Water resources and Water systems in the Anthropocene

THURSDAY 8th DECEMBER 2022 - 2:00 – 3:45 pm

Venue: Main Hall A

1) Assessing Erosion Risk and Heavy Metal Loading in Sediment from the Inner Murchison Bay (IMB) Catchment – *Gyaviira Ssewankambo*
2) Effect of Land-use/cover Changes on Groundwater Level Dynamics in Semi-Arid Region of India – *Suresh Chand Rai*
3) Effect of climate change on cotton production in Uganda – *EriaKubyanukula*
4) Evidence of presence of microplastics in the sediments of Lake Victoria, Uganda – *Jerome Sebadduka Lugumira*
5) Characterization of the water resources of the rivers of the city of Bandundu – *Valentin Tembe Mwela*
6) Spatiotemporal analysis of the hydrological responses to land use land cover changes in the Manafwa Catchment, Uganda – *Godwin Erima*
7) Investigating satellite-derived indices applicable for monitoring the algal bloom in Koka Reservoir, Ethiopia – *Eden Eritrea Desalegn*
8) Assessment of Climate Change Impacts on Hydrological Processes in Usangu catchment, Tanzania Under CMIP6 Scenarios – *Gift Raphael Mollel*
9) Gender perspectives on rural household water governance under changing climate in Uganda – *Stella Tereka*
10) Water yield sensitivity to land cover type in the fragile lake Kyoga Basin - *Ellen j. Kayendeke*

Session 3b: Water resources and Water systems in the Anthropocene

THURSDAY 8th DECEMBER 2022 – 4:15 – 6:00 pm

Venue: Main Hall A

1) Applying the EARTH and Thornthwaite Models for Estimating Groundwater Recharge in the Klela Basin, Mali – *Adama Toure*
2) Wavelet analysis of spatio-temporal variability in surface soil moisture under different landuses in southwestern Nigeria – *Adedayo Oreoluwa Adewole*
3) Opportunities for resilience facing water scarcity: cases studies from Madagascar's medium-sized cities – *Malalaniaina Miora Rakotoarivelo*
4) From co-operation to coercion: The effect of military intervention on the Nile perch fishery on Lake Victoria in Uganda – *Veronica Mpomwenda*
5) Economic analysis of water use of lower Kihansi hydropower plant – *Jumanne Moshi Abdallah*
6) Assessing chicken based organic fertigation for improved yield, above ground biomass, crop water productivity and crop quality of tomatoes, cabbage and pumpkin – *Diana Mukulu*
7) Assessing the Effect of Deficit Drip Irrigation on Yield and Quality of Eggplant Crop – *Godfrey Ouma*
8) Estimating rainfall input uncertainty to the SWAT hydrological in the Kyoga basin - The Upper Nile – *Max Kigobe*
9) Maximum runoff prediction for small ungauged watersheds in the Romanian zone of the Mures basin – *Mihai Voda*

Session 4a: The Future of Building Smart Cities and Urban Systems in SSA

THURSDAY 8th DECEMBER 2022 - 2:00 – 3:45 pm

Venue: Main Hall B

1) The Sub Saharan Countries future of a Smart City – *Gift LembsonNjoka*
2) Infrastructures of survival: Seeing Kampala's heterogeneous sanitation infrastructures beyond the logics of 'modernity' – *Kasaija*
3) Urban technical networks facing floods in Brazzaville (CONGO): modeling of functional interdependence – *Attipo ReischVanel*
4) Are Uganda's cities age-friendly? Analysing urban green space prevalence and accessibility – *Abel Nzabona*
5) Examining the Influence of The Urban Heat Island On Urban Thermal Comfort In The Greater Kampala Metropolitan Area (GKMA), Uganda – *Ritah Nakanjako*
6) 'Yellow' Toilets, Profiteers and Altruists: Analyzing the many faces of power behind Kampala's informal sanitation infrastructures – *Peter Kasaija*
7) Energy access and livelihood improvement: Evidence from the hybrid-solar energy system on Bugala Island, Kalangala District – *Patrick Kayima*
8) Local Community Resilience to the Proposed Oil Pipeline in the Albertine Region, Western Uganda – *Mutegeki Arnold Paul*
9) Analysis of the vulnerability of smallholder horticultural farmers to agricultural risks in Mbale city region – *Patricia Kiggundu Nagawa*
10) Spatial Differentiation of the Land and Nutrient Footprints for Kampala City: Implications for Urban Food Sustainability – *Asaba Joyfred*
11) Cities as determinants of health: opportunities and challenges of urbanization in Sub-Saharan Africa – *Odwa Atari*

Session 4b: The Future of Building Smart Cities and Urban Systems in SSA

THURSDAY 8th DECEMBER 2022 – 4:15 – 6:00 pm

Venue: Main Hall B

1) An Assessment of Climate Extremes in Mbale Municipality in Eastern Uganda – *George Oriangi*
2) Urban heat hazard exposure and future likelihood in Kampala city, Uganda – *Hakimu Sseviiri*
3) How can the geographic visualization tools facilitate sustainable development of communities under global environmental change? – *Tomasz Opach*
4) Assessing the Accuracy of Open Street Map (OSM) Building Layer in Jinja District, Uganda – *Joseph Kamoga*
5) Predicting Land use Land cover change of Jos-Bukuru Metropolis Plateau state through integrated CA-Markov approach – *Nanpon Zitta*
6) Towards sustainable urban tourism development in Uganda: A Risk analysis framework – *Jim Ayorekire*
7) Modeling the implication of household off-grid energy consumption in Suleja Lga of Niger state, Nigeria – *Bamiji Michael Adeleye*
8) Potential contribution of urban road-side plant nurseries to plant conservation and human well-being in the face of climate change, Uganda – *Edward Nector Mwavu*
9) Investigating peri-urban farmland by a mixed spatial and socio-economic approach aiming at a typology of peri-urban agro-systems in Nairobi-Machakos Counties Interface, Kenya – *Martinien Arcadius Ahogle Agassin*
10) Effect of the activity of black soldier fly larvae on the quality of compost produced from different organic waste sources at Makerere university agricultural research institute – *Ali Ssenabulya*

Session 5: Land degradation, Neutrality, and Net Zero

THURSDAY 8th DECEMBER 2022 - 2:00 – 3:45 pm

Venue: Board Room 3

1) Facts-based for assessing land degradation and how to turn-up Zero Land Degradation Neutrality in Rwanda – *Joel Ndayisaba*
2) Reassembling land degradation: towards a nature-society-inclusive soil erosion control strategy – *Thaddeo Kahigwa Tibasiima*
3) Geospatial analysis of soil degradation by erosion in Idemili Watershed, Nigeria using RUSLE and ancillary data – *Frank Chibuzor Okenmuo*
4) The Interplay of Mental Health and Environmentalism in Niger Delta Poetry – *Stephen Ese Kekeghe*
5) Raising public awareness of the effects of land degradation in Ishaka Division, Bushenyidistric- south-western Uganda – *Urban Atuhairwe*
6) Land degradation - *Jean D Amour Niyokwizera*
7) Contribution of land ownership to agricultural land use changes in Mwatate Sub-county, Taita Taveta County, Kenya – *Bonventure Obeka Mwanzi*
8) Implications of Land use and cover changes on upper Rwizi macro watershed health in South Western Uganda – *Ayesiga Patience*
9) An Assessment of the impact of land use/cover changes on soil erosion risk in River Mitano Catchment, southwestern Uganda – *Loy Turyabanawe Gumisiriza*
10) Afforestation as Zambia's Land degradation neutrality strategy till 2050 – *Mashuta Kalebe*
11) The Spatial extent of land use/cover changes between 2015 and 2021 in the River Malaba catchment, Eastern Uganda – *Sarah Mbabazi*
12) Assessment of soil nutrient variability on a bench terraced hill slope to strengthen adaptation to climate change impacts among small-holder farmers in Kigezi Highlands of Uganda – *Kisira Yeeko*
13) Understanding land use changes following agricultural investments in Kanungu, Nakasongola and Nwoya - *Byaruhanga Bruce Michael*
14) Harnessing indigenous knowledge to enhance farmers' capacity to use local indicators for soil degradation assessment in Tororo District, eastern Uganda - *Emmanuel Opolot*
15) Dynamics of geohazards and environmental sensitivity on mountain Elgon under changing conditions - *Frank Mugizi or Amos Ochieng*

Session 6: Migration and Displacement: Socio-ecological intricacies and benefits

THURSDAY 8th DECEMBER 2022 - 2:00 – 3:45 pm

Venue: Board Room 2

1) Emerging trends on climate change induces migration in Africa – *Emmanuel Aweda*
2) Exploring the food-climate-migration nexus in West Africa by analyzing land surface dynamics and weather extremes in combination with expert interviews – *Alina Schürmann*
3) The 'Everyday' Humanitarian Acts Embedded in Socio-cultural Practices Among South Sudanese Refugees in Uganda – *Emmanuel Viga*
4) Social Sustainability of Resettlement Housing in Uganda; Case of Pagirinya Refugee Resettlement Camp in Adjumani District – *Samuel Elong*
5) 'Timescapes' of 'Visible Relationality' and Implications for Provision of Humanitarian Assistance - *Emmanuel Viga*
6) Struggles of Migrant Women in Artisanal Stone Mines and Quarries in Acholi Quarters and Bidibidi Refugee Settlement, Uganda – *Eria Serwajja*
7) High population growth rate accelerated by in-migration in the greater Kamwenge area responsible for environmental changes – *Fredrick Ruguma Tumwine*
8) The impact of refugee settlement on landscape and green environment in West Nile region, Uganda – *Geofrey Kizito*
9) Building livelihoods through networks - South Sudanese refugee women in rural and urban Uganda – *Maja Simonsen Nilsen*
10) Livelihood adaptation to displacement and resettlement due to oil refinery development in Uganda – *Caroline Aboda*

Session 7: Geographies and Contexts of COVID-19 Processes and Sustainable Recovery

THURSDAY 8th DECEMBER 2022 - 2:00 – 3:45 pm

Venue: Board Room 1

1) Where is GIS Technology applied in the Public Health discipline: A Literature Review – *Beatrice Winnie Nyemera*

2) Demystifying the Impacts of Covid-19 on the Real Estate Market in Developing Countries. Case of Commercial Properties in Malawi – *Desmond Namanja Namangale*

3) Disaster Preparedness Response during COVID-19 Pandemic in Uganda – *Stephenson Tukahirwa*

4) Impediments contributing GIS Technology Non-Use in Ugandan Health Sector Organizations – *Beatrice Winnie Nyemera*

5) Exploring Impacts of GIS Technology Use in Ugandan Health Sector Organizations – *Beatrice Winnie Nyemera*

6) Current and Potential Nature of Activities of GIS Technology Use in Ugandan Health Organizations – *Beatrice Winnie Nyemera*

7) Impact of Covid-19 containment measures on the environment in Kasese district – *Augustine Aggrey Malinga*

DAY 2: FRIDAY 9th DECEMBER 2022

Session 9a: Climate Smart Agriculture and Sustainable Resilience

FRIDAY 9TH DECEMBER 2022 – 11:00AM – 1:00PM

Venue: Main Hall A

1) Assessing Soil Organic Carbon Stock and its Particle Size 2 Fractions Across Cropping Systems in Kiti Sub-watershed in Central Benin - *ArcadiusMartinienAgassinAhogle*
2) Livelihood diversification and multidimensional child poverty – *BogaleGebeyehuGemede*
3) How changes in climate are affecting people's welfare in Uganda? – *Peter Babyenda*
4) Pastoralist livelihood vulnerability to climate change and variability in southern Ethiopia – *ShetieGatew*
5) Factors influencing the adoption of conservation agriculture practices among smallholder farmers in Mozambique – *Oscar Joao Chichongue*
6) Physiological features reactivity of Arsi-Bale goats reared under the three agro-ecologies of the Bale zone, southeastern Ethiopia – *MesayGuyoGujje*
7) Climate change adaptation practices for sustainable sorghum production in drylands of Ethiopia – *Eshetu ZewduTegegne*
8) Occupational health, safety and environmental implications of flower farming on the local communities in Central Uganda – *OmuloOwenda Charles*
9) Tackling climate change-related disturbances to sustain livelihoods: Perceptions and adaptation strategies of smallholder farmers in northeastern Burundi – *PacifiqueBatungwanayo*
10) Environmental and economic implications of zero grazing – *Joyce Biwembwaku*
11) Lablab purpureus: Analysis of Landraces Cultivation and Distribution, Farming Systems, and Some Climatic Trends for Production in Tanzania – *Julius Sebastian Missanga*
12) Mitigation of greenhouse gases and nutrient losses attributable to wasted fruits and vegetables – *Isaac Rubagumya*
13) Past and future trends and magnitude of climate variability and change in a fragile tropical mountain catchment. A case of Sironko catchment on the slopes of Mt. Elgon, Eastern Uganda – *Justine KilamaLuwa*
14) Community Climate Change Coping Strategies Around and Within Saadani National Park, Tanzania – *RukumbuzyaManyamaMusoma*
15) Climate Smart Agriculture Technologies for Environmental Management: The Intersection of Sustainability, Resilience, Well being and Development - *Jean D Amour Niyokwizera*

Session 9b: Climate Smart Agriculture and Sustainable Resilience at

FRIDAY 9TH DECEMBER 2022 – 2:00 – 4:30PM

VENUE: Main Hall A

1) Climate Variability and Agricultural Productivity in Uganda – *Peter Babyenda*
2) What socio-economic, institutional and climate related factors influences the demand for climate smart agricultural practices? – *BabingaGeofrey*
3) Assessing the adaptive capacity of households to water scarcity during drought in Kasali sub-county, Kyotera district, Uganda – *Joseph Mukasa*
4) Fencing lands to Enhanced Climate change Resilience, promoting biodiversity regeneration and Improved Livelihoods of climate change in Makueni and Baringo Counties - *Francis Kevogo Keya*
5) Studies on the use of locally available (Coxs Bazar and Saint Martin) alternative renewable seaweeds wastes as compost organic fertilizer resources – *Durlave Roy*
6) Integrated Weed Management in Conservation Agricultural Systems – *Otim Godfrey Anyoni*
7) Acceptability of Gravilllearobusta in developing agro-forest based climate resilient systems among small scale holder farmers in Webuye-West Sub-County, Kenya – Insights and opportunities – *Mayeku Philip Wafula*
8) Smallholder Farmers' Perception of Climate Change and Adaptation Practices in Kitgum District, Northern Uganda – *Betty Adoch*
9) Assessing the vulnerability of indigenous chickens to climate change in Uganda – *ZainahNampijja*
10) Do transaction cost attributes mediate the trust-supply chain performance relationships? Evidence from Ugandan agribusiness – *Godfrey Moses Owot*
11) Assessing the impact of innovation adoption on Agropastoral Farmers' adaptive capacity to Drought Hazards Within the Cattle Corridor of Uganda – *James Mbaziira*
12) Is Tanzania Ready for Climate Smart Agriculture: A Systematic Review on Sustainable Agriculture Practices? – *DesderiaBetsonMapunda*
13) The feasibility of the biogas designs on the households in Mpigi District Uganda – *Grace Namirembe*
14) Trade-offs associated in the practice of Climate-Smart Agriculture (CSA) techniques for sustainable agricultural development in Nigeria – *ArchibongNtiense Akpan*
15) Can Climate Change Perception and Access to Information Constrain or Enhance Adaptation? Comparative Analysis across Agro-Climatic Zones of Tanzania – *Barnabas MsoliniMsongaleli*

Session 9c: Climate Smart Agriculture and Sustainable Resilience

FRIDAY 9TH DECEMBER 2022 – 2:00 – 4:30PM

VENUE: Main Hall B

1) Impact of climate change on food security in Uganda: a panel regression analysis – *Brian Ogenrwoth*
2) Climate patterns and extremes in Uganda's Arabica and Robusta Coffee Regions – *Catherine Mulinde*
3) Determinants of variation in climate adaptation levels among small holder farmers in the Kyoyoga plains of Uganda – *Chpmbo Oketcho*
4) Gendered perceptions and determinants of climate variability in Uganda's cattle corridor – *Faridah Sendagire Nalwanga*
5) On the Agency of Men and Women in Dry lands: Efficacy of Gendered Adaptation Strategies to Current and Future Drought Conditions – *Faridah Sendagire Nalwanga*
6) Rainfall Variability and Yam Production in the Ejura Sekyeredumase Municipal, Ghana – *Francis Kwame Bukari*
7) Climate variability adaptation and food security in Lamwo district, northern Uganda – *Muhamud Nabalegwa Wambede*
8) Determinants of livestock farmers' adaptations practices to climate variability in Ntoroko district, western Uganda – *Muhamud Nabalegwa Wambede*
9) Adoption of Multiple Climate-Smart Agriculture Practices: A Case of Smallholder Peanut Farmers in Tambacounda and Kolda, Senegal – *Beckie Nantongo*
10) Evaluation of Musa accessions indigenous to Benin Republic for resistance to black sigatoka disease – *Peter Nweze Nwabueze*
11) The influence of farmer perceived value on choice of climate-smart agricultural technologies in Lango sub region – *Tugume Howard*
12) Influence of Social Capital on Adaptation to Climate Variability and Vulnerability in Farming Households in Chamwino District, Tanzania – *Justin Kalisti Urassa*
13) Factors associated with justification of physical violence against women among communities living in wetlands: Implications for promoting alternative livelihoods in the context of climate change – *Peter Kisaakye*
14) Smallholders farmers adaptation strategies to climate change in Africa – *Jesugnon Esther Aldegonde Kpodo*
15) Effect of intensification of sorghum-based cropping practices on abundance and diversity of indicator organisms of soil health in eastern Uganda – *Giregon Olupot*

Session 10a: Nature-Based Systems in Mitigating Hydro-meteorological Hazards and Disasters

FRIDAY 9TH DECEMBER 2022 – 11:00AM – 1:00PM

VENUE: Board Room 3

1) Livelihood vulnerability to climate change and variability in Borana pastoralist southern Ethiopia – *Shetie Gatew*
2) Eri biryaamalhambo ['Cleansing of Ridges']: The Importance of Indigenous Farming Systems for Sustainable Livelihoods and climate resilience in the Rwenzori, Uganda – *Bosco Bwambale*
3) Risk assessments of longest dry spells phenomenon in Northern Tunisia – *Majid Mathlouthi*
4) Understanding natural hazards in a changing landscape: A citizen science approach in Kigezi highlands, southwestern Uganda – *Violet Kanyiginya*
5) Possible improvements for landslide susceptibility mapping using hybrid bivariate statistical model in Tsume micro-catchment, Manafwa Watershed. An integration of Frequency ratio, Shannon Entropy and Weighted overlay methods – *Shafiq Nedala*
6) An assessment of landslide disaster preparedness of schools in Bududa and Manafwa districts, eastern Uganda – *Flavia Joy Akello*
7) Risk assessments of longest dry spells phenomenon in Northern Tunisia – *Majid Mathlouthi*
8) Geotechnical and GIS-based Environmental Baseline and Vulnerability Studies of Okemesi Landslide, South-Western Nigeria – *Johnson Adedeji Olusola*
9) Shallow landslide risk mitigation through Nature-based solutions in the Elgon region – *Lilian Kempango*
10) Dam break inundation prediction and its impact on the communities of Isingiro District, Western Uganda – *Calvin John Esagu*
11) Forest Above-Ground Biomass estimation along an elevation gradient in Mt. Rwenzori, Southwestern Uganda – *Sarah Namayengo*
12) An evaluation and review of the utility of nature-based solutions for disaster risk reduction and resilience building in Africa - *Yazidhi Bamutaze*

Session 10b: Nature-Based Systems in Mitigating Hydro-meteorological Hazards and Disasters

FRIDAY 9TH DECEMBER 2022 – 2:00 – 4:30PM

VENUE: Board Room 3

1) The Relationships Between Climate Change and Vector Borne Diseases in East Africa: A Systematic Literature Review – *Yessey Ndyamuhaki*
2) Adoption of Climate Information Services and Its Impacts on Household Food Security among Smallholders of Semiarid Areas of Kiteto and Kondoa Tanzania – *Salma Khatibu*
3) Modelling Stationary and non-Stationary Hydrological Extremes under a Changing Climate in Lake Kyoga Catchments, Uganda – *Maximo Basheija Twinomuhangi*
4) What controls physical vulnerability to geohydrological hazards? A quantitative approach for landslides and floods in the Rwenzori and Ankole sub regions, western Uganda – *John Sekajugo*
5) Spatial and Temporal Patterns of Flood Hazards and their Impacts on Household Food Security in Eastern Uganda – *Stephenson Tukahirwa*
6) Nature-based Solutions for Climate Change Mitigation in Grasslands of Horn of Africa – *Sintayehu Dejene*
7) Nature-based solutions for drought risk mitigation in the Eerer Sub-basin, Eastern Ethiopia – *Sintayehu Dejene*
8) Assessing Community Resilience to Floods in Kampala City – *Allan Kivumbi*
9) Lightning Occurrence and Casualties in Uganda 2007-2020 – *Mary Ann Cooper*
10) How African Centres for Lightning and Electromagnetics Network Addresses Lightning Risk in Uganda – *Barnabas Akantambira*
11) Seasonal dynamics of climate change on medium timescale and potential effect on patterns of hydro-meteorological hazards in the Kyoga Water Management Zone – *Jesse Kisembe*

Session 11a: Biogeography, biodiversity, and ecosystem conservation at

FRIDAY 9TH DECEMBER 2022 – 11:00AM – 1:00PM

VENUE: Board Room 2

1) Impact of Climate Change and Variability on Forest Vegetation Zones in Malawi – *Edward Missanjo*
2) Assessing the role of indigenous and local knowledge (ILK) in the sustainable management of medicinal plants in the rural commune of Bamafélé, western Mali – *Fily Diébkilé*
3) Comparative study of the impact of climate change on the biodiversity of the soil macro-fauna in semi-arid areas: Specific richness, ecology and impact of agriculture on the soil – *Adama Traore*
4) Forest composition and structure of West Bugwe Central Forest Reserve – *Fatuma Mutesi*
5) Land use and land cover dynamics and traditional agroforestry practices in Wonchi District, Ethiopia – *Misganaw Meragiaw*
6) The Role Indigenous Tree Plants In Ecosystem and Biodiversity Conservation: A case In Gedeo Agro Forestry Ecosystem, in South Ethiopia – *Tadeyos Mesfin*
7) Effects of polyaromatic hydrocarbons (PAHs) on the selected enzyme systems in Land snail (Achatina fulica) – *Perfect Donga*
8) The changing natural landscape in Zambia: implications and challenges to ecosystem services in urban areas – *Mitulo Silengo*
9) Mapping water hyacinth infestation in the Murchison Bay, Lake Victoria basin -Uganda – *Kiyemba Hussein*
10) Plant Conservation in Mediterranean region: Case study Important Plant Areas (IPAs) in Morocco - *Mohammed Sghir Taleb*
11) Urban Ecosystem Services and most determinant variables of stakeholder's perception in Cotonou city – *Atchade Assouhan Jonas*
12) Land use and land cover dynamics in Mt. Elgon region and its implications for ecosystem sustainability – *Daniel Waiswa*

Session 11b: Biogeography, biodiversity, and ecosystem conservation

FRIDAY 9TH DECEMBER 2022 – 2:00 – 4:30PM

VENUE: Board Room 2

1) Biodiversity conservation through Sustainable management of agriculture production systems: A case of home garden plant diversity – *Hellen Naigaga*
2) Spatial-Temporal Dynamics of the Kampala Capital City Urban Forest – *Padde Daniel*
3) Pest status of key mango pests in Amach sub-county, Lira district Uganda – *PhionaNannozi*
4) The assessment of the geological and geomorphological elements from Glameia Scarp, Romania-implications in geoprotection – *Radu Negru*
5) Biodiversity offsetting in Uganda's protected areas: A pathway to attaining biodiversity and livelihood benefits? – *RitahKigonya*
6) Creating and transforming political forests: Changing materiality, access and use of Gangu Forest Reserve in Central Uganda - *RitahKigonya*
7) Evidence of microplastic contamination of Nile Tilapia (Oreochromis niloticus) and Nile Perch (Lates niloticus) from the Inner Murchison Bay of Lake Victoria in Uganda – *Sandra Mutesi*
8) Heading Towards a 21st Century Urbanized Africa – *Tayo Anthony Adeyinka*
9) Market System Analysis of Bamboo Products in Tanzania – *Jumanne Moshi Abdallah*
10) Evaluation of tropical white maize (Zea mays L.) genotypes for tolerance to fall armyworm (Spodoptera frugiperda J.E. Smith) infestation – *Nesma Alaa ElDin Zakaria Moussa*
11) Households Vulnerability to flood Hazards in Kalehe Territory, Eastern, DR Congo – *Murhula Ruhambya Benjamin*
12) Development of Enviro ewatch Mobile App for increased community surveillance in monitoring catchment degradation and restoration along River Rwizi – *Patrick Musinguzi*

Abstracts

SESSION 3: Water Resources and Water Systems in the Anthropocene

ASSESSING EROSION RISK AND HEAVY METAL LOADING IN SEDIMENT FROM THE INNER MURCHISON BAY (IMB) CATCHMENT

Gyaviira Ssewankambo[1], Isa Kabenge[1], Prossie Nakawuka[1], Joshua Wanyama[1], Yazidhi Bamutaze[1], Ahamada Zziwa[1], David Gwapedza[2], Tally Palmer[2],Jane Tanner[2], Sukhmani Mantel[2], Bezaye Tessema[3]

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Lake Victoria's Inner Murchison Bay (IMB) is suffering from deteriorating water quality, with pollutants including heavy metals posing grave ecological and human health concerns. The information gaps on sediment loading from the IMB catchment and its heavy metal content hindered the understanding of the sources, transportation and potential ecological threats. Therefore, this research aimed to assess the impact of erosion from the IMB catchment on sediment and heavy metal loads into the IMB. Revised Universal Soil Loss Equation (RUSLE) and field walks were used to map erosion sources in the catchment, while sediment yields from Nakivubo and Ggaba sub-catchments for ten individual storm events between March and May 2022 were modelled using the Modified Universal Soil Loss Equation (MUSLE). MUSLE was calibrated in Nakivubo sub-catchment and independently validated in Ggaba with R2 of 0.9, NSE of 0.57 and a PBIAS of -15.5. Eighteen suspended sediment samples from Nakivubo and Ggaba channels were analyzed for contamination by eight heavy metals using Environmental Protection Agency (EPA) standards. RUSLE identified croplands and hilly zones (LS-factor >20) as major erosion hotspots (>5 t·ha− 1·yr− 1), while the field walks revealed bare surfaces, murram roads and unlined drainage channels as other major erosion sources. Cadmium, lead, and zinc were the most prevalent heavy metals and Pollution Load Indices (PLI) revealed Nakivubo (PLI = 1.16) was more polluted than Ggaba (PLI = 0.43). Thus, soil and water conservation and mitigation efforts should address the identified potential sources to ameliorate sediment and heavy metal pollution into Lake Victoria.

Keywords: Land Use Land Cover; Inner Murchison Bay Catchment; Geographical Information System; RUSLE

EFFECT OF LAND-USE/COVER CHANGES ON GROUNDWATER LEVEL DYNAMICS IN SEMI-ARID REGION OF INDIA

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A large-scale land transformation after the green revolution and increased human pressure has altered the hydrological cycle and water balance in the semi-arid region of southern Haryana. In this context, this paper analyzes the impact of land-use/cover changes and intensive agricultural practices on the groundwater status in the area from 1980 to 2015. Supervised classification (maximum likelihood technique) has been used to perform change detection, whilst the Groundwater Development Index and change detection method had been used for the computation of groundwater storage change. The result indicates that the area under crops has decreased from 602611 km2 to 591589 km2 an unprecedented growth of 97.80% has been witnessed in the built-up area in all these years. The water table has fallen from 9.27mbgl in 1980 to 25.58mbgl in 2015, at the rate of 0.4m per year as the wafter-efficient crops such as wheat, sugarcane, and paddy have been replaced by less water-consuming crops such as mustered, jowar, bajara, maize, and gram. Groundwater development has exceeded 100% of the natural replenishment level in Gurgaon and Palwal districts and lies in the 'Over-exploited' category. Hence, it is needed to monitor the land-use/cover changes and groundwater withdrawals and increase the body of quantitative evidence to check the pressure of the growing human population and climate change on water resources in the region. This type of study is of interest to planners and policymakers for sustainable water resources management, as there is limited quantitative evidence on how land-use/cover changes in the semi-arid areas affect the groundwater dynamics despite that many people rely heavily on groundwater for their livelihoods.

Keywords: Land-use/cover change; Built-up area; Groundwater development index; Cropping pattern; Semi-arid region; India

EFFECT OF CLIMATE CHANGE ON COTTON PRODUCTION IN UGANDA

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Cotton is the most important fiber crop in Uganda and the world. The effect of climate change is being felt in Uganda in various forms including very high temperature, erratic nature of rains, floods, and droughts. The main aim of this study was to assess the potential effect of climate change on cotton production under the changing climate in Uganda. Cotton contributes highly to Uganda's GDP and its cultivation and utilization as a cash crop has recently gained interest from the government to revamp the crop to its original state of being the major cash crop. The FAO EcoCrop model in DIVA- GIS was used to predict climate suitable areas for cotton for the current and future climate scenarios. The EcoCrop is a model that uses climate datasets and expert-derived temperature and rainfall ranges as inputs to determine the main niche of a given crop and then produces a suitability score as output. For the current climate, data from WorldClim for temperature and precipitation was downloaded representative of the years 1950 to 2000and was used. Cotton suitable areas for future climate scenarios were also predicted where the future climate datasets projected by the Community Climate System Model (CCSM) 4 for the year 2050 under a Representative Concentration Pathway (RCP) 2.6 emission scenario were used. The model computes suitability index for precipitation and temperature differently and they are then integrated to obtain the final suitability rating. Assessing the potential effect of climate change on cotton production cotton in Uganda using the EcoCrop model was the main objective of this research work. The cotton suitability indexes were analyzed and very marginal, marginal, suitable, very suitable, and excellent sites were obtained in Uganda.

Keywords: Cotton; Crop suitability; DIVA GIS; Ecocrop; Representative concentration path way; Climate change

EVIDENCE OF PRESENCE OF MICROPLASTICS IN THE SEDIMENTS OF LAKE VICTORIA, UGANDA

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There is increasing global concern towards pollution of the environment by microplastics. This is because these very small particles, derived primarily from the fragmentation of discarded plastics or as plastics of small-size dimensions manufactured for specific purposes, have been found to affect organisms and humans alike. Unfortunately, studies of microplastics dominate the marine environment, and fewer for freshwater ecosystems. In particular, little is known about the presence of microplastics in Africa's freshwater systems, constraining attempts to further the understanding of any risk they pose to these systems and the health of dependent communities. This study was undertaken to establish presence of microplastics in the sediment of Africa's largest waterbody, Lake Victoria, and results are reported for dry weight samples. The sediment of Murchison Bay is rich in microplastics, with an average of 126.7 kg-1 for size range 0.15 – 0.29 mm and 301 kg-1 for size range 0.30 – 5.0 mm. For both size fractions, abundance generally increased away from the shoreline, and fibers dominate everywhere, while all shades of major colors are well represented. As would be expected, sediments recovered from the Bay bordering rural areas had the lowest concentration of microplastics (e.g. 26.7 kg-1 and 93 kg-1 for size ranges 0.15 – 0.29 mm and 0.30 – 5.0 mm, respectively), whereas sediments from the exit of the bay area, in the south, registered the highest concentration, especially for size range 0.30 – 5.0 mm (907 kg-1). This has to do with siting and sediment transfer dynamics – pollution loading is lowest were the bay is draining a rural landscape and generally, slow underwater currents favor movement of finer materials, organics and everything attached to them, offshore. These observations are important in guiding a survey of these habitats to profile the risk of ingestion of microplastics by all benthic feeders and those that prey on them.

Keywords: Environment; Freshwater; Microplastics

CHARACTERIZATION OF THE WATER RESOURCES OF THE RIVERS OF THE CITY OF BANDUNDU

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The City of Bandundu with its 1,100,000 inhabitants, located at the confluence of the Kwango, Kwilu and Kasai rivers, has significant surface water reserves and groundwater in quantity and quality, including the management, protection and in value are dependent on new challenges imposed by sustainable development and climate change. This study aims to provide decision-makers, researchers and donors with scientific information on the characteristics of the waters of the Kasai, Kwango and to date, there is a lack of a database and in addition a lack of human resources to deal with the difficulties of managing water resources in the Democratic Republic of Congo. Thus, the characterization of the water resources of the Kasaï , Kwango and Kwilu rivers is done using the isotopic tool and conventional hydrogeological techniques. The physico-chemical parameters (pH, electrical conductivity, oxygen, temperature, major ions are measured): Kasai River: pH= 10.025, cond.= 28.3µs/cm, T°= 29°C, O2= 4.53 (60.5%); NO3= 4.5mg/l; PO4= 0.36mg/l; NO2=0.021mg/l; SO4=1.6mg/l; AlK=7.5mg/l; CO2=16.5 x 2mg/l; Sechi=40cm. Kwango River: pH= 9.533 cond= 46µs/cm; T°= 28.5°C; O2= 4.82 (68.8%); NO3=8.1mg/l; NO2=0.071mg/l; PO4=0.64mg/l; SO4=7.1mg/l; AlK=12mg/l; CO2=15.5 x 2mg/l; Sechi= 36cm. kwiluRiver: pH= 9.245, cond= 9.2µs/cm; T°=28.3°C; O2=5.61-70.2%); NO3=0.6mg/l; NO2=0.032mg/l; PO4= 0.37mg/l; SO4=1.8mg/l; CO2= 12 x 2 mg/l; Sechi = 79 cm, AlK = 3mg/l. This research must continue for all the rivers of the Democratic Republic of Congo with the support of Partners and donors.

Keywords: Bandundu; Evaluation; Isotopic; Hydrogeological; Sustainable development

SPATIOTEMPORAL ANALYSIS OF THE HYDROLOGICAL RESPONSES TO LAND USE LAND COVER CHANGES IN THE MANAFWA CATCHMENT, UGANDA

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It is vital to quantify the impacts of land use land cover (LULC) changes on hydrology and to understand the mechanisms by which LULC changes affect the hydrological processes in a river basin for proper management of water resources and land use planning. This study evaluated the impact of LULC on the hydrologic characteristics of Manafwa watershed in Eastern Uganda using the Soil and Water Assessment Tool (SWAT) model. Model inputs used were the 1995, 2008 and 2017 LULC maps, digital elevation model, soil, climatological and hydrologic data. The model was calibrated and validated using stream ow data to understand the hydrological responses of each Hydrologic Response Units on reference simulation periods using the Calibration and Uncertainty Program (SWAT-CUP), Sequential Uncertainty Fitting (SUFI-2) algorithm. Model statistical measures obtained during calibration and validation ranged from 0.79 to 0.94 for R2, from 0.65 to 0.79 for ENS and between -12 and -30.2 for PBIAS, indicating good agreement between observed and simulated discharge values. Commercial farmland (405%) and built up areas (337%) increased, while wetland (82%) and tropical high forests (41%) decreased in area coverage. Reduction in forests and wetlands have led to increased annual surface runoff, sediment yield and water yield and decreased Potential evapotranspiration and Actual evapotranspiration. This study showed that predicted hydrologic responses will have negative impacts on water resources availability. Therefore, the implementation of integrated watershed management strategies such as soil and water conservation and afforestation could reverse the negative impacts and ensure effective water resources management.

Keywords: Hydrological response; LULC; Manafwa River; SWAT model; Uganda: Water resources

INVESTIGATING SATELLITE-DERIVED INDICES APPLICABLE FOR MONITORING THE ALGAL BLOOM IN KOKA RESERVOIR, ETHIOPIA

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Koka Reservoir in Ethiopia, which serves as important water resources for local inhabitants, has faced severe toxic cyanobacteria blooms, and continuous monitoring of the reservoir water quality is necessary. A satellite remote sensing technique is promising since it could effectively complement laborious field monitoring activities in a remote area like a place where Koka Reservoir is located. The main objective of this study was to explore two satellite-derived indices, which involved cross-validation of the floating algal index (FAI) derived from Sentinel-2 MSI and Landsat-8 OLI imagery, as well as investigating a correlation between the FAI and normalized difference chlorophyll index (NDCI) using Sentinel-2 MSI. This study revealed that FAI values derived from MSI imagery were slightly higher than those derived from OLI imagery. Still, a strong positive linear correlation (R2 = 0.82) was observed, indicating that the FAI algorithm is rather sensor-insensitive. The FAI values lower than -0.05 consists of only the dataset from the middle of May to November, and the dataset from January to April exhibited higher NDCI values, such that there are apparently two patterns for the FAI-NDCI relationship in Koka Reservoir. In a dry season, the south part exhibited higher NDCI values, while the rest showed relatively low values, and the distribution was homogeneous. On the contrary, in a minor rainy season, the northern part exhibited higher values than the southern region, except for an isolated small part in the south. This study demonstrated potential application of satellite images to understand phytoplankton dynamics in Koka Reservoir.

Keywords: Cyanobacteria; Koka reservoir; Landsat 8; MIS imagery; Normalized difference chlorophyll index

ASSESSMENT OF CLIMATE CHANGE IMPACTS ON HYDROLOGICAL PROCESSES IN USANGU CATCHMENT, TANZANIA UNDER CMIP6 SCENARIOS

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Climate change is anticipated to have long-term effects on hydrological processes patterns leading to water stress in agro-ecological catchments. Usangu catchment is a highly water competitive catchment best known for provision of ecological services and production of about 30% of country's rice through irrigated agriculture. Climate change altogether with socio-economic activities taking place in the catchment affects water balance components making it more vulnerable to water stress. This is evidenced by reduced flows and drying up of rivers during dry seasons. Therefore, this study was undertaken to assess climate change impacts on hydrology of Usangu catchment by utilizing the calibrated SWAT model and an ensemble of five downscaled Global Circulation Models under two emission scenarios. In comparison to the baseline period, mean annual precipitation in the future will potentially increase by 10 %. Maximum and minimum temperatures are projected to increase in a range of 0.6℃– 2℃ in 2030-2060. Corresponding to temperature increase, results showed that evapo transpiration will increase by 30% and decrease water yield and groundwater recharge by 5% and 18% respectively. However, the effect of precipitation increase is shown by increased surface runoff and stream flow during wetter months. The findings of this study provide to watershed managers crucial information for planning and managing the catchment in light of changing climate.

Keywords: Climate change; Hydrological processes; SWAT model; Usangu Catchment

GENDER PERSPECTIVES ON RURAL HOUSEHOLD WATER GOVERNANCE UNDER CHANGING CLIMATE IN UGANDA

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There is growing attention to the importance of water governance for climate change adaption and its multiple social aspects. Climate is changing and the ecosystems that provide water are endangered making water scarcer and unpredictable. The rural people in developing countries, highly dependent on subsistence agriculture, are the most vulnerable, creating disproportionate hardships and a gender gap in water governance. This study examines the gender inequalities in the water governance systems for domestic and water for agriculture production in rural Uganda. We employ an integrated analytical framework using the sustainable livelihoods framework to contextualize the role of water for the rural people´s livelihoods, a natural resource governance system framework to analyze interaction of their design and delivery and use insights from the feminist political ecology scholarship to explore the gender power relations and how they shape the water governance system. The study was conducted in six districts, representing three regions of Uganda defined as vulnerable to the effects of climate change, using qualitative and quantitative methods of data collection and analysis through household survey and focus group discussions. The borehole is the predominant technology for domestic water supply serving 90% of the study population. The water collection role is still feminized with women spending more than one hour daily on it. Agriculture remains predominantly rainfed, with little adoption of water harvesting technology. There is a water governance system for domestic water, designed around each borehole with defined actors, roles, and rules, delivering relatively accessible and quality water at a reasonable cost. There however, noticeable gaps in gender equality in these rural water governance systems, especially the heavy labor and long distances in water collection. The water for production local governance systems is less developed and incoherent, making farmers vulnerable to changes in climate. Boreholes have provided accessibility to quality water. However, it has not solved women´s drudgery and time conservation. Gender equality in water governance is far from being attained. There is need to advance the technology and processes in governance for more sustainable and equitable solutions that don't depend on and exacerbate the positionality of women as water collectors.

Keywords: Water governance; Gender equality; Climate change; Uganda

APPLYING THE EARTH AND THORNTHWAITE MODELS FOR ESTIMATING GROUNDWATER RECHARGE IN THE KLELA BASIN, MALI

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Investigations of groundwater recharge estimation are vital to the inhabitants of the Klela Basin, Mali, because groundwater is the only permanent water resource and is used for drinking water and irrigation. Due to climate change, this vital resource is being threatened. Therefore, the EARTH (Extended model for Aquifer Recharge and soil moisture Transport through the unsaturated Hardrock) model was applied in this study to simulate groundwater dynamics. This study aimed to evaluate the impact of climate change on groundwater recharge in the Klela basin using the RCP4.5 climate scenario. Climatological and hydrogeological data were collected and used in this study. Mean annual groundwater recharge was estimated to be approximately 176 mm/yr, or 13.9% of mean annual rainfall, using the EARTH model. This recharge value was then used to calibrate the Thornthwaite model, of which, the results show a decrease in groundwater recharge over time, and that recharge is mainly linked to seasonal rainfall amount. The 2030s are expected to be a severe drought period in the basin.

Keywords: Groundwater recharge; EARTH model; Klela Basin; Southern Mali

WAVELET ANALYSIS OF SPATIO-TEMPORAL VARIABILITY IN SURFACE SOIL MOISTURE UNDER DIFFERENT LANDUSES IN SOUTHWESTERN NIGERIA

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Soil moisture is dynamic over space and time. The surface (0 - 15cm) soil moisture content and variability have been reported to differ with landuse/cover and peculiarities of soil changes. Information is however unclear about such the pattern under the different soil classes and land use/cover in the southwestern Nigeria. Consequently, this study investigates the differential characteristics of soil moisture in cassava, cocoa, palm trees, built-up and riparian catchments, using the nonlinear Wavelet Neural Network (WNN) model on the Paleontological statistics software (PAST). It also assesses the influence of soil physical characteristics on soil moisture variability on different landuses. Soil moisture is determined using SM150 Delta-T Soil moisture kit at 20 randomly selected points within 25m by 25m quadrat in each landuse/cover catchment. The coordinates (x,y) of locations from where the soil moisture are recorded will be obtained using a handheld global positioning system (extrex model; <3m accuracy). The soil moisture records were obtained from January, 2022 and continued till Sepetember, 2022 to cover both dry and wet periods. Preliminary results showed different level of wetness in different landuses under same weather conditions and that soil properties differ across the landcover/use types. The soil class is predominantly sandy and has low retentive moisture capacity especially in cassava, palm trees, built-up. The results also depicted that riparian landuse was the only saturated area all through the study period even in the dry season. The soil characteristics and vegetal cover proved to be determinants of moisture variability in the different study sites.

Keywords: Surface soil moisture; Spatio-temporal analysis; SM150 Delta-T Soil moisture kit; Wavelet Neural Network; Southwest Nigeria

OPPORTUNITIES FOR RESILIENCE FACING WATER SCARCITY: CASES STUDIES FROM MADAGASCAR'S MEDIUM-SIZED CITIES

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Madagascar, in terms of ecological footprint, is ranked 173rd out of 188 countries, in 2021. However, the Big Island has been facing, for the last five years, a major climatic disruption, the first manifestation of which is the decrease of the rainfall regime at the national scale. Indeed, the drought that was assimilated in the southwest of Madagascar for more than 40 years, has spread to the hinterland causing: problems in the supply of drinking water, the delay of the agricultural calendar, disruptions in household food supply, the fluctuation of food prices, waterborne diseases, and even conflicts in the places of water resource extraction, often located in the localities bordering the cities. Climate change is inescapable, and reasoning more in terms of resilience, adaptation of communities and mitigation of its effects . Faced with water scarcity, how does the population organize itself? What are the sustainable resource management practices that deserve to be highlighted? The city of Ambositra is undoubtedly a concrete example of the population's experience with water shortages. It is a town where urban and rural life is mixed, with a very obvious increase in population and uncontrolled urbanization. The study is part of an inductive approach, coupled with: an analysis of rainfall over the last 30 years and the availability of resources; the evaluation of the drinking water supply chain, the mapping of water cuts and surveys of water users.

Keywords: Resilience; Water scarcity; Climate change; Rainfall; Ambositra

FROM CO-OPERATION TO COERCION: THE EFFECT OF MILITARY INTERVENTION ON THE NILE PERCH FISHERY ON LAKE VICTORIA IN UGANDA

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2 UNESCO-GRO Fisheries Training Programme

African small-scale inland fisheries are in transition. Around 2017, the Ugandan government deliberately changed its fisheries management regime by abolishing co-management (Beach Management Units) to enforce state military control, claiming lax performance of the co-management regime to effectively enforce fishery rules and boost fisheries. We evaluated the structure and effect of military intervention in fisheries management on Lake Victoria after five years of operation using a sequential mixed-method approach. The study shows that military operations were guided by the pre-existing rules on fisheries gear and supported by the major stakeholders of the commercial Nile perch fishery and the government unlike the co-management regime experienced. Consequently, commercial fishing effort indicators such as motorised vessels increased by half from 11,495 to 17,075 between 2016 to 2021; legal-sized multifilament gillnets by almost 60%, and legal-sized hooks increased almost six-fold in the same period. Illegal effort indicators were reduced significantly, most importantly the paddled fishing vessels (51%) which represent the artisanal fishery. By 2021, 90% of Nile perch catches were obtained from motorised vessels specifically gillnet (50%) and longline vessel trips (40%) with a slight increase in catches and exports. After the first five years of operation, it is obvious that the military intervention has been able to change the composition of the fishing effort on LV, hence from smaller boats to larger vessels and towards greater application of legal fishing gear. It is, however, not having the aspired impact on boosting the overall catch or export, hence the key ambition of the fisheries policy. It is therefore still not possible, after five years of operation, to identify direct positive effects of the regime change on the fisheries efforts and a negative indication of a drive towards overcapacity of the larger vessels on the lake, with lower CPUE. Uganda has been seeking to update its fisheries legislation, paving the way for future fisheries management. This study shows that more research is needed over a longer period to gain an understanding of the current strategy and rule enforcement, as executed by the military operation, will deliver the desired sustainable fisheries management outcomes.

Keywords: Lake Victoria; Rule compliance; FPU; Nile perch; BMU; Law enforcement

ECONOMIC ANALYSIS OF WATER USE OF LOWER KIHANSI HYDROPOWER PLANT

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Although hydropower generation contributes significantly to electricity generation to meet sustainable development through provision of community welfare, other water use interests (e.g. maintenance of biodiversity) must also be taken into consideration. Some of important interests are the long-term sustainability and conservation of the sub-catchment's biodiversity resources. However, sound and reliable information to advise policy that aims at integrating environmental mitigation measures into hydropower activities was lacking. In particular, information about economic value of the social and environmental impacts (positive and negative) of hydropower on the overall economy (economy-wide gains or losses in welfare) is required. Likewise, information about the additional economic benefits that take into account environmental costs for hydropower of increasing the availability of water, which is the result of water use permits for environmental flow, was also lacking. This study undertook economic analysis of water use using Lower Kihansi Hydropower Plant in (LKHP) Tanzania. Research methods used were literature review, stakeholders and household interviews, trend analysis of rainfall and river flows, reservoir data, dam seepage and water quality to reveal the changes over time, land use and land cover change analysis, estimation of environmental costs and benefits, benefit cost analysis, and incremental value of additional water provided under the water use permit for environmental through modeling using Generalize Additive Model (GAM). Results indicated that the optimal by-pass was 1 m3/s but with a lot of environmental consequences. It is possible to generate electricity with a by-pass of 2.8 m3/s because will not send LKHP outside the limit of its economic mandate but will also contribute to the catchment conservation.

Keywords: Hydropower; By-pass; Environmental conservation; Economic analysis

ASSESSING CHICKEN BASED ORGANIC FERTIGATION FOR IMPROVED YIELD, ABOVE GROUND BIOMASS, CROP WATER PRODUCTIVITY AND CROP QUALITY OF TOMATOES, CABBAGE AND PUMPKIN

Diana Mukulu, Isa Kabenge, Wanyama Joshua, Ouma Godfrey

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Increasing population, effect of climate change and food demand have forced farmers to make use of unproductive farmlands. This has led to high dependency on and inappropriate application of inorganic fertilizer. Appropriate chicken based organic fertigation regimes are essential to achieve improved yield, above ground biomass (AGB), crop water productivity (CWP) and good quality crops. At MUARIK, a three-replicate Randomized Complete Block Design (RCBD) field experiment was set up. The drip irrigation system was designed, and evaluated for the effect of non-static water level on the discharge of the emitters. The emission uniformity (EU), uniformity coefficient (UC) and Emitter flow variation (EFV) were determined for every crop field. Three treatments and two controls were set up: 100% Battery-Cage Manure, 100% Deep-Litter Manure and 50% Battery-Cage Manure + 50% Deep-Litter Manure, Rainfed and Water only. The chicken Manure regimes were extracted into liquid concentrations and examined for nutrients. These were applied according to a fertigation schedule generated to meet the crops' nutrient requirements. For each crop and treatment, statistics on crop development and yield were gathered. Harvested crops are being subjected to Proximate analysis for quality parameters. R software will be used to analyze yield and quality data, and differences in means will be examined at a 5% significant level. By the sixth day of December 2022, the study's findings and conclusions will be ready.

Keywords: Fertigation; Yield; Quality; Tomato; Pumpkin; Cabbage

ASSESSING THE EFFECT OF DEFICIT DRIP IRRIGATION ON YIELD AND QUALITY OF EGGPLANT CROP

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Globally, agriculture consumes up to 70% - 80% of freshwater. The freshwater demand is expected to increase by 40% by 2030 as a result of climate change, coupled with the increasing population. The unreliable rainfall and prolonged drought have caused a significant reduction in crop yields. There is, therefore, a need to minimize agricultural water use without compromising crop yield and quality. This study investigated the effect of deficit drip irrigation on the yield and quality of eggplants. A Randomized Complete Block Design (RCBD) field experiment with three replicates, was set up at MUARIK. The treatment was irrigation, at deficit levels of 25%, 50%, 75%, and 100% of the crop irrigation water requirement (IWR); with the control being no irrigation at all. Watermark sensors were installed at soil depths of 20 cm, 40 cm, and 60 cm, to determine the Soil Matric Potential. HH2 Moisture Meter was also used to collect soil moisture values for computation of daily crop IWR. The hydraulic performance evaluation of the field was performed, and Emission Uniformity (EU) and Emitter Flow Variation (EFV) were determined. Crop growth and yield data were collected for each of the deficit irrigation levels, and Proximate analysis is being conducted for crop quality parameters. Analyses of crop yield and quality data will be done using R software, and differences in means will be tested at a 5% significant level. The results and conclusion from this study will be ready for presentation by 6th December 2022.

Keywords: Deficit irrigation; Eggplant; Drip irrigation; Yield; Quality

ESTIMATING RAINFALL INPUT UNCERTAINTY TO THE SWAT HYDROLOGICAL IN THE KYOGA BASIN - THE UPPER NILE

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The interest in the application of climate and hydrological models in the Nile basin has risen in the recent past; however, the first drawback for most efforts has been the estimation of historic precipitation patterns. In this study we have applied stochastic models to infill and extend observed precipitation data sets to generate inputs for hydrological. Several stochastic climate models within the Generalised Linear (GLM) framework have been applied to reproduce spatial and temporal patterns of precipitation in the Kyoga basin. A logistic regression model (describing rainfall occurrence) and a gamma distribution (describing rainfall amounts) are used to model the rainfall patterns. The parameters of the models are functions of spatial and temporal covariates, and are fitted to the observed rainfall data using log-likelihood methods. Using the fitted model, multi-site rainfall sequences over the Kyoga basin are generated stochastically as a function of the dominant seasonal, climatic and geographic controls. The rainfall sequences generated are then used to drive a semi distributed hydrological model using the Soil Water and Assessment Tool (SWAT). The sensitivity of runoff to uncertainty associated with missing precipitation records is thus tested. In the application to the Lake Kyoga catch- ment, the performance of the hydrological model highly depends on the spatial representation of the input precipitation patterns, model parameterisation and the performance of the GLM stochastic models used to generate the input rainfall. The results obtained so far disclose that stochastic models can be developed for several climatic regions within the Kyoga basin; and, given identification of a stochastic rainfall model; input uncertainty due to precipitation can be usefully quantified. The ways forward for rainfall and hydrological simulation in Uganda and the Upper Nile are discussed.

Keywords: Uncertainty analysis; Hydrological Modeling; Kyoga basin

MAXIMUM RUNOFF PREDICTION FOR SMALL UNGAUGED WATERSHEDS IN THE ROMANIAN ZONE OF THE MURES BASIN

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The correct calculation of maximum discharge for small ungagged river basins is of significant importance for the safety and reliability of civil engineering, catchment planning, flood estimation and flood protection measures. From the point of view of river basin surface areas and resulting maximum flows, there is a difficult delimitation of small basins. The limit varies according to the geographical position, from the small watersheds in the mountainous area, to the hilly or plain regions downstream. The rational method used in this research represents the most direct way of quantifying the maximum discharge, which takes into account all the parameters that play an important role in the runoff formation. The research results on the maximum runoff in small basins without measurements highlight the significant adaptability of the rational method to the geographical characteristics of the Romanian hydrographic basins and especially to those in the Mureş river basin. The determination of peak flows is more accurate and the length of the concentration time remarkably follows the variation of the parameters influencing the flow.

Keywords: Maximum runoff; Maximum discharge; Runoff coefficients; Rational method; Roughness coefficients; Slope

WATER YIELD SENSITIVITY TO LAND COVER TYPE IN THE FRAGILE LAKE KYOGA BASIN

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Land cover types have varying impacts on catchment water yield due to differences in evapotranspiration, infiltration and runoff rates. However, there are limited studies on the effect of land cover type on water yield for specific catchments within the Kyoga Water Management Zone (KWMZ). Yet this information and knowledge is important in sustainable catchment management in response to climatically induced water fluxes. The objective of this study is to evaluate water yield dynamics in the upper, mid and lower catchments of KWMZ. Land cover types for the 11 catchments of the KWMZ were extracted from the Africa Sentinel Land Cover Map (2016). We simulated hydrological dynamics for the 11 catchments with varying land cover types using the SWAT model in a GIS environment. Preliminary results show that water yield was more sensitive to shrubland and agriculture than to wetlands and other land cover types. Catchments dominated by shrub/grass had a water yield of less than 40%, whereas those dominated with agricultural cover had a yield of more than 50% of precipitation. Akweng sub catchment had the highest water yield at 62% followed by Mpologoma, Lumbuye, Victoria Nile, and Sezibwa with yields of 60%, 57%, 57%, and 54%, respectively. The lowest yield was in Okere (30%) and Okot (38%) catchments, which had a shrub/grassland cover of >50% of total land area. It is noted that KWMZ is undergoing land use and cover changes, which together with climate change are further likely to alter hydrological charcateristics of the basin.

Key Words: Water Yield, Catchment Sensitivity, Land Cover Types, Environmental Fragility

SESSION 4: The Future of Smart Cities and Urban Systems in SSA

THE SUB SAHARAN COUNTRIES FUTURE OF A SMART CITY

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The purpose of the presentation will focus on conceptualization and define a Smart City from the African perspectives of context, relevance, and value. This presentation is consequentially important because efforts by African countries to develop Smart Cities are being measured by criteria of the Western world. Thus, many African countries are continually challenged in attempts to adopt the concept owing to different interpretations and understandings. Without an empirical basis, the challenges are often associated with the developing nature of the countries and slow technology advancements in the continent. The interpretivist approach must be employed to establish factors that define the concept in the African continent. From the analysis, the African perspective of Smart City will be further defined within context, relevance, and value of the discussion in presentation. This can help governments and citizens in the continent to gain a better understanding and focus on their pursuit and attempts to adopt a Smart City. The factors can also be used to assess and measure the value of the concept from developing countries' perspective. The general understanding is that the 'Smart city' concept emerged as a result of cities globally seeking innovative and sustainable solutions to cope with issues arising from rapid urbanization. Subsequently, smart city initiatives are often pursued with the intention of improving urban infrastructure and service delivery that led to improved socioeconomic and environmental conditions as well as providing more opportunities for those that live in the city. The focus areas include safety and security, environment and transportation, health, education facilities, and tourism.

‘YELLOW’ TOILETS, PROFITEERS AND ALTRUISTS: ANALYZING THE MANY FACES OF POWER BEHIND KAMPALA’S INFORMAL SANITATION INFRASTRUCTURES

Peter Kasaija

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Drawing mainly from qualitative data generated through experiential knowledge, in-depth informal interviews, FAPO and critical observation in three of Kampala’s informal settlements, this study employs the SUPE theoretical framework to interrogate how power manifests at various nodes along the sanitation infrastructure gradient from fecal containment, extraction, transportation and finally, to treatment and disposal. Critical analysis of the findings suggests that the repetitive convergence of human actors and sanitation infrastructure artefacts to mediate fecal waste flows is a highly diffuse, power-laden process involving multiple state and non-state actors. Within this process, the positioning of the different actors, the motivations/interests, sources of legitimacy and the resources they wield (financial, non-financial or otherwise) are critical in dictating the resulting power configurations that shape access to sanitation services especially for the urban poor. All the actors involved are active performers in a never-ending choreography of power interactions with each other to meet their individual/collective objectives. These insights reveal that power relations constitute a significant part of an expansive socio-environmental complex that is more than just a mere amalgamation of technological artefacts. This study asserts that in place of the reductionist, technocratic and managerial approaches that have been deployed in the past, more holistic strategies that fully account for power and how it operates along the sanitation value chain are needed to ensure more just African urban futures with equitable access to sanitation services.

Keywords: Power; Legitimacy; Interests; Sanitation infrastructure; Informal settlements; Kampala

URBAN TECHNICAL NETWORKS FACING FLOODS IN BRAZZAVILLE (CONGO): MODELING OF FUNCTIONAL INTERDEPENDENCE

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Climate change affects different elements of cities, such as economic development and infrastructure. The effects depend on the geographic location, characteristics and adaptive capacity of cities. Cities depend on different types of infrastructure such as electricity, water, waste removal and transportation. Heavy rains, floods, droughts and landslides can damage roads, bridges and other infrastructure. Urban utilities are critical infrastructure that can be vulnerable to the adverse effects of climate change. Their proper functioning is therefore a major challenge for risk management and resilient territories. The multiple networks that serve the city are particularly exposed to flooding due to their structure and location constraints. During a flood, they can be partially destroyed or temporarily degraded. The impacts resulting from the dysfunction of these networks make the city very vulnerable. Thus, a flood causing the flooding of an electrical transformer disrupts the electrical network generating many power cuts. These blackouts create disruptions on some parts of the drinking water network, even damaging the pumps. Numerous dependencies are both technical and organizational, but the first portrait at the global level does not allow to differentiate the criticality of these dependencies, which must be remedied. On the other hand, the functional dependencies allow us to identify the most critical ones. This paper aims at showing on the one hand the interdependence between urban technical networks, and on the other hand to model this interdependence.

Keywords: Technical network; Flooding; Vulnerability; Modeling; interdependence

ARE UGANDA'S CITIES AGE-FRIENDLY? ANALYSING URBAN GREEN SPACE PREVALENCE AND ACCESSIBILITY

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Access to urban green space in cities is one of the desirable ingredients of quality life as articulated in the UN Sustainable Development Goal (SDG)11. Uganda is experiencing gradual increase in the number and size of urban settlements but this is happening alongside a range of urban challenges. Although there are efforts to improve urban conditions, there is limited understanding of progress towards achieving the SDG 11.7 target that focuses on having urban green space for all. Knowledge is limited on inclusivity of population sub-groups such as older persons' access to urban green spaces .The paper uses secondary survey data collected by the Uganda National Population Council and Chrisbert Consult in March 2022. A sample of 936 urban residents was drawn from six cities: Kampala, Jinja, Mbale, Masaka, Fort Portal and Arua. The outcome variable is 'accessibility to urban green space; measured by asking heads of households whether urban green space is freely accessible to the public. The variable is recoded "1" if urban green space is freely accessible and "0" if otherwise. Descriptive statistics are computed and a probit regression model is fitted to determine the predictors of perceptions on accessibility to urban green space. Overall, urban green space prevalence and accessibility is low. Urban location, urban residence duration and socioeconomic status are significant predictors of perceptions on urban green space accessibility. Conserving existing and planning new green spaces is recommended.

Keywords: Urban settlement, Green space, Public space, SDGs, Accessibility, Age-friendly city, Uganda

EXAMINING THE INFLUENCE OF THE URBAN HEAT ISLAND ON URBAN THERMAL COMFORT IN THE GREATER KAMPALA METROPOLITAN AREA (GKMA), UGANDA

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Greater Kampala Metropolitan Area (GKMA) being the central hub of Uganda has continuously led to land transformations and changes in the city's climate in form of increasing temperature differences known as the Urban Heat Island (UHI). In spite of a myriad of research done on the urban heat island in Kampala city, there are still inadequate studies on the city and its metro area, the contribution of land transformations on the temperatures, and the impact of the urban heat on thermal comfort within GKMA. Therefore, this study objectively sought to; 1) analyze the influence of the built-up density on the spatial-temporal patterns of the urban heat island and 2) determine the influence of the urban heat island on the urban thermal comfort in GKMA. The study used Lands at imagery, ERA5 Re Analysis data, and GIS with the Rayman model for analysis from 2002 to 2020. Results indicated a greater transformation of undeveloped land cover into built-up and a constant increase of the built-up index; 2012 exhibited the highest built-up index in addition to identifying various urban heat spot areas across the GKMA sub-counties. In spite of fluctuations in Land Surface Temperatures (LSTs) across the study period (from 43.740C in 2012 to 32.030C by 2020), there was a clear existence of a positive correlation between the NDBI and LST, indicating that an increase in built-up is followed with an increase in LST. Furthermore, both PET and UCTI indices indicated similar fluctuation patterns with an increase in moderate heat stress hours in 2012 (10 hours) to later decreasing in 2020 (4 hours) and exhibiting strong correlations with air and surface temperatures throughout the entire period. THI index also exhibited an increase in heat stress health impacts from 2002 to 2012, the threat later slightly dropping in 2020.

Keywords: Land Use Land Cover; Land Surface Temperature; Urban Thermal Comfort

INFRASTRUCTURES OF SURVIVAL: SEEING KAMPALA'S HETEROGENEOUS SANITATION INFRASTRUCTURES BEYOND THE LOGICS OF 'MODERNITY'

Peter Kasaija

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This paper employs a Heterogeneous Sanitation Infrastructures (HSI) lens to critically analyze Kampala's 'informal' sanitation infrastructures through the everyday modalities around access, use, maintenance and their spatiality within the city's broader sanitation geographies. Mobilizing both qualitative and quantitative data including a 151-household survey, in-depth interviews, FAPO, experiential knowledge, critical observation, grey and published literature, the study examines the city's informal sanitation infrastructure gradient from fecal waste containment to treatment and disposal. Empirics suggest that these infrastructures are tethered by multiple working arrangements for different socio-technological options to mediate the metabolism of fecal waste across the urban milieu. Assimilating and transcending colonial legacies and neoliberal 'modernist' logics, these infrastructures are intricate sites of intense social networking, socio-technological and environmental interactions characterized by multi-functionality, negotiation, value and risk trade-offs. I argue that Kampala's 'informal' sanitation infrastructures are intransient and pragmatic 'infrastructures of survival,' in contrast to perceptions of them as 'out of place,' 'illegal,' or 'provisional' in the 'modern' city by city planners and managers. These infrastructures are vital entry-points for understanding the complex ways in which the ecosystems of cities like Kampala are (re)made, (re)ordered and most importantly, experienced, beyond the normative and deconstructive approaches that have mostly fixated on what they 'ought to be' and not 'what they are.' Engaging with these infrastructures from this perspective, alternative pathways can be opened up to compel city planners and managers to recalibrate their approach to effectively address pervasive sanitation poverty for more just and sustainable urban futures especially in Africa.

Keywords: Sanitation infrastructures; Informal settlements; Sanitation poverty; Global South; Kampala; Uganda

ENERGY ACCESS AND LIVELIHOOD IMPROVEMENT: EVIDENCE FROM THE HYBRID-SOLAR ENERGY SYSTEM ON BUGALA ISLAND, KALANGALA DISTRICT

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Access to clean, reliable and renewable energy constitutes a crucial link between social, economic and environmental dimensions of sustainable development. Besides, it is also important for sustaining basic human needs, productive uses and modern society needs. Given the low access to clean energy, on Bugala Island, the on-grid solar energy has become a popular transitional approach to solve energy poverty issues as well as livelihood challenges. However, little is known about the effects of this hybrid solar energy plant on people's livelihoods. Based on the random sample of 357, data were collected from various households and business enterprises on Bugala island using questionnaires to bridge this gap. At household level, the nominal logistic regression results, indicate that significant livelihood improvements with P-values <.005 have been observed in the education sector in regards to time spent studying, teacher's presence in schools, access to learning materials. On the health and wellbeing, improvement has been observed in regard to safety inside homes, reduced workload for women, reduced respiratory diseases. It has also led to improvement in access to information relevant to climate, agricultural issues, income generating activities among others. At business enterprises, various income generating activities have been formed while working hours and sales have increased. Besides more jobs and network have also been created. If solar energy connectivity is intensified, three important problems will be addressed in a sustainable manner; 1) low electrification rates, 2) enhancing sustainable development goals and 3) reduced greenhouse gas emissions.

Keywords: Energy access; Hybrid solar energy; Livelihoods

LOCAL COMMUNITY RESILIENCE TO THE PROPOSED OIL PIPELINE IN THE ALBERTINE REGION, WESTERN UGANDA

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Natural gas and oil pipeline development projects can potentially result into safety and environmental violations to project affected persons (PAPs). The construction of the East African Crude Oil Pipeline (EACOP) is underway after partnering states (Tanzania and Uganda) signed agreements for its commencement. This led to large scale displacements and resettlement of the PAPs. The PAPs were rendered vulnerable and thus the need to be resilient to this project. This study examined the communities' interpretation of resilience, barriers faced and the strategies in building their resilience to the proposed construction and operation of the EACOP in Kiziranfumbi (where majority PAPs not compensated) and Kabaale (where majority PAPs were fully compensated) districts. Descriptive and interpretive research designs were employed to gather data through FGD, KII and PAPs' interviews from 65 PAPs in Kabaale and 100 in Kiziranfumbi. Findings indicated that the Kiziranfumbi community had a more positive attitude compared to Kabaale towards the resilience of their community in preparation to likely EACOP disturbances. Illiteracy, unemployment and delayed compensations were the major barriers to the building community resilience cited in Kiziranfumbi. On the contrary, residents of Kabaale cited low-income levels and unemployment. Approximately 63% of the respondents in Kabaale depend on the support from family and friends compared to majority respondents in Kiziranfumbi (87%) who depend on the access to the health centers in the preparation for the disturbances that may arise due to the construction and operation of the EACOP. Community resilience can be fostered through ensuring timely compensation, improving access to health care services and improving literacy rates among the PAPs in both Kabaale and Kiziranfumbi sub counties.

Keywords: Community Resilience; EACOP; Perceptions; Barriers; Strategies; PAPS; Kabaale; Kiziranfumbi; Albertine Region

ANALYSIS OF THE VULNERABILITY OF SMALLHOLDER HORTICULTURAL FARMERS TO AGRICULTURAL RISKS IN MBALE CITY REGION

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As Sub–Saharan Africa continues to urbanize, the contributory role of smallholder farmers towards food and nutrition security has been underscored by scholars. However, smallholder farmers face a mix of interrelated risk which threaten their livelihoods. The study aimed at contributing to our understanding of the vulnerability of smallholder horticultural farmers to agricultural risks as a cornerstone for building urban food system resilience in Mbale City Region. Specifically, we sought to 1) determine Mbale city Region's foodshed in terms of production location, travel routes, markets and consumption points; 2) assess the agricultural risks experienced by smallholder horticultural farmers; 3) evaluate the effectiveness of agricultural risk reduction strategies adopted by smallholder horticultural farmers. Seventy-seven smallholder farming households were purposively selected for the study. Data on food flows was generated and visualized through a map depicting food travel routes, consumption and market points. Data on agricultural risks were collected through key informant interviews and household questionnaires loaded onto Open Data Kit toolbox (ODK) software. Data were analyzed using descriptive statistics notably, independent t- tests and ANOVA. Results reveal floods and dry spells (88.3%) especially in the tomato gardens (72.7%) as the most significant agricultural risks; price fluctuations (76.8%) and stealing of crops (66.2%) were the other key risks that smallholder farmers encountered. Education level, gender and income were positively correlated with the effectiveness of risk reduction strategies (p-value < 0.005). The study recommends better coordination of Government and other interventions for enhanced agricultural productivity and sustainable livelihoods for smallholder farmers.

Keywords: Smallholders; Agricultural Risks; Food shed; Vulnerability; Mbale City Region

SPATIAL DIFFERENTIATION OF THE LAND AND NUTRIENT FOOTPRINTS FOR KAMPALA CITY: IMPLICATIONS FOR URBAN FOOD SUSTAINABILITY

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The current wave of urbanisation in developing countries, has brought with it an increase in urban food demand and the shrinkage in urban agricultural land. This has made cities effectively dependant on external food sources. To illustrate the impact of urban food dependence on external sources, the urban foodprint is used. But in Uganda, a country with fast urban growth, data on the scale of the rural-urban food flows and the embedded foodprint is scanty. As such, this study quantified the rural-urban flows for cooking banana (matooke) and the imbedded land and nutrient footprints for Kampala city. Food freight surveys, conducted in ten purposively sampled Kampala city markets, revealed that 88.5% of the city's matooke inflows are sourced from western Uganda. The mean daily matooke inflow to Kampala city was 323.06 metric tons, translating into 117,916.9 metric tons annually, with a computed land footprint of 15,268 hectares. The ANOVA results revealed significant differences ($P<0.05$) in the matooke land footprint among the source regions and between the peak and lean banana supply seasons. The hot spots for NPK nutrient mining associated with the matooke flows are in the Ankole region, with mean daily losses of mean±se 362.29±29.13Kg (K), 104.66±8.42Kg (N), and 4.03±0.32Kg(P). These nutrients lost from rural farms end up in pools in city from which recycling back to the farms is impossible. Thus, to ensure sustainable matooke production for urban food security, there is need to engineer waste diversion strategies that enable nutrient recycling back to rural farm lands.

Keywords: Urban Foodprints; Urban Food Flows; Urban Foodshed

AN ASSESSMENT OF CLIMATE EXTREMES IN MBALE MUNICIPALITY IN EASTERN UGANDA

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This study investigated historic and future characteristics of precipitation periods in Mbale municipality. Observed historic (1982-2014) and modelled future (2021-2050) precipitation data was analyzed using Standardized Precipitation Index (SPI). Modelled data depicts a likelihood of more frequent extremely wet and dry periods in the near future as compared to the historic period. In particular, there is a likelihood of more frequent extremely wet periods in 2020's and 2030's and more frequent extremely dry periods during 2030's and 2040's as opposed to findings from regional z-indices. Both historic and future precipitation extremes are pronounced between August and January. These findings imply that livelihoods in Mbale are likely to be threatened by precipitation extremes. Thus, researchers, practitioners, and policy makers need to assess influential factors that can enhance resilience. In conclusion, localized rather than regional indices are more able to distill local conditions, at the same time provide more accurate predictions of future extremes.

Keywords: Climate; Extreme precipitation; Uganda; Mbale; SPI; Index.

URBAN HEAT HAZARD EXPOSURE AND FUTURE LIKELIHOOD IN KAMPALA CITY, UGANDA

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Global changes in climate and environment, rising greenhouse gasses (GHGs) emissions and rapid urbanization are increasing the frequency, intensity, and severity of extreme heat. Surface temperatures are rising across Africa, making several regions vulnerable to heatwaves. However, evidence on extreme heat hazard in urban Africa is still very limited, with the situation being worse in Sub Saharan African (SSA) cities that are experiencing unprecedented urbanization growth rates, environmental degradation as well as industrial growth and development. This study deployed surveys (n=382), key informant interviews (n=12), focus group discussions (n=8) and literature review to investigate experiences and future possibility of dangerous heat in Kampala. The findings revealed that temperatures in Kampala have increased by 1.5 degrees Celsius within 50 years and urban heat island effects are becoming more significant. Temperature trends and patterns indicate a rise in the past three decades, with frequent warmer conditions observed recently. Over 90% of the respondents experienced unusually hot weather, with about 85% exposed to very hot or hot temperatures. Hottest years observed included; 2009, 2016,2020, 2021 and 2022 with July, June, January and May being the warmest months. Extreme heat is largely perceived as severe (74%) and communities are mostly worried (73%) about the hazard. Whereas 74% perceived that increase in hotter days and nights within a month is very likely, 68% perceived it unlikely within a year. The age, marital status, main income source and monthly income of respondents were statistically significant (P-value <0.05) with heatwave exposure and future likelihood. Our study findings suggest that more research to enrich understanding of heat risk amid rapid urbanization rate is crucial to shaping national, sub-national and city level urban heat island resilience planning and policy.

Keywords: Climate change; Extreme heat; Urbanisation; Exposure; Kampala city

HOW CAN THE GEOGRAPHIC VISUALIZATION TOOLS FACILITATE SUSTAINABLE DEVELOPMENT OF COMMUNITIES UNDER GLOBAL ENVIRONMENTAL CHANGE?

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Urbanization processes are speeding up worldwide. For example, Sub Saharan Africa (SSA) is increasingly becoming urbanized with projections indicating a significant proportion of the population being in urban areas by 2050. However, rapid urban development typically generates challenges such as insufficient amount of residential areas, high unemployment and crime rate, ineffective city services, and unequal access to infrastructure. Therefore, ensuring sustainable urbanization processes is necessary to properly balance citizen needs and ambitions against administrative capabilities. In many regions the term "smart city" became a target goal regarding urbanization processes and city management. However, the question arises as to what is needed to make smart cities achievable? In smart cities geographical information is used extensively to manage assets, resources and services efficiently and thus, to facilitate sustainable development. Furthermore, not only administrative officers and other decision makers have access to map-based decision support systems, but also citizens can actively create georeferenced data and use maps showing local geographical information of any type. Therefore, a broad access and use of geographic information systems (GIS) and geographic visualization tools facilitate sustainable development of communities in general, and smart cities under global environmental change in particular. Adequate visualization tools support decision making process regarding such issues as infrastructure planning and development and emergency management during natural hazards. Nevertheless, well designed university education programs are necessary to instruct future specialists both how to use geographic visualization tools effectively and how to make them. The latter are feasible, due to freely available web mapping frameworks and solutions such as Openlayers, Leaflet, and D3.js that make possible to develop even sophisticated geographic visualization tools with multiple coordinated views.

Keywords: Geographic visualization; Sustainable development; Decision support systems; Smart cities

ASSESSING THE ACCURACY OF OPENSTREETMAP (OSM) BUILDING LAYER IN JINJA DISTRICT, UGANDA

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Open Street Map (OSM) is one of the most successful Volunteered Geographic Information (VGI) developments that avails a free editable map of the world. OSM collection does not require expertise in GIS and as such citizens who collect this data seldom observe quality control measures and standards. Much as OSM is freely available for use in Uganda, its quality has not been comprehensively assessed. The aim of this research therefore was to assess the accuracy of OSM building data for Jinja district relative to the corresponding official topographic data in urban, peri-urban and rural areas. Internal quality elements of; position, completeness, attribute, and shape were chosen as the evaluation criteria for this study. The methodology for the research involved; finding matching buildings, computing metrics for the selected quality elements and quantitative analysis Results from positional accuracy assessment showed an average offset of 4.00 meters between OSM and the reference datasets across Jinja district. OSM completeness results showed a decrease from urban through peri-urban to rural with 61.1%, 41.8% and 3.9% accuracy respectively. Much as most buildings lacked attributes, the tested OSM attributes compared well with corresponding reference attributes with a similarity of 90%. In terms of shape, this study has revealed that OSM buildings shapes compare well with those of reference datasets with an average similarity of 98.8%. It can be concluded that the overall quality of OSM buildings in Jinja district is still lacking and needs improvement especially in terms of completeness. It's therefore recommended for use in low accuracies applications.

Keywords: Volunteered Geographic Information; OpenStreetMap; Accuracy

PREDICTING LAND USE LAND COVER CHANGE OF JOS-BUKURU METROPOLIS PLATEAU STATE THROUGH INTEGRATED CA-MARKOV APPROACH

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The dynamics of Land use Land cover (LULC) is an essential concern that affects the global environment, climate change, and sustainable development and Jos-Bukuru Metropolis is not an exception. Hence, detecting and predicting these changes will help in deriving active land use and planning policies that fits the local conditions. Landsat images of the years 1986, 2000 and 2019 were used to study the spatio-temporal distributions pattern of LULC. The study is aimed at modelling these changes using the integrated CA-Markov process. The maximum likelihood algorithm and cross tabulation technique (CTT) was performed to analyze these spatial changes. Validation and prediction using CA-Markov was performed. The accuracy of classification obtained are: 0.9659, 0.9510, and 0.9537 for 1986, 2000 and 2019 images respectively. Change detection from 1986 to 2000 reveals that built-up areas and rocks have positive image difference while vegetation, water body, mining area and open space with negative image difference. Built-up area continuously dominate with annual rate of change (ARC) by 6.27% from 1986 to 2000 and 2.17% from 2000 to 2019 while rock has 5.80% and 0.45%. – 2.82%, -0.87%, -8.00% and -5.265 for vegetation, water body, mining area and open space from 1986 to 2000. Likewise -0.48%, -0.88%, -2.78% and -2.65% from 2000 to 2019. CA-Markov analysis was used to predict LULC of 2019 where a Kappa statistics of validation was 0.8083. This shows a substantial level agreement. Based on the analysis of LULC change, this has revealed that there is rapid conversion of LULC classes most especially, vegetation cover, water body, mining area and open space to built-up. The worst hit LULC is open space while built up continually shows significant increase based on the predictive LULC.

Keywords: CA-Markov; Land use; Land cover

TOWARDS SUSTAINABLE URBAN TOURISM DEVELOPMENT IN UGANDA: A RISK ANALYSIS FRAMEWORK

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Tourism plays a significant role in socio-economic development of developing countries that are striving to harness the potential by diversifying the predominantly wildlife-based sector. As Sub-Saharan Africa increasingly urbanizes, several countries in the region are promoting the development of urban tourism to diversify the tourist experience, contribute to socio-economic development and strive to become smart cities. However, there is limited information about the risks that tourism will likely have on the community's livelihoods and the sustainability of urban systems. Based on the context in Uganda, the paper examines the levels of urban tourism development and assesses the risks it poses based on the analysis of existing policies and institutional and regulatory frameworks. Focusing on Kampala, Entebbe and Jinja cities, the study employs a case study research design involving a mixed methods approach that integrates desktop research, survey and non-survey techniques to collect information from urban management authorities, public and private sector organisations. The study reveals that in spite of the growth in urbanization and urban tourism, there is inadequate planning and existing facilities and institutional structures are on the verge of getting overwhelmed. Guided by the risk analysis framework, the study identifies the physical infrastructure and technology, economic, political and organisational, environmental and health, and socio-cultural risks to urban tourism development. Employing the risk analysis matrix, the paper identifies the extreme risks that require immediate intervention, high risks that can be mitigated by short-term planning, moderate risks that require long-term planning and low risks that require routine planning. The findings are novel and crucial in informing planning for urban tourism development in Uganda and other Sub-Saharan African countries which is envisaged to enhance local community livelihoods, contribute towards the drive of becoming smart cities and build sustainable urban systems.

Keywords: Urban tourism; Risk Analysis; Uganda

MODELING THE IMPLICATION OF HOUSEHOLD OFF-GRID ENERGY CONSUMPTION IN SULEJA LGA OF NIGER STATE, NIGERIA

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The incessant power outages experienced in Suleja LGA have prompted households to seek various alternative means to the national grid. The alternative energy sources to the national grid include diesel/petrol-powered generator sets, house solar systems, and kerosene lanterns. The reliance on fossil fuels (diesel, petrol and kerosene) for household activities in Suleja LGA negatively impacts the environment and the actualisation of SDG 7. This study aims at modelling household off-grid energy consumption in Suleja LGA. Attention is paid to: (1) the total off-grid energy consumed; and (2) implication of the use of off-grid energy sources on the environment. Using the proportional sampling technique, data were collected from 149 households in Suleja LGA. Descriptive statistics and the Low Emission Analysis Platform (LEAP) tool were used to analyse the data collected. The study reveals that due to the constant power outages experienced in Suleja LGA, diesel and petrol-powered generator sets were used by 65.10% of the households in the study area for lighting. Renewable energy sources were not common among households, as only 16.11% of households were discovered to be using the home solar system. Carbon dioxide, Nitrous oxides, and Methane were found to be the major greenhouse gases emitted in the study area due to the use of fossil fuel-powered technologies. The study further reveals that between 2019 and 2030, 583.8 million metric tonnes of CO2 equivalent would be emitted in the study area. This study recommends an improvement in the current use of the renewable energy source (Home Solar Systems) by households in the study area.

Keywords: Generator Sets; Greenhouse gases; Households; Suleja; Off-grid

POTENTIAL CONTRIBUTION OF URBAN ROAD-SIDE PLANT NURSERIES TO PLANT CONSERVATION AND HUMAN WELL-BEING IN THE FACE OF CLIMATE CHANGE, UGANDA

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Plant diversity is one of the fundamental cornerstones for human well-being and sustainable development particularly in developing countries where the majority of the household livelihoods are dependent on tropical forests and savanna woodlands. Such countries are increasing facing loss of forest cover and increasing urbanization. This calls for increased efforts to conserve biodiversity ex-situ strategies like plant nurseries establishment and maintenance. We surveyed 70 urban road-side plant nurseries across Kampala District, with a view to understand their contribution to plant conservation and human livelihoods in the face of increasing natural habitats loss and climate change. A total of 79 species were recorded, of which majority (61) were exotics and 18 indigenous. However, the most frequent indigenous species across the nurseries were Musangacecropioides, Elaeisguinensis, Maesopsiseminii, and the endangered Encephalartos hildebrandtii. Customer demand appears to be the main factor influencing the choice of the plants species raised by the nursery owners/operators. The results further showed that 94% of the respondents relied mainly on the nursery business for their economic needs. If properly managed, road-side plant nurseries can enhance forest plant conservation and urban forestry development as well as acting as green businesses that may contribute to improvement of the livelihoods of the low-income urban households. These nurseries may also contribute to achieving the assisted colonization/migration as an adaptation strategy for plant conservation in the face of global climate change.

Keywords: Assisted plant migration; Climate change; Plant conservation; Human livelihoods; Urban forestry development

INVESTIGATING PERI-URBAN FARMLAND BY A MIXED SPATIAL AND SOCIO-ECONOMIC APPROACH AIMING AT A TYPOLOGY OF PERI-URBAN AGRO-SYSTEMS IN NAIROBI-MACHAKOS COUNTIES INTERFACE, KENYA

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In a rapidly urbanizing world, peri-urban agriculture plays a multi-disciplinary role in cities' resilience, i.e. sustainable development, food security, livelihood, waste recycling and climate regulation in metropolitan regions. Farming in the peri-urban landscape is attracting more attention from various actors, including urban planners, policymakers, scientists, and multinational and local investors. However, farming activities in peri-urban landscapes in Kenya take on various forms and structures endowed with different factors related to urban and peri-urban landscapes. This paper aims to understand different farm types in the Nairobi-Machakos counties interface, map their spatial distribution in the peri-urban interface, and evaluate the underpinning factors of each farm type in the peri-urban interface. The paper implements a mixed spatial and socio-economic approach combining high-resolution Google Earth imagery with socio-economic investigation of 140 peri-urban farmlands and key informants' interviews. The spatial distribution of peri-urban farmland resulted in five farmland types i.e. residential gardens, small-scale open-field farming, large-scale open-field farming, small-scale greenhouse farming, and large-scale greenhouse farming. The analysis of socio-economic data using a factorial analysis of mixed data exhibited four distinct farm types. Farm types 1 and 2 combined residential garden, small-scale open-field and large-scale open-field, while farm types 3 and 4 encompassed the greenhouse farming systems. Determinant factors of PUA in the Nairobi-Machakos interface include PUA type, irrigation water source, presence of stream and land tenure system. The principal bottlenecks of peri-urban agriculture are water pollution, water scarcity, climatic variability, land accessibility, and high input cost. The findings provide insightful data for upscaling peri-urban agriculture in Kenyan metropolitan regions for food security, environmental sustainability and city resilience.

Keywords: Per-urban agriculture; Urban food system; Livelihood; Farm types; City resilience; Sub-Saharan Africa

EFFECT OF THE ACTIVITY OF BLACK SOLDIER FLY LARVAE ON THE QUALITY OF COMPOST PRODUCED FROM DIFFERENT ORGANIC WASTE SOURCES AT MAKERERE UNIVERSITY AGRICULTURAL RESEARCH INSTITUTE

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With increased waste accumulation in urban areas as population increases exponentially, over 90% of the waste is attributed to organic origins. Organic wastes can be utilized to address the declining soil fertility for sustainable production if properly decomposed. Potential of black soldier fly larvae rearing in decomposition of organic wastes for manure production provides an entry point for utilization of organic wastes. This potential was evaluated through complete random design with three replicates and three rates of the Black Soldier Fly Larvae (BSFL). The study aimed at establishing the nutrient of BSFL-composted manures for production and fertility and solving the organic waste accumulation in our urban areas using locally available means. Organic sources assessed were market waste, cow dung and poultry litter. After composting, the manure samples were thoroughly mixed; samples were dried, ground and sieved for various analyses following standard laboratory analytical procedures. Data was analyzed using a one-way analysis of variance (ANOVA) using Genstat14 edition and the selected macro and micro nutrient content generally differed significantly ($p<0.05$) as the trend in Nitrogen, Organic matter, Calcium and potassium followed the trend of Market waste<Poultry litter<Dung. The pH followed a trend of Dung<poultry litter<Market waste; total phosphorus followed the trend Poultry litter<Dung<Market waste. Market waste had reduced by 71.52%, cow dung by 46. 82% and poultry litter had reduced by 22.23% during the composting period. The rationale of the study was to evaluate the potential of BSFL to compost different materials. The high nutrient composition in market waste makes it the best soil amendment if we are targeting supply of K, Ca, N and O.M with the aim of improving nutrient availability in the highly weathered soils of Uganda. For soils characterized with low pH, I would recommend using BSFL composted manure from cow dung because it will raise the pH making it suitable for crop production which in turn increases crop yields. Furthermore, nutrients such phosphorus deficiency can be addressed by applying BSFL composted manure comprising of poultry litter. Finally, we can incorporate BSFL in the efforts to manage organic waste at the source especially in the urban areas.

Keywords: Organic waste; Black Soldier Fly Larvea; Nutrient Composition; Crop production; Soil Fertility; Urban Areas

SESSION 5: Land Degradation, Neutrality and Net Zero

FACTS-BASED FOR ASSESSING LAND DEGRADATION AND HOW TO TURN-UP ZERO LAND DEGRADATION NEUTRALITY IN RWANDA

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Our world's land is now rapidly degraded. Ensuring food security for a growing world population requires healthy land resources and thriving ecosystems. However, our current agricultural practices are eroding soils around the world 100 times faster than natural processes are replenishing them and The Government of Rwanda is also substantially investing its domestic resources in agriculture and activities related to sustainable land management.The land is a fixed quantity, there is increasing competition to control resources and exploit the flow of goods and services from the land, which risks causing socio-political instability, and exacerbating further poverty, conflict, and migration. The Earth is under increasing pressure from competitive use. The UNCCD defines Land Degradation Neutrality as "a state whereby the amount and quality of land resources necessary to support ecosystem functions and services and enhance food security remain stable or increase within specified temporal and spatial scales and ecosystems" (UNCCD, 2015a).The research will examine the expectations of the Zero Net Land Degradation targets in the context of promoting the recognition of land degradation as a global threat and its contribution to global food security. Next, we detail the challenges of bringing Zero Net Land Degradations to life, including scoping (determining the spatial scale and selected domain to achieve land degradation neutrality); mapping (classification of land according to its current use and productive status); regulations (specifying relevant management methods for each type of land); apply selected soil management (to reduce degradation, restore productivity or increase resilience); and monitoring management and its results. Sustainable development can't be achieved with great land degradation like how it happened in our daily life. Planning for neutrality by projecting potential losses and planning for comparable or greater gains should be linked to long-term land use planning, whereby decisions are based not only on threats of serious or irreversible damage within a particular site but also on the contribution of each of those decisions, positive or negative, to the goal of neutrality at the landscape or national level.

Keywords: Land degradation; Restoration; Sustainable development goals; Zero Net Land Degradation; Sustainable land management

REASSEMBLING LAND DEGRADATION: TOWARDS A NATURE-SOCIETY-INCLUSIVE SOIL EROSION CONTROL STRATEGY

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Effective management of land degradation is increasingly seen to require bridging the mismatch between science, policy, and practice. This further requires understanding land degradation as an assemblage or hybrid (of the biophysical and anthropogenic aspects) and an epistemology that levels the grounds between scientists, policymakers, and farmers whose farm production, as well as livelihoods, are at-risk. Towards this need, we test the recently proposed hylomorphic (disaster risk management) framework. This framework structures the procedure of bridging the lived experiences (of the communities at risk) with the theoretical knowledge (of scientists and policymakers) to enable the co-creation of knowledge and co-designing options for solving natural risks. Using Focus Group Discussions (FGDs) with farmers, scientists, and policymakers, we test this framework on a case of soil erosion in the Rwenzori region, Uganda to find out the possibility of producing a hybrid context-specific knowledge theory on soil erosion, and soil erosion control measures, understand what informs the hybridization, and the nature of the difference between the hybridized soil erosion control measures and the conventional ones. Drawing on the insights from this study, we show that the lived experiences not only expose blind spots in understanding the local context of soil erosion; but also, flatten the ontology and facilitate a hybrid context-specific epistemology of soil erosion control. Insights from this study stimulate innovations towards a context-specific soil erosion control strategy.

Keywords: Soil management; Land use planning; Natural hazards; Land use policy

GEOSPATIAL ANALYSIS OF SOIL DEGRADATION BY EROSION IN IDEMILI WATERSHED, NIGERIA USING RUSLE AND ANCILLARY DATA

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Data on hydro-soil degradation owing to erosion is vital for soil conservation policies. The Revised Universal Soil Loss Equation (RUSLE) model is satisfactory for the assessment of soil erosion at a macro scale. Here, we assessed soil erosion at a lower macro scale on the Idemili River Watershed. An ancillary dataset on erosion occurrence obtained from the Nigerian Geological Survey Agency (NGSA) was overlaid on delineated watersheds to select the most eroded areas for a detailed resource conservation plan. The RUSLE model was run in a geographic information system (GIS) to obtain a more comprehensive spatial distribution of soil loss in the study area. The factors employed include: the R-factor established from the rainfall data, the K-factor map generated from the FAO Harmonized World Soil Database, the C-factor map produced from Landsat imagery and the normalized difference vegetation index, and a digital elevation model with a spatial resolution of 30 m in developing the LS-factor map and support practice P factor was mainly contouring. The results showed that the maximum soil erosion at the watershed was 671 ton ha-1 year– 1. Soil loss was highest at steep slopes from 15 to 24 and elevations above 80 m. Urban areas and bare lands land use had the highest soil loss. Urgent measures are needed to avert the impending dangers of soil erosion on the entire watershed. The results of this study will provide a guide for timely erosion management in erosion-ravaged areas. The scale at which this study provides more meaningful management planning information for sustainable environmental planning.

Keywords: Land degradation; Soil loss; RUSLE; Built-up area; Adaptation measures

THE INTERPLAY OF MENTAL HEALTH AND ENVIRONMENTALISM IN NIGER DELTA POETRY

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Scholars in the domain of environmental and health humanities have revealed that the physical environment influences mental quality of the people that reside in it. This notion has given rise to the discipline of ecopsychology, which examines the interaction between the human's mind and the natural environment. For over half a century, the Niger Delta region of Nigeria has been subjected to environmental devastation and degradation, occasioned by intense nature of the oil explorations and extractions of different local and multinational companies both on the land and in the swamps of region. Unfortunately, since the main sources of livelihood for the Niger Delta natives are fishing and farming, the plunder of their lands and waters, which are their main means of income and living, continues to trigger anger neurosis, depression and disinhibition; these mental health episodes have been imagined in poetry from the region. Selected poetry volume from the Niger Delta region of Nigeria, Tanure Ojaide's. The Tale of the Harmattan, IbiwariIkiriko's Oily Tears of the Delta, and Nnimmo Bassey's. We Thought it Was Oil but it Was Blood, are subjected to critical analyses, showing how the destruction of the people's ecology and their means of continued existence induce psychiatric episodes of varying degrees. The twin theories of ecocriticism and psychoanalysis are adopted in this study.

Keywords: Environmental health; Medical humanities; Ecopsycology; Niger Delta Poetry

RAISING PUBLIC AWARENESS OF THE EFFECTS OF LAND DEGRADATION IN ISHAKA DIVISION, BUSHENYI DISTRICT- SOUTH-WESTERN UGANDA

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Introduction; this is majorly introduced to address a on the study topic: (Raising Public awareness of the effects of Land degradation in Ishaka Division, Bushenyi District-South-western Uganda). Generally, environmental degradation is the deterioration of the environment through depletion of natural resources such as air, water and soil; the destruction of ecosystems and the extinction of wildlife.Study objective; the main objective of the study is to increase public awareness about environmental issues, explore possible solutions to the effects and to lay the foundations for a fully informed and active participation of individual in protection of the environmental in Ishaka division, Bushenyi Municipality. Method; A cross sectional study is employed for collecting information in the study areas whereby various parts of the study area were visited at a time. Results; From the findings, participants agree that deforestation, air pollution and water pollution, solid and hazardous waste exposure, soil degradation are effects of environmental degradation. Findings also indicate that there are atmospheric changes due to environmental degradation.Recommendation; this study recommends more information on environmental degradation provided it increases awareness and promotes safe practice on land use. Also, more effort is required on community sensitization about the outcomes of destructive practices on the environment. Conclusions; the study is meant to emphasize big number of people (50%) to know the effects of environmental degradation and more than 50% also to know on how to conserve the environment but environmental degradation still remains a challenge in our country especially in rural communities despite the interventions. These interventions have negatively influenced people's attitude and practices.

Keywords: Land degradation; Ecosystems

LAND DEGRADATION

Jean D Amour Niyokwizera

Land degradation is extensive, covering approximately 23% of the globe's terrestrial area, increasing at an annual rate of 5–10 million ha, and affecting about 1.5 billion people globally. Such detrimental processes call for urgent and comprehensive action to halt land degradation. In this paper, we assess the causes and extent of land degradation around the world, followed by an outline of the various challenges in implementing a global Zero Net Land Degradation policy. The concept of ZNLD proposes a scheme under which the extent of global degraded lands will decrease or at least, remain stable. To enable this type of scenario, the rate of global land degradation should not exceed that of land restoration. Restoration efforts should include not only croplands, rangelands, and woodlands, but also natural and semi-natural lands that do not generate direct economic revenues. The United Nations Convention to Combat Desertification envisages achieving this target by 2030. Despite being seemingly ambitious, the target of ZNLD could be achieved if degraded lands are restored to a considerable extent and, at the same time, land-degrading management practices are replaced with ones that conserve soils. To enable effective implementation of these steps, it is necessary to formulate a ZNLD Protocol aimed at managing assessment actions and maintaining of supportive policies and regulations. Restoration projects could be financed through payments for improving ecosystem services, as well as other economic mechanisms. Achieving the target of land degradation neutrality would decrease the environmental footprint of agriculture, while supporting food security and sustaining human wellbeing. One third of the world's land is degraded, affecting 3 billion people, and the situation is expected to worsen as food demand grows (FAO, 2020). In addition to other consequences, land degradation also hastens climate change and jeopardize agricultural productivity, water quality, biodiversity, sustainable development, and human and wildlife living conditions. India accepted the "Bonn Challenge" in a worldwide initiative to rehabilitate 150 million hectares of deforested and damaged land by, 2020, and 350 million hectares by 2030 (The Hindu, 2020). Generally, our Africa may suffer if we never take hard decision to fight these serious issues yet we able.

Keywords: Sustainable Consumption Practices; Farmers' Perception, Soil Erosion and Degradation, Livelihoods.

CONTRIBUTION OF LAND OWNERSHIP TO AGRICULTURAL LAND USE CHANGES IN MWATATE SUB-COUNTY, TAITA TAVETA COUNTY, KENYA

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Land use change is a global phenomenon that has significantly altered the global biodiversity landscape. Various factors led by population growth have been linked to land use changes. However, the influence of land ownership rights on these changes is yet to be given adequate attention. This study therefore sought to establish the contribution of land ownership rights to agricultural land use changes in Mwatate Sub County in Taita County, Kenya. The study employed a cross sectional research design on a sample of 300 households. These households were selected using both stratified disproportionate and simple random sampling techniques. Data was entered and analyzed using Statistical Package for Social Science (SPSS) version 23.0. Using the Neo-Malthusian theory, the findings revealed that there has been increased population growth in the site of study that could be associated with increased anthropogenic forces on agricultural land and unsustainable land use practices including deforestation, tree logging, heavy use of fuelwood, clearing of bushes for human settlement and agriculture, poor farming techniques and a general reliance on agriculture as a source of livelihood. A chi-square analysis, using a 95% confidence level, revealed that there was a significant relationship between land ownership rights and agricultural land use changes, majorly dictated by adoption of agriculture as the main source of livelihood, deforestation, poor farming techniques and clearing of bushes for agriculture. These findings demonstrate the need to empower and encourage households to diversify sources livelihood to reduce over reliance on agriculture because of its obvious implications to the environment. Moreover, these findings highlight the need to institute land use policies proactively to regulate agricultural land use. Additionally, there is need to increase awareness in the community of the benefits of environmental conservation and its benefits to the agricultural sector.

Keywords: Land Use Land Cover; Land degradation

IMPLICATIONS OF LAND USE AND COVER CHANGES ON UPPER RWIZI MACRO WATERSHED HEALTH IN SOUTH WESTERN UGANDA

Ayesiga Patience

The upper Rwizi river system in South Western Uganda has been severely degraded due to encroachment and unsustainable resource utilization. Little is however, known about the link between the quality of upper Rwizi macro-watershed and land use/cover patterns from the spatial and temporal perspective. This study evaluated the relationship between spatial temporal land use/ cover change and upper river Rwizi macro watershed health. Remotely sensed data was used to analyse the spatio-temporal land use and land cover changes and distribution for upper Rwizi macro watershed. The analysis was done using Landsat and Sentinel imagery datasets spanning 1990 to 2020 and 2016 to 2021 respectively. Field verification was undertaken to confirm the land use and cover types and evaluate the implications of prevailing anthropogenic activities on the river ecosystem health. The land use and cover characteristics in the upper Rwizi macro-watershed exhibits both highly spatial and temporal variations. By 1990, grassland was the dominant land use and cover type with 45% followed by farmland at 30%. Forest land, open water and settlements covered 12 %, 10% and 3% respectively. There has been a significant change in the land use and land cover distribution in the study area over 30 years. Whereas grassland and forest cover have diminished drastically by 64% and 71% respectively, settlements and farmland have increased tremendously by 79% and 50% between 1990 and 2020. The hillslope hydrological characteristics in the watershed are severely hampered due to increased human activities. The water quality and levels in the river channel and its tributaries have drastically reduced. It is therefore, recommended that afforestation in the degraded areas be undertaken in the watershed to restore the watershed ecosystem health which could improve on hillslope hydrology. With Mbarara's transformation into a city, there is need to have stable and clean water supply for the City's growing population through improved watershed health.

Keywords: Land use-cover changes; Watershed health; River Rwizi

AN ASSESSMENT OF THE IMPACT OF LAND USE/COVER CHANGES ON SOIL EROSION RISK IN RIVER MITANO CATCHMENT, SOUTHWESTERN UGANDA

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Assessment of the hydrological response of a catchment to land use/cover change is imperative for the proper management of water resources within a catchment. River Mitano catchment has undergone significant land use/cover changes (LULC) engineered by numerous socio-economic and environmental drivers. The effect of such changes on soil erosion risk has however not yet been fully recognized. This study therefore investigated the extent of land use/cover changes experienced in River Mitano catchment for the period 2000-2020 and the effect of these changes on soil erosion risk. To quantify the extent of land use/cover change in River Mitano catchment, Landsat-7(2000), Landsat-8 (2010), and Sentinel-2A and 2B images for 2020 were obtained from United States Geologic Survey (USGS). LULC change analysis using the supervised classification of the Landsat and Sentinel images was done to reveal Land use/cover changes in the catchment for the period 2000 to 2020. To determine the effect of LULC change on soil erosion, modeling was performed using Revised Universal Soil Loss Equation (RUSLE). Results of the LULC change revealed a decrease in grassland, wetlands, and woodland by 6.7% and 5.9%, 0.12% and 0.14%, 0.01% and 0.29% for the period 2010 and 2020 respectively. However, subsistence farming, built-up and tree plantation steadily increased by 2.96% and 3.59%, 0.70% and 2.33%, 3.14% and 0.11% for the period 2010 and 2020 respectively. Soil erosion rate varied from very high (10-500 t ha-1yr-1) with an increase of 11% and 5% for the LULC of 2010 and 2020 in the catchment. The study concludes that soil erosion in the catchment was influenced by Land use/cover change through conversion of grasslands, tropical high forests and wetlands to subsistence farming which has persistently increased soil erosion risk. It is recommended that soil and water conservation practices be adopted to minimize soil erosion and ensure proper protection of River Mitano catchment.

Keywords: Land use/cover changes; Soil erosion risk; Supervised classification; Soil erosion modeling

AFFORESTATION AS ZAMBIA'S LAND DEGRADATION NEUTRALITY STRATEGY TILL 2050

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Deforestation led to the loss of timber and wood sources in Zambia's Copperbelt. Dryland Miombo forests were transformed into open areas for agriculture, mining, industries and settlements. Alternatively, fast growing subtropical coniferous species were grown for wood and timber requirements. These could also build up soil carbon rapidly, from litter drop, and decay processes. A chronological (±8, ±16 and ±39 years) P. kesiya study was conducted to look at the fast-growing species in 2018 to 2020. The age groups were studied allometrically by height (H), diameter (D) biomass assessment, and by soil organic matter (SOM). The two datasets were contrasted and assessed for their contribution to being tools of land degradation Neutrality (LDN) assessment. SOM assessments by simple linear regression models surface linear equations ±39-year (y= 0.574x+0.411), ±16-year (y=0.277x+2.157), and ±8-year (y=0.257x: 3.024). exhibited significant potency $p<0.005$, and their allometric above ground biomass (AGB) indicated similar properties. Surface SOM explained carbon periodicity, while above ground biomass models explained the productivity, and subsoils plant age-vigor-SOM relationship. The above ground biomass, and soil organic matter, proved to be useful proxy indicators for explaining the positive relationship to land degradation neutrality in new, medium, and old P. kesiya plantations. A need to adopt and adapt afforestation with a reinvigorated community forest focus approach to attain Zambia's LDN by 2050 in northern Zambia is the goal.

Keywords: Pinus kesiya; Soil organic matter; Miombo; Ndola; Zambia

THE SPATIAL EXTENT OF LAND USE/COVER CHANGES BETWEEN 2015 AND 2021 IN THE RIVER MALABA CATCHMENT, EASTERN UGANDA

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Changes in land use/cover (LULC) have affected the riparian ecosystem services as a result of natural and human activities. Human activities like; Deforestation, agriculture, and urbanization are the primary drivers of land use/cover change. These land use/cover changes occurring in the River Malaba catchment were recently mapped by downloading high-resolution Sentinel-2 imagery for the research region from the USGS earth explorer website (https://earthexplorer.usgs.gov/), pre-processing, supervised and unsupervised classification was done in ArcGIS. The identified imagery was divided into six (6) types of land use/covers: built-ups, grasslands, open water, farmlands, wetlands, and woodlands. An accuracy assessment was done giving above 90% for both the 2015 and 2021 images. Results showed that in the River Malaba Catchment, built-up areas and farmland increased between 2015 and 2021 by 1.0% and 15.3% respectively, whereas grasslands, wetlands, and woodlands decreased by 13.2%, 0.2%, and 2.8%, there was no change in the amount of open water. Between 2015 and 2021, the predominant land use/cover transitions in the River Malaba basin were from "grasslands to farmlands". These findings are attributed to the growing population in the catchment, where most land covers are turned into built-up areas and agriculture production which is the primary source of income in the majority of Uganda,(UBOS, 2014).

Keywords: Land use/cover; Sentinel-2 imagery; Supervised and Unsupervised classification; USGS earth explorer; ArcGIS

DYNAMICS OF GEOHAZARDS AND ENVIRONMENTAL SENSITIVITY ON MOUNTAIN ELGON UNDER CHANGING CONDITIONS

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The strongly coupled highland ecosystems in the tropics continue to grapple with environmental hazards due to the interplay of changing ecological conditions and anthropogenic factors. The situation is expected to be altered by a series of global environmental factors. In this study, we investigated the sensitivity of mountain Elgon ecosystem to a series of geohazards and their trajectories with a spatial lense. The study is premised on desktop review and meta-analysis of existing information. We collated up to 114 studies covering a period between 1981 and 2022 that formed the data inventory for our analysis. The data was subjected to cross tabulation and descriptive analysis. The results reveal a diversity of up to 15 environmental and geohazard issues prevalent on the mountain Elgon ecosystem. This indicates the high dense population inhabiting on mountain Elgon are exposed to multiple environmental stressors. The most significant ones are land degradation (27%)> landslide hazards (20%)>climate change (11%)>land use and land cover change. These geohazards are inextricably linked often with a process in one location triggering others either insitu or offsite. With respect to spatiality, Bududda and Manafwa districts distinguish themselves as hotspots geohazards and degradative processes on mountain Elgon. A geospatial analysis reveals that the terrain in these districts in terms of critical slope gradients (>30%), is significantly more fragile. A temporal analysis as expected shows an increasing occurrence of geohazards probably due to land use and land cover conversion together with increasing variability and change in climatic conditions. The sustainability of the mountain Elgon ecosystem and the future of its population will be largely premised on how best to harness the green assets to propel environmental stewardship and integrity, as well innovations for ecological resilience.

Keywords: Geohazards, Environmental Sensitivity, Environmental change, land degradation

SESSION 6:Migration and Displacement: Socio-ecological Intricacies and Benefits

EMERGING TRENDS ON CLIMATE CHANGE-INDUCED MIGRATION IN AFRICA

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Understanding the drivers of migration and its relationship to climate change remains a global challenge for global demographers. There has been much debate regarding the relationship between climate change and migration and this has been increasingly recognized by policymakers. However, there is still considerable uncertainty about how many factors contribute to migration as a result of climate variability and change. While there have been a number of publications summarizing developments in migration and climate change studies, publications have focused on providing a description of the current state of knowledge rather than emphasizing research trends and future prospects. This study examines the evolution of research on climate change-induced migration between 1991 and 2022 and applies a scientometric design to identify research trends in Africa, a continent highly vulnerable to climate change. Features of publications, key scientific disciplines and cooperation between countries and institutions were determined through citation analysis. Furthermore, we discuss research trends, including future directions, approaches, and expected data on climate change-induced migration. From the first published article in 1991, a gradual increase in studies was noticed in the mid-2000s which has been continual to date. South Africa was seen to be the most productive African country in terms of research studies, far ahead of other African countries. This paper provides a broad overview of climate change-induced migration research progress, which can serve as an inspiration for future studies of the migration phenomenon by new and emerging researchers in this field.

Keywords: Climate change; Migration; Africa; Bibliometrics

EXPLORING THE FOOD-CLIMATE-MIGRATION NEXUS IN WEST AFRICA BY ANALYZING LAND SURFACE DYNAMICS AND WEATHER EXTREMES IN COMBINATION WITH EXPERT INTERVIEWS

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Environmental conditions, including the frequency of droughts and floods as well as land degradation, are known to influence human migration patterns in West Africa. To cope with adverse climatic conditions, poverty, and food insecurity, migration has been a strategy in this region for centuries. Within the MIGRAWARE project, this study aims to define hypothesis regions, meaning to identify regions where several unfavorable or favorable conditions could promote out-migration or in-migration, respectively. The Climate Hazards Group InfraRed Precipitation with Station Data (CHIRPS) and the ERA5 dataset are used to analyze historical precipitation and temperature indices. Further, the MODIS Normalized Difference Vegetation Index (NDVI) dataset provides information on spatial and temporal changes in vegetation greenness to assess land degradation. Time series analyses using Mann-Kendall tests are performed for the period 2000-2020 to quantify temporal trends. To address the complexity of the phenomena, environmental factors are integrated into the network of drivers and processes of migration. Interactions between the different drivers of migration are additionally explored by including data on, among others, armed conflict and population density in the analysis. Expert interviews conducted in Ghana contribute to weighting the importance of various factors influencing migration decisions. A weighted-overlay approach for different scenarios, combining spatial data and qualitative interviews, will result in valid information on current migration patterns in West Africa. The results of this study will help formulate recommendations for stakeholders to better target climate change adaptation measures and the advancement of policies and solutions related to the food-climate-migration nexus in the region.

Keywords: Climate change; Geospatial data; Migration patterns; Survey; Time series analysis; Weighted-overlay approach

THE 'EVERYDAY' HUMANITARIAN ACTS EMBEDDED IN SOCIO-CULTURAL PRACTICES AMONG SOUTH SUDANESE REFUGEES IN UGANDA

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This paper examines 'everyday' humanitarianism acts that are shaped by the African care ethics and informed by Ubuntu philosophy. It argues that humanitarian acts take different forms and vary across the different global 'geo histories'. While humanitarianism is mainly rooted in the western care ethics, principles and practices, the African dimension mainly focuses on 'everyday' socio-cultural practices that are often taken for granted. One is Oya – a communal farming tradition. Another is Lokita, the gathering of kin, friends, and neighbors to assist in activities such as erecting mud houses and harvesting of farm produce as practiced by women, third is Rabita, crowd funding scheme for property recovery mostly practiced by women. Fourth, is the taking in of orphans, children of distant relatives and friends, and unaccompanied minors in refugee spaces, and fifth are funeral and burial arrangements where there is communal weeping for loss of an intimate kin, fictive kin, a neighbor, or a friend. In this paper we explore how these lesser understood practices make up an important part of refugee everyday lives, how they change over time and how they are adapted to the specific places' refugees find themselves in, be it refugee settlements or urban areas. We conclude by discussing how a better understanding of humanitarian acts embedded in socio-cultural practices can inform a more inclusive approach to humanitarianism that recognize, support, and build on the capacities of refugees themselves.

Keywords: Everyday Humanitarianism; Socio-Cultural; Localisation Agenda

SOCIAL SUSTAINABILITY OF RESETTLEMENT HOUSING IN UGANDA; CASE OF PAGIRINYA REFUGEE RESETTLEMENT CAMP IN ADJUMANI DISTRICT

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Access to shelter is essentially the first step in the process of refugee resettlement and integration, as housing conditions greatly influence the ability of refugees to adapt to a new society. This study explores the social sustainability of resettlement housings in Uganda, with Pagirinya refugee settlement camp as the case study. Data was collected from 318 proportionately sampled refugee respondents through administered questionnaires, as well as focus group discussions (FGDs) held with two community-based organizations and interviews with selected stakeholders from Office of the Prime Minster (OPM) and Non-Government Organization (NGO) officials operating within Pagirinya settlement camp. The study finds a strong tendency towards permanence in the housing constructions by the refugees within the refugee camp, with comparatively good housing conditions to those of the host communities. Further, the study established that, there are a number of conditions that influences access to and provisions of sustainable housing but these conditions have varying magnitudes with the availability of construction materials evaluated as the most critical condition. The study also finds significant relationship between housing and social sustainability when considered jointly on the variables of wall of buildings, area of buildings, main face orientation of building, number of direct access roads and sharing available resources since p-values were less than 0.05. The study recommends that government should develop clear guideline criteria for allocation of land to refugees and review the housing policy of Uganda to address issues of housing permanence by the refugees who are deemed temporary residents.

Keywords: Social sustainability; Resettlement; Housing; Refugees; Pagirinya

‘TIMESCAPES’ OF ‘VISIBLE RELATIONALITY’ AND IMPLICATIONS FOR PROVISION OF HUMANITARIAN ASSISTANCE

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A relationality of ‘shared humanity’ that inspired traditional humanitarianism for centuries needs reflection. The notion of ‘saving the stranger’ is contradictory as the dictionary definition of a ‘stranger’ refers to ‘a person whom one does not know or with whom one is not familiar’. This implies that in traditional humanitarianism, the ‘giver’ and ‘receiver’ have always been discrete individuals who are ‘invisibly related’. Notwithstanding the importance of ‘invisible relationality’ in such things as highlighting the plight of refugees and attending to emergencies, ‘invisible relationality’ championed a conceptualization of humanitarian assistance as ‘hand-outs’ among the ‘givers’ (donors) and portrayed the ‘receiver’ (POCs) as ‘helpless and in dare need of help’. It informed an understanding of humanitarian crises as a third-world problem allowing for implementation of policies and programmes that confine refugees (receivers) in inhuman and non-relational camps and settlements far away from the ‘givers’ of assistance. Instead of a humanitarianism cemented by an ‘invisible relationality’, this paper presents an emergent humanitarianism of ‘visible relationality’ where the ‘giver’ and the ‘receiver’ are closely knit through established relationship as is observed among non-traditional humanitarian actors. The goals of the paper are threefold: (1) examine the nature of relationships; (2) understand how relationships evolve in time (3) examines how a humanitarianism focused on relationships enhances or contravenes traditional humanitarian norms and standards and the implications this has for possible partnerships and engagements between traditional and non-traditional actors in humanitarian space.

Keywords: Visible Relationality; Shared Humanity; Humanitarian Principles

STRUGGLES OF MIGRANT WOMEN IN ARTISANAL STONE MINES AND QUARRIES IN ACHOLI QUARTERS AND BIDIBIDI REFUGEE SETTLEMENT, UGANDA

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Artisanal stone mines and quarries present multiple opportunities for migrant women in Uganda's urban and rural landscapes. Stone mining and quarrying has transformed the lives of migrant women through employment provision, possibilities of earning an income, economic empowerment, financial independence, and livelihood diversification. However, the transformations and benefits are unequally distributed across diverse socio-economic classes of migrant women who engage in these activities. In addition to causing mining accidents for miners and other community members, mining pits are invariably transforming the mining landscapes in intricate ways. This study: first, highlights the [often ignored and taken for granted] contribution of migrants especially women to the development processes of host communities in Uganda. Second, explores the socio-economic impacts of stone mining and quarrying activities on migrant women. Third, examines how migrant women, both urban IDPs and refugees, survive and navigate the challenges which they encounter in the stone mines and quarries in Acholi Quarters and Bidibidi refugee settlement in Uganda. Although the construction industry has been dominated by men, this study shows that women play a central role and are key players whose contribution cannot be ignored. Many migrant women are exercising their agency in the informal settlements so the state should provide them with appropriate laws and conditions to foster their full engagement in the industry.

Keywords: Agency; Artisanal Stone Mines; Quarries; Refugee; Uganda

HIGH POPULATION GROWTH RATE ACCELERATED BY IN-MIGRATION IN THE GREATER KAMWENGE AREA RESPONSIBLE FOR ENVIRONMENTAL CHANGES

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Greater Kamwenge, composed of Kamwenge and Kitagwenda districts has one of the highest population growth rates in the country (3.91%) during the period 2002 to 2014 compared to the national average of 3.03% (UBOS, 2014). The increasing population has resulted in the increase in population density from 82.69, 114.7 and 172.8 persons per square km in 1991, 2002 and 2014 respectively (UBOS, 2014). This paper was guided by three objectives: To examine the positive and negative implications of continued increase of population in greater Kamwenge by both natural growth and in-migration. To analyse the positive and negative contributions of the in-migrants into the area. Suggest measures of improving livelihoods of the inhabitants of the area. The paper utilises data from key informants and literature review. Land use land cover maps of the area of study shall be classified (supervised classification) using ArcGIS 10.8 software and the changes in land cover shall be compared. The data shall be obtained from satellite images from 2000 to 2020. The authors observe that a number of benefits such a variety of crops were introduced by the in-migrants at different times. Areas which were formerly infested with tsetse flies were made habitable by the in-migrants and animal rearing extended into areas that were not formally used for the economic activity. On the other hand, the increase in population has culminated to encroachment on areas that were not formerly settled and cultivated leading to soil creep, erosion, destruction of wetlands, forests and woodlands. The authors recommend strengthening the benefits of the in-migrants in order to reduce poverty in the area. In addition, the authors recommend vigorous campaign for modern family planning methods to reduce the high population growth and emphasize education and mind-set change.

Keywords: Population growth; In-migrants; Greater Kamwenge; Poverty reduction; Positive and negative contributions

THE IMPACT OF REFUGEE SETTLEMENT ON LANDSCAPE AND GREEN ENVIRONMENT IN WEST NILE REGION, UGANDA

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Uganda continues to experience high-refugee population influx that is beyond the established settlement capacities. In places where resources are already stretched thin, friction between refugees and host-community nationals has emerged over land usage, access to employment and government services, and environmental degradation particularly in settlement camps. The study shall be guided by two objectives; to examine the spatial and temporal extent of landscape and vegetation change in West Nile, to assess the causes of landscape and vegetation degradation in West Nile. Little information is available on the present and future impacts of settling refugees and host-communities on land use changes, vegetation changes and degradation. The paper focuses on the past and present impacts of settling refugees on landscape changes and vegetation degradation-due to subsistence farming and built-up areas (period 2010-2020) in BIBIBIDI refugee settlement camp. (Because according to literature its vegetation-grassland, woodland and wetlands is highly degraded than other camps in the sub-region). It intends Group focus discussions shall also conducted in conjunction with face-to-face interviews with key informative personnel. (ArcGIS 10.8 software shall be used to determine the past and present spatial areal-extent of changes from 2010 to 2020) using satellite images from 2010-2020 since the previous Authors used Sentinel-2 images (20m) of 2016-2019 and Dinamica Ego-software to determine the current and future spatial areal-extent of changes in 2022. Findings revealed a rarefied increase in areas under subsistence-farming, builtups and refugee-settlements while the losses were seen in savannah-grasslands, wetlands and woodlands. The most degraded vegetation types were savannah-grassland, woodlands and tree-plantations. These were primarily attributed to unending activities of deforestation, bush-burning, high-refugee population, land-conflicts with host-communities and wetland reclamation. There is a need to promote a shift from use of non-renewable energy sources like charcoal to renewable and environmentally friendly energy sources like biogas, use of briquettes which are relatively cheaper and affordable by the majority and have the potential to effectively substitute wood and charcoal that has massively led to deforestation and its effects.

Keywords: Refugees; Settlement camps; Environmental degradation; Host communities; West Nile sub region

BUILDING LIVELIHOODS THROUGH NETWORKS - SOUTH SUDANESE REFUGEE WOMEN IN RURAL AND URBAN UGANDA

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With Uganda's open-door policy and progressive legislation refugees are given relative protection, freedom of movement and access to work and services on the same basis as Ugandan nationals. Schemes within this self-reliance model seek to improve the economic and social conditions for refugees by facilitating the use of creative agency and skill sets amongst refugees themselves. However, what self-reliance means specifically and how it should be measured is not a straightforward exercise, and the opportunities for it are distributed unequally. When the strategy of self-reliance is promoted and aid agencies are withdrawing their funding, refugees with little access to meaningful economic activities are forced to rely on support from their social networks in order to survive. Moreover, opportunities for relational aid are not an inexhaustible resource, and it is situated in networks of power making it more available to certain groups of people. Refugee women leverage their social networks as part of their livelihood strategy, especially in situations of economic insecurity where they have become single mothers and the head of the household. How these networks are built, what benefits they bring, and why some are part of them and others not, is important to understand when looking at how refugee women are surviving and managing themselves and their families in areas where self-reliance is promoted. In this presentation, I build on interviews conducted with refugee women in BidiBidi refugee settlement and urban neighborhoods in Kampala to examine how women use their social capital and networks to build their livelihoods, and what this means for their prospects of self-reliance.

Keywords: South Sudanese refugee women; Social capital; Social networks; Livelihoods; Rural; Urban

LIVELIHOOD ADAPTATION TO DISPLACEMENT AND RESETTLEMENT DUE TO OIL REFINERY DEVELOPMENT IN UGANDA

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Resettlement due to natural resources extraction and infrastructural development is known to be associated with impoverishments globally. In the Albertine region of Uganda including Hoima District, resettlement has resulted into loss of assets and livelihood resources yet the exploratory and infrastructural development activities were still at infancy stage. The study therefore assessed how households are adapting, constraints affecting adaption strategies and ways to improve adaption strategies in relocation areas. Qualitative information was gathered by interviews and focus group discussions with people receiving different type of compensation, and host community. The results of the study indicated that, farming remains a dominant activity where rural communities make a living. Although there were no variations observed in activities undertaken as coping strategies by men and women, divorced women and widows found it difficult to adjust with the situation, as they must take up all activities and responsibilities for the family. Resettled communities face several challenges such as reduced access to land, water and fuel wood, making it difficult to rebuild their livelihoods in relocation areas. Lack of access to infrastructural facilities including roads, markets was emphasized during interviews and affected coping strategies. There is a need to ensure that important resources such as trees and water that women are so dependent on in their daily activities are easily accessed in relocation areas to minimize walking long distances and time wastage. The request made by resettled people to build resettlement houses in their own identified land would minimize complaints about too small compounds and lack of privacy and help polygamous families to relocate together.

Keywords: Livelihood Adaptation; Resettlement; Uganda

SESSION 7: Geographies and Contexts of COVID-19 Processes and Sustainable Recovery

WHERE IS GIS TECHNOLOGY APPLIED IN THE PUBLIC HEALTH DISCIPLINE: A LITERATURE REVIEW

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The purpose of this study was to identify the use of GIS (Geographical Information System) technology in supporting information required for public health evidence-based planning and decision-making. The review discusses examples of different areas GIS technology have been applied in public health. A search of scientific databases and online resources was undertaken to describe the uses of GIS technology in public health research. Our study contributes to research examining the uses of GIS in public health in two ways: It gives an understanding of how GIS can be adapted and applied to public health decision-making in developing countries, and it identifies both barriers limiting GIS use in Africa and measures that can be used to successfully apply GIS in its public health sector. Additionally, our literature review adds knowledge on how GIS technology is understood by decision-makers, health professionals in evidence-based planning and decision-making processes. Conclusively, there are many African studies in the literature that have benefited from using (in which the use of) GIS technology in guiding to (helped) solve health problems.

Keywords: Geographical Information Systems; Public health sector; Uses; Africa

DEMYSTIFYING THE IMPACTS OF COVID-19 ON THE REAL ESTATE MARKET IN DEVELOPING COUNTRIES. CASE OF COMMERCIAL PROPERTIES IN MALAWI

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International Monetary Fund described the economic downturn caused by COVID-19 pandemic as the worst economic recession since the great depression of 1930 and predicted a global economic set-back worse than the global financial crisis of 2007. What began as a humanitarian crisis emerged into economic crisis of uncertain capacity with long-lasting impacts on commercial real estate based on the nature of the responses including policies instituted by governments to curb the vice. This study sought to assess the impacts of COVID-19 on commercial properties in Blantyre-Malawi by using mixed methods design to collect data from property managers and tenants who were sampled purposively and randomly respectively. Descriptive data was analysed using Statistical Package for Social Sciences and correlation analytics and Taguette Qualitative Data Analysis (QDA) Software for thematic data. COVID-19 resulted into decreased demand for office space by prospective tenants. Additionally, transitioning to teleworking reduced demand for office space which resulted into reduction of rent escalation rates by altering lease/contractual agreements to mitigate the effects of the pandemic on tenant's ability to pay rentals. Furthermore, there was need for investment in sanitary fittings to limit infection risks in office space environments which would become key sustainability features of offices in the long run. Therefore, this study recommends flexibility of rent payment and inclusion of clauses in commercial office leases that allow lease reviews in times of economic downturn and uncertainty. Furthermore, property investors should retrofit commercial properties through investment in sanitary fixtures and fittings that limit the spread of COVID-19.

Keywords: Covid-19; Commercial property; Property market; Lease agreement; Sustainability; Office space

DISASTER PREPAREDNESS RESPONSE DURING COVID-19 PANDEMIC IN UGANDA

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There were several disasters (floods, landslides, locusts) reported in Uganda during the Covid-19 pandemic. When disasters occur during a pandemic, this would imply to a phenomenon of cascading disasters or compounding disasters. Therefore, a single hazard approach to disaster response system is not suited for this scenario. In Uganda, there was need to integrate new measures, including basic skills training on handling Covid-19 for disaster responders, standard operation procedures (SOPs) and guidelines for disaster response to adapt to a multi-hazard approach. An assessment was conducted to determine the impact of the Covid pandemic on preparedness and response to natural disasters. A cross-sectional household survey covering 150 respondents and 10 Key Informants was administered through interviews and questionnaires in Bududa and Bulambuli districts. Data analysis involved descriptive and inferential analysis. The pandemic negatively affected disaster preparedness and response, making it harder to plan for evacuations in the event of floods and landslides. Specific concerns included negative consequences of Covid on evacuation procedures, search and rescue teams, assessment teams, health services and relief distribution systems. Competition for funds to support disaster-related activities in local government structures also hindered response to other disasters. However, several strengths based on disaster preparedness experience and capabilities were identified, including providing a framework for how to integrate Covid response with other disaster preparedness plans and activities. This could serve as a starting point for Uganda to shift the disaster response system from a single-hazard approach towards a multi-hazard approach.

Keywords: Disaster preparedness; Disaster response; Hazard

IMPEDIMENTS CONTRIBUTING GIS TECHNOLOGY NON-USE IN UGANDAN HEALTH SECTOR ORGANIZATIONS

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Many barriers contribute to non-use of geographic information system (GIS) technology in health sector organizations worldwide. The study described in this paper explored which barriers contribute to the non-use of GIS technology in Ugandan health organizations. To determine which barriers hinder the use of GIS technology in Ugandan health sector organizations, we used thematic coding to analyse our qualitative content. The study findings indicate that the following barriers contribute most to GIS technology non-use in Ugandan health sector organizations: a lack of awareness, knowledge, understanding, and information about GIS technology and activities it can be used for; a lack of funds to implement a GIS infrastructure and to acquire necessary equipment; insufficient skills of personnel in handling and maintaining geospatial data, in collecting field data, and in handling GIS field activities; and high costs of GIS-related hardware, software, license renewal, and yearly version upgrades. GIS technology use in organizations handling health-related activities requires the Ugandan government to enact a GIS-technology policy and to assign the responsibility for Ugandan GIS data to a ministry. This will enable GIS professionals to create awareness through practical demonstrations of health organizations successfully using GIS technology for their activities. Equally, health organizations, GIS professionals, users of GIS technology, geospatial producers, and interested individuals should jointly develop and implement an integrated collaborative spatial-data infrastructure (SDI).

Keywords: Geographical information System; Contributing barriers; Health sector organizations; Uganda

EXPLORING IMPACTS OF GIS TECHNOLOGY USE IN UGANDAN HEALTH SECTOR ORGANIZATIONS

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The effects of geographical information system (GIS) technology are numerous. Aim of this study was to explore effects of GIS technology. The research utilized qualitative survey design and purposive sampling to collect qualitative data in the health sector in the study area. Interview guide constructed by the researcher helped the study data collection. Thematic coding was used to analyze qualitative study effects. The study findings indicate the following effects: Seven beneficial themes with forty-two respective sub-categories emerged: system quality, information quality, information use, user-satisfaction, individual, organizational, and societal effects. Four shortcomings' themes with seven sub-categories emerged: system quality (sub-categories: technical and GIS equipment), organizational impact (sub-category: institutional), user-satisfaction (subcategory: attitude), and societal effect (sub-categories: legal, social, and economic). Further findings indicate benefits of GIS technology range from reducing operational costs to enhancing data integration, and from accessibility to sharing and utilizing health information. Shortcomings range from requiring expertise, poor data quality, yearly software renewal and expensive hardware purchase, and resource intensity to establishing, buying and maintaining a GIS infrastructure, and, no privacy, and confidentiality to creating staff reduction and unemployment. The growth and wide use of technology in organizations requires awareness and sensitization to encourage adoption and increase collaboration, partnership, and sharing of geospatial data to avoid duplication.

Keywords: Geographical information System; Impacts; Health sector organizations; Uganda

CURRENT AND POTENTIAL NATURE OF ACTIVITIES OF GIS TECHNOLOGY USE IN UGANDAN HEALTH ORGANIZATIONS

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This paper examines the uses of Geographic Information Systems (GISs) in health sector organizations in Kampala, Wakiso-Entebbe, Gulu and Rakai, in Uganda. Of the 75 participating organizations handling health-related activities in Uganda, 43 organizations were and 32 were not using GIS technology. The study's aim was assessing the nature, and identifying the users of GIS technology and purpose of GIS technology use in the organizations, the rationale behind the organizations' GIS technology use, and the activities for which GIS technology has been used in the studied organizations. In this study's qualitative approach, snowball interviews helped identify the participating organizations. The results show that even though many organizations use GIS technology, its use is project based in Ugandan health organizations. Once a project has ended, most organizations stop using GIS technology until another GIS-based project is implemented. Furthermore, even though GIS benefits can be articulated in the health sector, most organizations are lacking the skills and knowledge to be able to adequately apply GIS technology during activities. This study also indicates that GIS technology has only been scarcely used for activities indicated in GIS literature (e.g., surveillance disease modeling, crisis management, and risk analysis), and widely in health care research and management, community health profiling, disease mapping, and strategic health planning. However, it has neither been used in built environments and neighborhoods, nor in spiritual health. The results also show that GIS technology can be used in communication and advocacy of services, coordination and monitoring of immunization programs, fleet management, vehicle and health-commodities tracking, food security, and health/nutrition livelihood. Furthermore, the results indicate that despite obvious reasons for applying GIS technology in these activities, organizations tend to use basic GIS techniques, and when advanced methods are used, these are outsourced to external contractors with expertise. This illustrates a significant GIS under capacity within the studied health sector organizations. Conclusively, this study shows the importance of creating awareness and sensitizing Ugandan health sector organizations to the use of GIS technology and to its benefits when applied in health-related activities.

Keywords: Geographical Information System; Qualitative Method; Public Health; Activities; Health Sector; Uganda

ASSESSING SOIL ORGANIC CARBON STOCK AND ITS PARTICLE SIZE 2 FRACTIONS ACROSS CROPPING SYSTEMS IN KITI SUB-WATERSHED IN CENTRAL BENIN

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Soil organic carbon storage in agricultural soil constitutes a crucial potential for sustainable agricultural productivity and climate change mitigation. This paper aims at assessing soil organic carbon stock and its distribution in three particle size fractions across five cropping systems located in Kiti sub-watershed in Benin. Soil samples were collected using a grid method on four soil depth layers: 0-10, 10-20, 20-30 and 30-40 cm in five cropping systems maize-cotton relay cropping (MCRC), yam-maize intercropping (YMI), teak plantation (TP), 5-years fallow (5YF) and above 10-years fallow (Ab10YF). Soil organic carbon stock (C stock) was estimated for the different soil layers and particle-size fractionation of soil organic matter considering three fractions. The fractions of coarse particulate organic matter (cPOM: 250-2000 µm), fine particulate organic matter (fPOM: 53-250 µm and non-particulate organic matter (NOM: < 53 µm) were separated for two layers 0-10 and 10-20 cm. The results show that fallow lands Ab10YF and 5YF exhibited the highest C stock 17.74 and 22.20 mg C.ha-1 while cultivated land under tillage MCRC and YMI depicted the lowest C stock. The three organic carbon fractions showed a significant variation across the cropping systems with the NOM fraction holding the largest contributions to total soil organic carbon for all the cropping systems. The cPOM and fPOM were the most influenced by cropping systems with the highest concentration observed on Ab10YF and 5YF. The findings provide insights for upscaling farm management practices towards sustainable agricultural systems with substantial potential for carbon sequestration and climate change mitigation.

Keywords: Carbon sequestration; Sustainable farming systems; Particulate organic carbon; Particle-size fractionation

LIVELIHOOD DIVERSIFICATION AND MULTIDIMENSIONAL CHILD POVERTY

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The objective of the study is to ascertain the linkage between household livelihood diversification and child poverty. Multistage sampling methods were used to select 401 respondents from four kebeles based on probability proportional to size. Enumerator-administered interview schedules were used to collect data from the sample households. Data were analyzed using descriptive statistics and multivariate analysis methods. A multidimensional approach was used to analyze child poverty considering indicators like nutrition, health, education, water, sanitation, housing condition, information, energy, and proportion of total annual income to household size. The result from the descriptive analysis revealed that about 80% of children in the study area are multi dimensionally poor. The Simpson diversity index was used to measure the extent of livelihood diversification. The result showed that nearly 56% of households have very highly diversified and 25% of them have moderately diversified their livelihoods. The results on the linkage between the extent of household livelihood diversification and child poverty showed that most livelihood diversification activities have a significant effect on child poverty reduction.

Keywords: Extent of livelihood diversification; Multidimensional child poverty; Multivariate analysis; Dietary diversity score; Household poverty status

HOW CHANGES IN CLIMATE ARE AFFECTING PEOPLE'S WELFARE IN UGANDA?

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We analyse six sets of Uganda's National Panel Survey (UNPS) collected by UBOS from 2009 to 2019 and Uganda's climate data from 1979 to 2013 at the household level to show the impact of variability in climate on welfare of Ugandans. Our results show that indeed Uganda's climate is changing especially the rainfall reliability and patterns which have a great impact on Uganda's main economic activity – rain fed agriculture. As a country, we have just witnessed a very long dry spell that has drastically affected agricultural yields and as a result, reduced farmers' incomes and at the same time led to increase in price of agricultural produce, this might rise the number of poor people in the country. The results further show that in comparison to changes in temperature, changes in precipitation have a greater impact on welfare of Ugandans especially those with limited non-farm employment and livelihood options. We analyse six sets of Uganda's National Panel Survey (UNPS) collected by UBOS from 20009 to 2019 and Uganda's climate data from 1979 to 2013 at the household level to show the impact of variability in climate on welfare of Ugandans. Our results show that indeed Uganda's climate is changing especially the rainfall reliability and patterns which have a great impact on Uganda's main economic activity – rain fed agriculture. As a country, we have just witnessed a very long dry spell that has drastically affected agricultural yields and as a result, reduced farmers' incomes and at the same time led to increase in price of agricultural produce, this might rise the number of poor people in the country. The results further show that in comparison to changes in temperature, changes in precipitation have a greater impact on welfare of Ugandans especially those with limited non-farm employment and livelihood options.

Keywords: Climate variability; Household consumption expenditure; Uganda

PASTORALIST LIVELIHOOD VULNERABILITY TO CLIMATE CHANGE AND VARIABILITY IN SOUTHERN ETHIOPIA

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Climate change is adversely affecting pastoralists' livelihood in Ethiopia. However, the level of vulnerability varies across the communities. Identification of factors that influence the level of vulnerability to climate change is crucial to select appropriate and effective adaptation mechanisms. This study was conducted to measure the livelihood vulnerability of Borana pastoralists to climate change and variability in southern Ethiopia. Pastoralists' households were sampled using multistage sampling techniques. Quantitative and qualitative questionnaire surveys were employed to collect data at the household level. A total of 27 socio-economic and biophysical indicators were used to reflect vulnerability components: adaptive capacity, exposure, and sensitivity. Vulnerability was measured as the net effect of adaptive capacity, sensitivity, and exposure to climate change and variability. Principal Component Analysis (PCA) was used to develop weights for indicators and to produce Livelihood Vulnerability Index (LVI) to classify households according to their level of vulnerability. To understand the determinants of vulnerability to climate-induced stresses, an ordinal logistic regression model was employed with predictor variables. The results showed that 24.4% of households were highly vulnerable, 60.3% were moderately vulnerable and 15.3% of households were less vulnerable to climate-induced stresses. Factor estimates of the logistic model further revealed that early warning information, bush encroachment, coping strategy, temperature, drought frequency, provision of humanitarian services, and food shortage during the normal season of the year have a significant influence on vulnerability in the study area. Therefore, policies that address these determinants of vulnerability likely enhance the resilience of pastoralist households in the study area.

Keywords: Borana pastoralist; Climate variability; Drought; Livelihood vulnerability; Vulnerability index

FACTORS INFLUENCING THE ADOPTION OF CONSERVATION AGRICULTURE PRACTICES AMONG SMALLHOLDER FARMERS IN MOZAMBIQUE

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This study aimed to identify the factors that influence smallholder farmers' decisions to adopt four different conservation agriculture (CA) practices (i.e. minimum tillage, intercropping, cover cropping and crop rotation) in Mozambique. A non-probability sampling approach, incorporating both purposive and accidental sampling types, was followed. Three agro-ecological regions, followed by four provinces, were purposely selected. In addition, Accidental sampling was used to select 616 smallholder farmers from 38 communities in the three agro-ecological regions where CA projects were historically implemented by several NGO institutions. A questionnaire was administered to the 616 selected smallholder farmers. A descriptive logit model was applied in STATA to determine the probability of respondents adopting CA practices. The findings show that 44.6% of smallholder farmers adopted one or more of the CA practices, and 55.4% did not. It was also clear that most farmers did not adopt all components CA. Results obtained revealed that household size, animal ownership, communication assets (such as television, radio, and cell phone) and group membership had a positive influence on CA adoption. Interestingly, female-headed households were more likely to adopt CA. Awareness of soil health decline is an important factor determining adoption. The study concluded that the reasons for adoption are site-specific and a 'blanket approach' to promote adoption of CA is unlikely to be successful.

Keywords: Agro-ecological region; Cover cropping; Crop rotation; Intercropping; Logit model; Minimum tillage

PHYSIOLOGICAL FEATURES REACTIVITY OF ARSI-BALE GOATS REARED UNDER THE THREE AGRO-ECOLOGIES OF THE BALE ZONE, SOUTHEASTERN ETHIOPIA

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The study aimed to evaluate physiological features responsiveness of Arsi-Bale goats reared under the three agro-ecologies for the effects of season, sex and age groups. Data were collected from 90 goats kept in a free-range milieu. Data were recorded on bioclimatic and live body weight. SAS, 2012 vr.9.4 were used for analyses. The impacts of climatic and physiological variables were significantly different ($p<0.05$) among agro-ecologies in dry and wet seasons. The thermal effect magnitudes were varying existed severe and extremely severe conditions across season. The effects of thermal load were non-significant ($p>0.05$) for sex while significant ($p<0.05$) for age groups. The reactive response indicator thermal indices were highly significant ($p<0.05$) across a season and agro-ecologies. More, heat tolerance index varied experiencing moderate to severe stress during wet and dry season affecting significantly weight gain performances ($p<0.05$) for cold and hot stress, respectively. The comfort bioclimatic condition indices of general, effective and practical's were highly significant ($p<0.05$) among agro-ecologies across seasons. As well, the comfort environment indices of general, effective and practical's were highly significant ($p<0.05$) across seasons and among agro-ecologies. The comfort bioclimatic conditions were highly correlated with physiological responses for their impacts in production ecology. But, heat tolerance coefficients were negatively correlated due to biotic sways on growth rate. Therefore, the study concluded that in order to maintain yield by providing a suitable habitat for ecotypes, production ecologies require interventions during cold stress for night shelter and feeding strategies to reduce heat exposure promptly and offer supplementary feed.

Keywords: Pulse rate; Rectal temperature; Relative humidity; Respiration rate; Thermal indices

CLIMATE CHANGE ADAPTATION PRACTICES FOR SUSTAINABLE SORGHUM PRODUCTION IN DRYLANDS OF ETHIOPIA

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Even if agriculture is the basis for most African countries, like Ethiopia, it is bedeviled by many production limiting factors. In most developing countries like Ethiopia, climate is the major factor which significantly determine production and productivity of agriculture upon its strong reliance on rainfall system. This day, climate change has intensified the ongoing food security challenges of Ethiopia making many million Ethiopians food insecure. Therefore, research and development attention is needed to make agriculture climate smart that adopts the new normal climate. The major target of this research is to evaluate and identify potential adaptation practices for sorghum production in dry land growing regions of Ethiopia. Cropping System Model (CSM) approach; which Decision Support System for Agro technology Transfer (DSSATv4.8) is used to conduct this research. Model calibration and performance evaluation for the two sorghum cultivars; ESH-1 and ESH-2; were conducted and the model shows a good fit in observed and simulated outputs for anthesis, maturity and grain yield. According to the result, yield variation is observed across location, variety and time periods. In this regard, production is a bit risky at Miesso relative to Kobo and Melkassa areas. In general, climate change impact would be intensified by 2080s. Here with, mid planting (16-30 June) and increasing rate of fertilizer by 50 percent would enhance sorghum production under a changing climate. Finally, the study concluded that the ongoing food production challenges would be intensified, unless appropriate adaptation plans be designed. Indeed, the findings of this study would give a huge insight for policy makers, researchers, and agricultural experts to aware them for further decisions concerning future sorghum production.

Keywords: Adaptation; Climate change; DSSAT; Sorghum and dryland

OCCUPATIONAL HEALTH, SAFETY AND ENVIRONMENTAL IMPLICATIONS OF FLOWER FARMING ON THE LOCAL COMMUNITIES IN CENTRAL UGANDA

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This study examines the Occupational Health and Safety implications of flower farming on the local communities in central Uganda. It also explores the environmental impacts particularly the ways in which the chemicals and other agro-inputs employed in the propagation of flowers are invariably affecting the fragile landscapes within and around the Lake Victoria basin where the farms are located. A qualitative research design and methodology was employed, with multiple data collection which included interview, focus group discussion and survey. The findings show that Occupational Health and Safety issues remain a major problem at the flower farms. While some of the workers are provided with protective equipment such as gloves and boots, others simply do not have any or have worn out protective gears. Other workers reported irritation, painful and sore eyes, stiff necks, back pain and constant headache, with some women indicating that miscarriages arising out of inhalation of chemicals used in the pests and diseases control processes are commonplace at the farms. Pollution of the environment by the chemicals was widely reported. The study recommends increased vigilance of flower farm owners in terms of the provision of safety gears and also to put in place stringent environmental protection policies to minimise the contamination of the ecosystems within and around the areas where the flower farms are located.

Keywords: Flower farms; Environment; Agrochemicals; Occupational Health and Safety

TACKLING CLIMATE CHANGE-RELATED DISTURBANCES TO SUSTAIN LIVELIHOODS: PERCEPTIONS AND ADAPTATION STRATEGIES OF SMALLHOLDER FARMERS IN NORTHEASTERN BURUNDI

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Rain-fed agriculture remains the principal source of employment for most of Burundi's population, especially in the northeastern part of the country. This research aims to examine farmers' perceptions and practices in adapting to climate change and variability in the North-East region of Burundi, based on data from 200 smallholder farmers and on actual weather data recorded between 1986 and 2017. The results show that farmers in the area are aware of climate change and variability and are adjusting to adapt their agriculture in response to changes in climate. Over 80% of farmers have adopted at least one adaptation strategy among the nine assessed. Changing crop varieties, planting shade trees, and changing fertilizers are the main adaptation strategies implemented by farmers in the study area. The results of a binary regression model reveal that the farmer's education and experience in farming, as well as the farm's size and the household's size, livestock ownership, access to climate information, access to credit, and farm income, are all highly influencing smallholders' decisions regarding adaptations to cope with climate change. The main obstacles are the lack of information on climate and adaptation strategies, and poverty, making it difficult to cope with the increased costs of farming. The present study suggests the need for strengthening farmers' capacities and improving the institutional framework for climate change adaptation to improve farmers' livelihoods. Implications for policy-making will be to make credit facilities more flexible and invest in training for extension agents on climate change education and adaptation strategies.

Keywords: Climate change; Smallholder farmers; perceptions; Adaptation strategies; Northeastern Burundi

ENVIRONMENTAL AND ECONOMIC IMPLICATIONS OF ZERO GRAZING

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The study was about the environmental and economic implications of zero grazing in Kaato a subcounty in manafwa district. The specific objectives were to assess the feedstock demand and availability to support zero grazing, to assess the quantity of greenhouse gases emissions due to zero grazing and lastly to determine the economic implications of zero grazing to the environment. The study adopted a descriptive survey design. It was a mixed method study with both quantitative and qualitative paradigms. In quantitative approaches data collection and analysis necessitated a clear understanding of the association among variables using either descriptive or inferential statistics. While in qualitative data was transcribed and organized in themes. The study population was 179, constituting livestock farmers 142, farmer forum members 28 and 9 production staffs. From this the sample was 118 and the final response rate was 116 giving a percentage of 98.3%. Data was collected through questionnaires, interviews, observations and data worksheets then analysed both qualitatively and quantitatively. The study revealed that there is a significant correlation between zero grazing and the environment. Zero grazing was adopted because of land fragmentation with the average number of animals kept ranging between 1_3. They mainly depend on banana stems and elephant grass however affording other feeds is a challenge. Secondly the study revealed that GHG emissions resulting from manure storage are at minimal levels for both manure and nitrous oxide. Also poorly fed animals were not healthy and had problems with digesting what they had consumed. The animal produced carbon dioxide and methane in the process of digestion. Finally the study revealed that farmers were not aware of the economic implications of zero grazing. However due to the behaviour of farmers cutting young banana stems and then use them to feed animals and their concentration on animals at the expense of other important activities like land cultivation food insecurity is evident. The study recommended that farmers need to be educated about feeding regimes, responsive manure storage practiced and also how to benefit from zero grazing while at the same time ensuring that damage to the environment is mitigated.

Keywords: Zero grazing; Feedstock demand; Economic implications; Greenhouse gases

LABLAB PURPUREUS: ANALYSIS OF LANDRACES CULTIVATION AND DISTRIBUTION, FARMING SYSTEMS, AND SOME CLIMATIC TRENDS FOR PRODUCTION IN TANZANIA

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Lablab is a multifunctional crop that was underutilized in Africa. This study was performed to assess Lablab landraces cultivation and distribution, farming systems and some climatic trends in Lablab production in Tanzania. A socio-economic survey was engaged to locate the main production areas using GPS while participatory research was used to assess farmers' practices, farming systems and challenges in production. Some weather data was collected to establish climatic trends in Lablab production. The study, revealed a wide cultivation and distribution of Lablab landraces in five agro-ecological zones with some variations. These variations were influenced by market demand for the crop in Kenya and its role in subsistence farming. Farmers were producing Lablab for conservation agriculture and enhanced soil fertility (27.9%), marketing (22.1%), livestock feeding (21.5%), food during drought conditions (15.4%), traditional purposes (7.4%), regular consumption (3.8%) and other minor uses (1.8%) varied significantly across the zones ($\chi 2=37.639$, $p=0.038$). A wide range of farmers' practices in production were noted zone-wise. Their farming systems included intercropping (59.0%), mono-cropping (31.0%), home based gardening (5.0%), crop rotation (3.0%) and relaying cropping (2.0%) with no significant difference across the zones ($\chi 2=15.049$ $p=0.314$). Farmers mentioned unavailability of improved varieties and poor markets as their key challenges in production. June and July were established as the driest months across the zones. It was finally suggested that effort should be put forward to develop improved varieties while enhancing genetic resource conservation. A need should also be there to enhance value addition while diversifying market channels to other countries.

Keywords: Lablab purpureus; Landraces; Farming systems; Agro-ecological zones; Climatic trends

MITIGATION OF GREENHOUSE GASES AND NUTRIENT LOSSES ATTRIBUTABLE TO WASTED FRUITS AND VEGETABLES

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Given their perishable nature, substantial quantities of fruits and vegetables (FV) are lost along the supply chain due to various reasons including lack of refrigerated transport systems, rough road conditions, and a lack of cold storage facilities. The objectives of this research were to (i) quantify the wastage of selected FV and nutrient losses at each stage of the supply chain, (ii) investigate emissions of greenhouse gas (GHGs) from three FV waste management technologies namely, aerobic composting (AC), anaerobic digestion (AD), and Black soldier fly larvae (BSFL) composting, and (iii) optimize the lowest GHG emitting technology for better utilization of wasted FV. A predetermined quantity of FV was sorted at each stage of the supply chain to determine FV wastage as well as to collect samples for nutrient loss analysis. For emissions of GHGs, the static chamber method was used. Four different mixes of FV waste and cow dung were used to optimize AD. The losses of potato, mango, banana, and tomato from main FV growing districts along the supply chain were 19.8, 27.6, 34.1, and 39.3% respectively. Nutrient loss ranged from 4.31% (Potassium) to as high as 20.76% (Nitrogen). The total Carbon dioxide emissions for the different FV waste treatment methods investigated were 108.0, 87.5, and 61.21 g CO_2 kg-1 of FV waste initial FV for BSFL, AC, and AD respectively. AD, the lowest GHG emitting technology was then optimized for better utilization of wasted FV. A 50:50 (FVW: cow dung combination) operated at mesophilic temperature yielded the highest biogas value of 1328.4 mL/gVs with a methane content of up to 60.5%. This particular combination also had a nutrient content of N, P, and K of 64.6, 15.3, and 20.3 gkg-1, respectively, recoverable in the digestate. The heavy metal contents of Cu, Zn, Pb, Fe, and Mn of 0.02, 0.05, not detectable, 88.6, and 3.67 gkg-1 were below and within the range of compost quality guidelines and standards for unrestricted use by international standards. Overall, this study established that AD should be utilized to ultimately reduce GHG emissions and nutrient losses while managing wasted FV.

Keywords: Circular economy; Fruit and vegetable waste; Greenhouse gases; Nutrient losses; Mitigation

PAST AND FUTURE TRENDS AND MAGNITUDE OF CLIMATE VARIABILITY AND CHANGE IN A FRAGILE TROPICAL MOUNTAIN CATCHMENT. A CASE OF SIRONKO CATCHMENT ON THE SLOPES OF MT. ELGON, EASTERN UGANDA

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Rain-fed agriculture is one of the major drivers of livelihoods in Sironko catchment. This study assessed the past-future 1980-2009/2025-2040 trends and magnitude of climate variability and change in Sironko catchment to support policy and practice. Climate data for three virtual stations Buginyanya, Kumi and Nakapiripirit were obtained from the Modern Era-Retrospective Analysis for Research and Applications (MERRA) provided by the Agricultural Model Inter-comparison and Improvement Project (AgMIP). Future climate was statistically downscaled from 29 Global Circulation Models (GCMs) of the Intergovernmental Panel on Climate Change (IPCC) Fifth Coupled Model Inter comparison Project (CMIP5). Five regimes Cool-wet, Col-dry, Hot-wet, Hot-dry, and Middle were considered under Representative Concentration Pathways RCP 4.5 and RCP8.5. Data analyses focused on the crop growing seasons: March, April, May (MAM), September, October, November (SON) and annual time scales. Variability was computed using descriptive statistics while trends and trend magnitudes were determined using Mann–Kendall trend test and Sen's slope estimator. One-way sample t-test confirmed any significant difference in seasonal rainfall. Result showed that SON rainfall is highly variable (CV > 30), MAM rainfall is less/moderately variable (CV < 20)/(20 < CV < 30). Significant increase ($p < 0.05$) detected in mean temperatures across Sironko catchment. Significant differences ($p < 0.05$) detected between MAM and SON rainfall both in past and future depending on model and scenarios. Nakapiripirit station registered significant increase in annual rainfall ($p < 0.05$) between 2025-2040 under both RCPs and all regimes. Famers should target MAM, grow pest resistant and temperature tolerance crops varieties.

Keywords: Substance agriculture; Livelihoods; Growing seasons; Virtual stations

COMMUNITY CLIMATE CHANGE COPING STRATEGIES AROUND AND WITHIN SAADANI NATIONAL PARK, TANZANIA

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This study aimed at assessing the coping mechanisms in response to the impacts of climate change and variability in three purposively selected villages of Saadani, Matipwili and Gongo located adjacent and within Saadani National Park (SANAPA) in Tanzania. Data were collected in 2017 using Key Informant Interviews (KII), Focus Group Discussion (FGD), Household Questionnaire, field observation and review of secondary data sources. Questionnaires were randomly administered to 10% of the total households in each study village leading to 161 households. Qualitative data were organized and analyzed using content analysis while quantitative data were analyzed using SPSS version 20.0. The findings from the study indicated that communities in the study villages had been negatively affected by climate change and variability impacts. Those impacts were such as prolonged drought, sea level rise, change in rainfall patterns, increase in floods and changes in wind speed and patterns. Mann Kendall trend tests showed a significant trend of increase in temperature ($p<0.05$) and decrease of rainfall trend ($p<0.05$) which supported respondents' perceptions about increase and decrease of temperature and rainfall respectively. In coping to climate change impacts and variability, communities employ multiple of coping strategies such as cultivating varieties of drought and diseases resistant crops, searching for other jobs in nearby cities such as Dar es Salaam, conducting petty business, increasing fishing nets and use of improved fishing gears/vessels. These coping strategies could enhance not only community resilience to climate change impacts but also address sustainable development if taken into consideration.

Keywords: Climate change and variability; Coping strategies; Community livelihoods; Saadani National Park; Coastal communities

CLIMATE SMART AGRICULTURE TECHNOLOGIES FOR ENVIRONMENTAL MANAGEMENT: THE INTERSECTION OF SUSTAINABILITY, RESILIENCE, WELL BEING AND DEVELOPMENT

Jean D Amour Niyokwizera

Agriculture sync with the existence of humanity. Converging demands from human population, food security, climate change mitigation and adaptation, agricultural resources, biofuel and oil prices, food prices, have engendered a new transformative, resilient and smart agricultural approach entitled “Climate Smart Agriculture”. Rapid alteration by humans on agricultural landscape driven by aspirations to maximize production, productivity, and profit with scant regard to environmental concerns led to the degradation of agricultural lands, alteration in global carbon and nitrogen cycles, loss of soil fertility and biodiversity, pest and disease outbreaks. Under such circumstances, agriculture production system must be insured against impending danger of climate change; augmented with diversity of biological resources; enhanced with adaptive capacity and resilience; provided with site-specific sustainable management practices like integrated crop management, conservation agriculture, agriculture diversification and landscape management. Climate Smart Agriculture (CSA) is construed as a “comprehensive agricultural approach that aims at sustainable productivity enhancement, mitigation of and adaptation to climate change, and achieving global food security and other related sustainable development goals”. CSA incorporates the virtues of “climate-smart food system”, “climate-proof farms”, and “climate-smart soils”. Climate-Smart Agriculture (CSA) is seeking to overcome the food security problem and develop rural livelihoods while minimizing negative impacts on the environment. However, when such synergies exist, the situation of small-scale farmers is often overlooked, and they are unable to implement new practices and technologies. Therefore, the main aim of this study is to improve CSA by adding the neglected but very important element “small-scale farmer”, and introduce Vulnerable-Smart Agriculture (VSA) as a complete version of CSA.VSA indicates, based on the results of this study, that none of the decisions made by policymakers can be realistic and functional as long as the voice of the farmers influenced by their decisions is not heard. Therefore, to identify different levels for possible interventions and develop VSA monitoring indicators, a new conceptual framework needs to be developed. This study proposed such a framework consisting of five elements: prediction of critical incidents by farmers, measuring the consequences of incidents, identifying farmers' coping strategies, assessing farmers' livelihood capital when facing an incident, and adapting to climate incidents.

Keywords: Climate smart agriculture; Food security Resilience; Sustainable development goals; Environmental stewardship; Technological use in agriculture

CLIMATE VARIABILITY AND AGRICULTURAL PRODUCTIVITY IN UGANDA

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Uganda's climate is changing in terms of increasing temperatures and altered precipitation patterns, leading to extreme meteorological conditions such as prolonged drought, floods and landslides, yet the majority (70 percent) of Ugandans largely rely on rain fed agriculture, which can easily be affected by climate variability. Thus, this study investigates the effect of climate variability on agricultural productivity in Uganda by combining the long-term climate data sourced from the United States National Oceanic and Atmospheric Administration (NOAA) and six waves of Uganda National Panel Survey (UNPS) spanning over the period 2009 to 2019. Trend analysis and the regression analysis estimated with panel data confirm the existence of climate variability as well as vulnerability of farming households especially to precipitation variability across all regions of Uganda. The regression results indicate a significant U-shaped impact of precipitation variability on agricultural productivity with a turning point experienced when the coefficient variation of precipitation is 1.06. Regional and crop specific analysis show that relative to other regions of the country, Eastern Uganda is likely to be most affected region while beans and banana crops are likely to be more affected by climate variability as compared to other crops such as maize and cassava. The study thus recommends measures aimed at encouraging farmers to adapt to climate variability and of precipitation variability and increase agricultural productivity in Uganda such as farmer provision of extension services and training farmers on how to use irrigation across the entire country.

Keywords: Climate variability; Agricultural productivity; Maize; Panel data; Uganda

WHAT SOCIO-ECONOMIC, INSTITUTIONAL AND CLIMATE RELATED FACTORS INFLUENCES THE DEMAND FOR CLIMATE SMART AGRICULTURAL PRACTICES?

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Climate change is a current threat to food security, a limiting factor to increasing per capita income and food production among smallholder farmers in Eastern Uganda. The study investigated if socio-economic, institutional and climate related factors influences the demand for climate smart agricultural practices. Multi-stage stratified random sampling technique was employed, 240 respondents interviewed in districts of Namutumba, Bugiri and Busia in Eastern Uganda in 2020 A cropping season. Primary data was collected through face-to-face interviews. To group CSA practices, a Principal component analysis (PCA) was applied, and Poisson Regression analysis was used in analyzing demand for CSA practices. Multinomial Endogenous Switching Regression was employed in analyzing the effect of using the practices on household food security status. Results revealed that 14 individual CSA practices which were grouped into 4 were actively in use. The groups included: crop management, field management, farm risk reduction and specific soil management practices. The results also showed that demand for CSA practices was positively influenced by gender of the household head, household size, levels of education and participation in off-farm employment, farm size, group membership, and annual contacts with extension service agents, credit access and negatively influenced by age of the household head. The mean number of CSA strategies used by farmers was 2 applied by 44.8% of farmers. Most importantly, it was evident that CSA practices had a great potential to solve food security challenges. A complete package with crop management, field management, farm risk reduction and specific soil management practices had the highest implication to food security. To improve demand for CSAs, farmers need to be motivated to join and participate in farmer organizations trainings through which they could gain access to extension information and credit. Additionally, farmers should be sensitized on the need to invest in farm productive assets in order to absorb the risks of climate change while also enabling them to benefit from use of CSAs which require these important assets. Finally, land fragmentation should be discouraged through civic education and provision of alternative income generating activities for farmers to benefit from CSAs when practiced on relatively bigger land.

Keywords: Climate: variability; Socio-economic factors; Institutional factors; Climate smart agriculture; Food production; Climate change

ASSESSING THE ADAPTIVE CAPACITY OF HOUSEHOLDS TO WATER SCARCITY DURING DROUGHT IN KASALI SUB-COUNTY, KYOTERA DISTRICT, UGANDA

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Approximately 4 billion individuals globally are experiencing water scarcity due to drought. In Uganda about 10% of the population per year experience water scarcity due to drought especially in the south and north-eastern parts of the country. Studies are therefore required to understand the situation to develop mitigation and adaptation strategies. The objective of this study was to assess drought and the adaptive capacity of households to water scarcity during drought in Kasali sub-county (SW Uganda). This was done through determining drought trends in a 30-year period (1987-2017), assessing the impact of drought on water availability, determining the adaptation strategies of households to water scarcity and assessing the indicators of adaptive capacity of households to water scarcity. Data was collected using 195 household surveys, interviews and 3 focus group discussions. Temperature and rainfall components were analyzed using regression analysis. Drought values per year were assessed using RDI and SPI values calculated using Drought index Calculator (DrinC). The climate results for 1987-2017 show a decrease in the average annual rainfall, MAM and JF seasons, while SOND and JJA seasons show an increase in rainfall trend. Additionally, the average maximum and minimum annual temperature, MAM, JJA, SOND and JF seasons increased significantly. Average minimum temperature increased more than the average maximum temperature. Kasali experienced one extremely dry year (1991-1992) and four moderately dry years (1988-1989, 1999-2000, 2008-2009, 2016-2017) based on RDI. SPI values show that 1988-1989 was an extremely dry year, 1991-1992 was a severely dry year and 199-2000, 2008-2009, 2016-2017 were moderately dry years. Households spend longer hours collecting water during dry years than wet years hence drought has had a negative impact on water availability in the region. Adaptive capacity of households to water scarcity in Kasali based on the indicators of adaptive capacity was moderate.Generally, Kasali has had increased temperature, reduced precipitation and increased drought events over the 30-year period which has reduced water availability. Households have few adaptation strategies to water scarcity and their adaptive capacity is moderate. The study recommends provision of early warning information, more water points and adaptation strategies to the households.

Keywords: Climate change; Water scarcity; Drought; Adaptation; Mitigation

FENCING LANDS TO ENHANCED CLIMATE CHANGE RESILIENCE, PROMOTING BIODIVERSITY REGENERATION AND IMPROVED LIVELIHOODS OF CLIMATE CHANGE IN MAKUENI AND BARINGO COUNTIES

Francis Kevogo Keya, Frank Wesonga

AAHRED

Kenya is a food insecure country, weather patterns are drastically changing and people are losing livelihoods and earnings when their lands dry, water for domestic supply lacks and livestock die further frustrating livelihoods of the poor. This paper briefly discusses Fencing of lands as prerequisite to biodiversity protection and faster water retention mechanism, through tree planting, enhancing CO2 sequestration as trees, shrubs and vegetation's find suitable environment to grow. Baringo and Makueni County are characterized by unsustainable agriculture, environmental degradation resulting from soil erosion, high poverty levels and food insecurity due to unpredictable dry spells and climate change. The present paper illustrates that Fencing of lands improves agricultural land management practices, biodiversity growth increased soil carbon sequestration.

Keywords: Food security; Soil carbon sequestration; Climate change; Soil erosion; Desertification; Growing water scarcity

STUDIES ON THE USE OF LOCALLY AVAILABLE (COXS BAZAR AND SAINT MARTIN) ALTERNATIVE RENEWABLE SEAWEEDS WASTES AS COMPOST ORGANIC FERTILIZER RESOURCES

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Marine algae Marine red algae from the Bangladesh Bay of Bengal HypneaSp are often regarded as an underutilized bio-resource seaweed have been used as organic materials due to the presence of a number of plant growth stimulating compounds. The effect of various seaweed species on plant growth and development with an emphasis on the use of this renewable bio-resource in sustainable agricultural northern fertilizers raw materials system. A plant needs organic fertilizer for it to grow in a balanced way .The combined use of organic and inorganic fertilizers can improve crop production and maintain soil health. Many important soil properties depend on to some degree on the quality of organic matter. Organically made fertilizers play an important role in increasing the crop yield and the quality of crops promises improvements considering climate adaptation. Research on marine products has enormous unexploited potential and significant advantages. Although Bangladesh possesses a part of the Bay of Bengal, the vast ground of our marine resources is yet to be explored and the application of biotechnology to marine biodiversity remains poorly developed. This part of the study is directed towards the analysis of the future trend and performances of Composting Seaweeds wastes. Demo plot- one Zoom production betel-leaf 2880 per day, Control plot-one zoom production betel-leaf 2780 per day. Difference 100 leaf meaning increased plucking 100 leaf production per day used by seaweeds wastes mixed compost organic fertilizer.

Keywords: Seaweed; Plant Growth; Organic Material; Northern fertilizer; Sustainable

INTEGRATED WEED MANAGEMENT IN CONSERVATION AGRICULTURAL SYSTEMS

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Weeds cause a significant economic impact more harmful than insects and fungi. An integrated weed management approach is more effective than a single control. Decades of herbicide use as a single weed control method have caused the rise of herbicide-resistant weeds. Weeds are more difficult to manage in Conservation Agriculture (CA) than in conventional agriculture. In Uganda CA farmers only adopted two of the three principles minimum tillage and crop rotation. Soil cover by mulching is not practiced due to the difficulty in obtaining mulch. A diverse weed management system will require a better understanding of the soil seed bank; these are regionally specific. To investigate an appropriate method to estimate the soil seed bank among the three commonly used methods (Floatation, Cloth bag, and Greenhouse), weed seed bank composition and diversity were determined at soil depths (0–30 cm). Weed management practices were evaluated using a split-plot experimental design with two tillage practices (tillage1, and tillage2) as the main plot treatment and five soil cover practices (Soilcover1, Soilcover2, Soilcover3, Soilcover4, and Soilcover5) as the subplot treatments established for 3 years (4 rainy seasons) on a sandy loam texture (ferrosols) in Lira, Uganda. Maize crop acted as the test crop and soybean provided soil cover (intercrop). The diversity of weed species was high for the Greenhouse method (Shannon diversity index H= 1.0309) compared to the Floatation (H= 0.6538) and cloth Bag (H=0.5428). For the total soil depth sampled (0–30 cm), the weed seed population was significantly greater under tillage2 (119 weeds m2) compared to tillage1 (99 weeds/m2). For the effect of soil cover practices on weed diversity, there were no significant differences (P>0.05) between the five soil cover practices. A combination of tillage practice and soil cover was more effective in suppressing weeds, especially broad-leaved weeds.

Keywords: Tillage; Integrated weed management; Soil cover; Conservation agriculture; Soil seed bank

ACCEPTABILITY OF GRAVILLLEA ROBUSTA IN DEVELOPING AGRO-FOREST BASED CLIMATE RESILIENT SYSTEMS AMONG SMALL SCALE HOLDER FARMERS IN WEBUYE-WEST SUB-COUNTY, KENYA – INSIGHTS AND OPPORTUNITIES

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Small scale subsistence agriculture typical to most tropical regions is highly vulnerable to climate change. Agro-forestry has been identified as an important strategy of improving climate change resilience and agricultural land use. Besides mitigating accumulation of Green House Gases, agro-forestry has been reported to improve climate change adaptation among small scale holder farmers. Suitability of Gravillearobusta in small scale farming systems in most parts of Kenya is documented. However, full scale adoption of the tree species by small scale farmers is yet to be realized. In this work, a randomized design was used to select 200 farmers for the study. Questionnaires and face to face interviews were used to collect information targeting the selected 200 small scale farmers in Webuye West Sub-County in Kenya to determine acceptability of G. robusta in community based agro-forestry. Specifically, the study sort to answer the following questions: (i) what is the average size of land owned by a small scale holder farmer, (ii) how many G. robusta trees is a farmer willing to plant on his farm and (iii) which crop are farmers willing to intercrop G. robusta with. Finding of the survey revealed that on average, the size of farm land owned by farmers who participated in the survey was 2.5 hectares. The number of G. robusta tree likely to be planted by a farmer was directly proportional to the size of land. 93.5% (187) of the sampled farmers recorded a score of highly acceptable on adopting G. robusta in agroforestry. Out of this, 95% (177) expressed willingness to adopt G. robusta if incentives like fertilizer, seeds and boreholes are given. 82% (153) of farmers participating in study expressed willingness to intercrop G.robusta with coffee and maize. Findings of the study offers insight and highlights the opportunity for adoption of G. robusta in agroforestry and increasing forest cover in areas where small scale farming has lead to increase land fragmentation.

Keywords: Gravillea; Robusta; Agroforestry; Small scale farmers

SMALLHOLDER FARMERS' PERCEPTION OF CLIMATE CHANGE AND ADAPTATION PRACTICES IN KITGUM DISTRICT, NORTHERN UGANDA

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The purpose of this research was to assess smallholder farmers' perception of climate change and adaptation practices in Kitgum District, Uganda. The study examined smallholder farmers' perception and its impacts on climate change, adaptation practices, perceived effectiveness and actual effectiveness of the adaptation practices. Using cross-sectional design, this study analysed the smallholder farmer's perception and its impacts on climate change for the past 30 years (1988-2017), adaptation practices, perceived effectiveness and actual effectiveness of the adaptation practices. Results show that all (100%) smallholder farmers perceived climate change through rainfall and temperature. Attaining primary level of education was a positive predictor and significant (p=0.027) for perceived decrease in rainfall amount. Over 50% of the smallholder farmers are adapting to the perceived decrease in rainfall amount and increase in temperature. More so, several socio-economic characteristics are influencing adaptation practices with the most significant ones being age, education level, main agricultural activity and major source of income. Mixed farming and intercropping were considered effective adaptation practices, while mulching and irrigation not effective adaptation practices. Adaptation practices considered profitable were intercropping, early planting of groundnut and simsim and planting of fast maturing maize crops. Those not profitable were mixed farming, drought tolerant crops, early planting of maize and millet and fast maturing cassava crop. It is recommended that smallholder farmers should consider early planting in their overall adaptation practices since it was considered cost effective. However, this will require technical interventions by agricultural extension workers to ensure that adaptation responses are holistic and sustainable.

Keywords: Smallholder farmers; Perception; Climate change; Adaptation

ASSESSING THE VULNERABILITY OF INDIGENOUS CHICKENS TO CLIMATE CHANGE IN UGANDA

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Uganda's indigenous chickens are predominantly raised under free-range scavenging systems which directly exposes them to environmental extremes. The study used current and predicted future rainfall and temperature for two agro-ecological zones (AEZ) with the highest population of indigenous chickens and most vulnerable to climate change (Low Lying Kyoga Plains and North Eastern Savannah Grassland), 50 key informant interviews and 10 focus group discussions were conducted for the vulnerability assessment. The average monthly maximum temperatures for the two agro-ecological zones for the period between 1979 and 2019 were above 300C (Thirty degrees Celcius) for at least four months in a year while predictions indicate that temperatures will increase by +1.8/ +5.10C under Representative Carbon dioxide concentration Pathway (RCP) 4.5/8.5 respectively by 2080. During the same period and RCP, rainfall will decrease by 103/159.2 mm, hence creating a drier-warmer environment in all AEZ. The results of this study indicate that indigenous chickens are currently produced under mild to moderate heat stress in the two AEZ and this will escalate to extreme heat stress by 2080. The predicted changes in rainfall and temperature are also expected to alter crop production and biodiversity hence decimating the feed resources of scavenging chicken increasing their vulnerability to climate change and reducing their production and sustainability.

Keywords: Resilience; Poultry; Sustainable; Chicken production; heat stress; Prediction

DO TRANSACTION COST ATTRIBUTES MEDIATE THE TRUST-SUPPLY CHAIN PERFORMANCE RELATIONSHIPS? EVIDENCE FROM UGANDAN AGRIBUSINESS

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The direct effect of trust on supply chain performance is adequately explored. With transaction cost attributes measured by different constructs in manufacturing and service sector, little is known about its mediation effect in the trust- supply chain performance relationships in agri-food sector. Based on transaction cost theory, this study develops structural equation models (SEM) through bootstrapping approach to investigate the link in the trust-supply chain performance through transaction cost attributes. Data collected from 396 questionnaires from farmers (n=203) and traders(n=193) in agribusiness across 5 districts in Northern Uganda which data was analyzed in SPSS and Analysis of Moment Structure (AMOS) software. The finding of the paper is that transaction cost attributes partially mediate the relationship between trust and supply chain performance through information sharing and uncertainty. Further, associations between trust and transaction cost attributes, transaction cost attributes and supply chain performance and between trust and supply chain performance were found to be significant and positive. Agribusiness managers therefore need to pay keen attention to information sharing and uncertainty management in order to enhance supply chain performance.

Keywords: Transaction cost attributes; Mediation effect; Trust; Supply chain performance; Agribusiness relationships; Uganda

ASSESSING THE IMPACT OF INNOVATION ADOPTION ON AGROPASTORAL FARMERS' ADAPTIVE CAPACITY TO DROUGHT HAZARDS WITHIN THE CATTLE CORRIDOR OF UGANDA

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Conventional determinants of adaptive capacity overtime have been constantly changing as the social, economic, and environmental landscapes within which communities operate also change. Given the limited understanding of the process, within the cattle corridor, studies often provide generalized assumptions about the close links between adaptive capacity and drought hazards. The success or failure of adaptation of a system is dependent on its adaptive capacity. Thus, this study investigated the role of innovations in the cycle of adaptive capacity to drought among agropastoral farmers. A cross-sectional design with 426 household interviews was used. Adaptive capacity was measured as an index constructed from four main dimensions; innovation, flexibility and forward-looking, knowledge and information, and asset base indicators using the principal component analysis (PCA) method. The role of innovation in adaptive capacity was projected using the Ordinary Least square (OLS) model and fitted into Local Adaptive Capacity framework (LAC) and measured in terms of both aggregated and composite indices using PCA. Results from composite indices for innovation indicators showed that the contribution of manure use (83%), fodder making (73%), and crop residue practices (72%) to adaptive capacity was positive and superior to other innovation indicators like access of residues outside the home for livestock due pasture shortage (-0.51%) and practice of burning crop residues and grass (-0.32%) which negatively affect the adaptive capacity of households to drought. The study revealed superior contributions of innovations to agropastoral household adaptive capacity to drought as opposed to asset base indicators. Integrating technical and social-innovations into agropastoral adaptive capacity dynamics to help agropastoral farmers, leaders and managers, community development practitioners build adaptive capacity levels. The study recommends increased emphasis of integrating technical and social-innovations into agropastoral adaptive capacity to help agropastoral farmers, leaders and managers, community development practitioners build adaptive capacity levels for future resilience to drought hazards.

Keywords: Agropastoral system; Adaptive capacity; Drought hazards; Innovation

IS TANZANIA READY FOR CLIMATE SMART AGRICULTURE: A SYSTEMATIC REVIEW ON SUSTAINABLE AGRICULTURE PRACTICES?

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The increasing global population leads to growing food demand by more than 50% by 2050. This trend however, is made more serious by increased climate variability causing a major threat to agricultural production and food security in Tanzania. In this case climate smart agriculture (CSA) is crucial innovation in addressing the potential in impacts. This paper provides systemic review of contemporary literature on the status of CSA adoption by farmers and understands its potential in increasing crop yields in Tanzania. It examines the potential synergistic across agro-ecological zones, between crop intensities, among practices and single against combination of methods to see its outcomes. 30 peer-reviewed studies were extracted covering the time period between 2015 and 2022. The main findings show that farmers' crop diversification, social trust and perceived behaviour control have strong effect on the adoption of combination of residual retention, intercropping and usage of drought tolerant varieties. It further portrays positive association between CSA practices on crop yield increase and food security in southern highland areas, although there is lacking evidence on their impact to crop yield and food security among farmers in semi-arid zones. Farmers' age and education are found to systemically influence the practice of singly farming adoption. While other factors, such as farm awareness on impact of climate change or the use of extension information, may be important determinants of adoption, it is hard to recognize definite patterns of their impact across technologies given a shortage of empirical evidence. More research on comparative analysis on effectiveness of CSA combination practices utilization and crop yield across different agro-ecological zones is needed to formulate qualified guidelines and recommendations for policy.

Keywords: Climate smart agriculture; Sustainable agriculture; Agriculture practices; Crop yield

THE FEASIBILITY OF THE BIOGAS DESIGNS ON THE HOUSEHOLDS IN MPIGI DISTRICT UGANDA

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The increasing energy poverty in Uganda is a limitation to sustainable development. Hence attempts to disseminate and promote the relevance of clean renewable energy resources such as Biogas technology in Mpigi District to fulfill the domestic energy need. However, its use and uptake is still low in countrywide. This gap prompted the study to categorize the adopters and assess the impacts of biogas technology on the households in Mpigi District. The primary data was obtained through household and key informant interviews with the help of questionnaires. Random and purposive sampling techniques were used to select respondents. Descriptive statistics (mean and percentages) analyzed the household characteristics. The adopters were classified based on the diffusion innovation theory. Both Benefit-cost Ratio (BCR) and Net present value (NPV) analyzed costs using Excel software. Carbon emissions avoided were estimated using the FAO (Food & Agricultural Organization) charcoal to dry wood conversion rate and the IPCC (Intergovernmental Panel on Climate Change) conversion factor of fuel wood from dry weight to carbon dioxide equivalent (CO_2e). The mean estimated time saved. The results showed 9m3 to be more profitable with the higher ratio of 7.8. The adopters were consistent with the five categories of the Diffusion innovation Theory. Also biogas use in Mpigi Town Council indicated the highest total reduction of 182,613 kg CO_2e. On average, 2.42 hours/week is saved on firewood collection. The study recommends the promotion of 9m3 biogas units in Uganda and further research should be on why biogas from other feedstock (human excreta and pig manure) are less utilized at the household level.

Keywords: Energy poverty; Adoption; Net present value; Cost Benefit Ratio; Bio digesters; Diffusion

TRADE-OFFS ASSOCIATED IN THE PRACTICE OF CLIMATE-SMART AGRICULTURE (CSA) TECHNIQUES FOR SUSTAINABLE AGRICULTURAL DEVELOPMENT IN NIGERIA

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This work assessed the trade-offs associated with the practice of Climate-Smart Agriculture (CSA) techniques for sustainable agricultural development in Nigeria. The main objective was to investigate the factors constraining the adoption of CSA and the trade-offs associated in the practice of CSA to accelerate sustainable agricultural production in Nigeria. The study area was delineated into 3 agroclimatic zones (A-1, F103 and A4). The concept of CSA prioritization was adopted to underpin the work and a mixed method approach was used to triangulate data extracted from Cool Farm Tool (CFT), Focus Group Discussions, in-depth interviews and Questionnaire Forms (QFs). Using stratified random sampling technique, 1392 farmers who practiced Traditional and CSA methods were administered with QFs and CFT across the 3 agroclimatic zones A-1, F103 and A4 to elicit data in-line with the research objectives. Findings from the trade-off matrix revealed that out of the 14 preferred CSA techniques in Zone A-1, farmers prioritized Farm Input Management (46.65 score), storage and processing technique (34.15) and Farm Intensification (31.9). In Zone F103, farmers prioritized use of improved varieties (27.65), Mechanized farming (25.3) and Farm Intensification (18.7). In Zone A4, farmers prioritized conservative weeding/pruning (45.55), Zero-Burning technique (39.85) and Agroforestry (36.55). From these relative differences in CSA choices and low rate of practices across the Zones, there is need to strengthen farmers' adaptive capacity to reduce associated trade-offs in order to improve sustainable CSA practice.

Keywords: CSA; Resilience; Food Security; Climate Change; Agriculture

CAN CLIMATE CHANGE PERCEPTION AND ACCESS TO INFORMATION CONSTRAIN OR ENHANCE ADAPTATION? COMPARATIVE ANALYSIS ACROSS AGRO-CLIMATIC ZONES OF TANZANIA

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Perception of climate change is generally considered contextual and location-specific. Different studies have focused on a small area's perceptions of biophysical or socio-economic aspects of climate change. This study presents a comparative assessment of perceptions of climate change across four end-to-end agro-climatic zones of Tanzania. A hypothetical transect of four points representing each agro-climatic zone is separated from one another by a distance of about 300 km. 250 respondents were used as a proportionate sample across the four points from Ngerengere in Morogoro to Kazuramimba, in Kigoma region. A cross-sectional design was adopted using questionnaires, focus group discussions and key informant interviews as data collection methods. Descriptive statistics were used to evaluate the socio-economic data while the Multinomial Logit (MNL) model was used to analyse the factors associated with the choice of adaptation strategies across the four agro-climatic zones viz. semi-arid, sub-humid, dry sub-humid and wet sub-humid. Many households (76.4%) highly perceived that climate change is happening through increased temperatures and the unpredictable start of the growing seasons. Accordingly, adaptation strategies implemented by agro-pastoralists include crop-based management (54%), land and/or soil-based management (31.2%) and non-farm income and agroforestry (14.4%). The econometric model's findings show that agro-pastoralists' adoption of adaptation strategies is significantly influenced by CC perception, access to climate information, educational level and agro-climatic setting. The dry sub-humid zone has positive and negative significant associations with CC perception and access to climate information, respectively. The study recommends the enhancement of climate information access to support adaptation decisions.

Keywords: Perception; Climate information; Adaptation strategies; MNL model; Agro-pastoralists; Tanzanian agro-climatic zones

CLIMATE PATTERNS AND EXTREMES IN UGANDA'S ARABICA AND ROBUSTA COFFEE REGIONS

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Future climate change and variability is unlikely to offer better opportunities, especially for many African countries. For proper projections of climate into the future, there is need to establish past patterns in trends and extremes in climate. However, limited studies have ascertained spatial and temporal climate patterns due to lack of high resolution and continuous climate data at more local altitudinal scales. This study characterized rainfall and temperature trends and climate extremes in Arabica and Robusta coffee altitudes of Uganda; using hybrid of daily and remotely-sensed observational climate data, Mann-Kendall test and Sen's estimate, Rainfall Anomaly Index and farm-households' perceptions of climate extremes. Results showed that annual and seasonal rainfall was quadratic in Robusta and positively linear in Arabica regions. Rainfall also increased during December-to-February, while it remained near-normal in June-to-August and high-altitude western Uganda. While minimum, maximum, annual and seasonal temperatures decreased in Robusta, they increased in Arabica regions. Moderate drought and extreme rainfall generally had cyclic patterns and commonly occurred during March-to-May and September-to-November, respectively. Extreme rainfall was received in mid-to-high altitude Arabica and Robusta regions while drought occurred in Robusta and low altitude Arabica regions. Farm-households also reported drought, extreme rainfall, floods, landslides and hailstorms as major climate extremes. This suggests that should similar climate patterns continue in the future, vulnerability of livelihoods to related climate extremes and risks is likely to increase. This study, therefore, recommends implementation of operational adaptation policies and practices for efficient climate risk management in Arabica and Robusta coffee altitudes of Uganda.

Keywords: Climate variability; Climate change; Africa; Drought; Climate risks; ENSO

DETERMINANTS OF VARIATION IN CLIMATE ADAPTATION LEVELS AMONG SMALL HOLDER FARMERS IN THE KYOYOGA PLAINS OF UGANDA

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This study investigated variation in the level of adaptation and the factors that determine this variability among smallholder farmers of different socioeconomic characteristics in the Kyoga plains of Uganda. A survey involving 384 respondents (farmers of different socioeconomic characteristics) from across the two districts of study was conducted using structured questionnaires. Farmers were asked whether or not they adapted on realising a change in climate and those who had adapted were then asked to indicate the strategies that they used out of a list of adaptation strategies provided. The farmers' strategies were then aggregated into ranges 1-2, 3-4 and 5-7, to determine the level to which each farmer adopted adaptation strategies and how this varies among farmers of different socioeconomic characteristics. Multi Nomial Logit (MNL) was used to analyse the factors that determine the variation in the level of adaptation to climate change among the farmers. There was a significant negative relationship between gender (female) and the level of adaptation in the TS sub zone while in the BCMS, income and education were positively and significantly related to the level of adaptation. There is need for institutional, policy, financial and technological support especially for female farmers. It is also necessary to develop and disseminate area specific incentives to encourage adoption of more adaptation strategies given the variation that exists in the level of adaptation to climate change among farmers in the different sub zones.

Keywords: Climate change; Adaptation strategies; Variation

GENDERED PERCEPTIONS AND DETERMINANTS OF CLIMATE VARIABILITY IN UGANDA'S CATTLE CORRIDOR

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Risk perceptions and impacts experienced by men and women are important determinants of gendered adaptation. However, there is a dearth of context- specific information to support evidence-based decision-making processes towards gender-sensitive interventions to effectively tackle climate adaptation strategies. Using the theory of planned behavior, this paper assessed the perceptions of men and women in relation to drought risk in the cattle corridor of Uganda by examining the demographic and socio-economic determinants of their perceptions. A survey, focused group discussions and purposive key informant interviews were undertaken in three of the Uganda's cattle-corridor districts. Results revealed that for men, remittances, their health, access to information, water and agricultural inputs were key factors that significantly influenced their perceptions about climate variability while for women, factors such as age, education level, their health, security of tenure, position as the main decision maker in the household, livelihood diversification and access to agricultural tools and inputs were key in shaping their perceptions about the same. These results indicate a significant variation in what informed each gender about farm-based livelihood activities with women reporting a higher number of factors in contrast to the men. Therefore, for more effective and equitable adaptation planning in the context of accelerated and unpredictable climate disruptions, it is critical that the capacities of women, who constitute the greater percentage of farm-based labour especially in the global south are better equipped to effectively manage and safe guard their livelihoods.

Keywords: Risks; Gendered perceptions; Climate variability; Cattle corridor Uganda

ON THE AGENCY OF MEN AND WOMEN IN DRY LANDS: EFFICACY OF GENDERED ADAPTATION STRATEGIES TO CURRENT AND FUTURE DROUGHT CONDITIONS

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Climate change discourses and international policies on enhancing people's livelihoods and strengthening community resilience to drought effects through effective adaptation strategies has been on the rise. In the cattle corridor of Uganda, men and women appear to have coped and adapted to the adverse effects of recurring drought to improve livelihoods and food security. However, changes in climate continue to affect the agricultural activities and livelihood system especially in the dry land areas. This raises questions of how effective these adaptation strategies have been in shielding men and women against the unpredictable weather patterns particularly under the current and projected climate changes. The study employed a mixed method research design to examine the efficacy of gendered adaptation strategies in three of Uganda's cattle corridor districts. The findings indicated that while men and women took on different coping and adaptation strategies, household incomes continued to decrease especially when the potential of diversified livelihood/alternative source of income has been limited. It concludes that although gendered adaptation strategies provide some hope and prospects for the day- today survival of men and women keeping them afloat, they are short term and have embedded environmental and social costs. This means that they not sustainable in the long run and therefore, hinder the ability of households to reduce poverty and contribute to national development. In response, government should support the potential of households in respect to their needs and capacities to adapt in order to improve incomes and livelihoods which are central to sustainable development.

Keywords: Agency; Efficacy; Gendered adaptation strategies; Drought; Cattle corridor Uganda

RAINFALL VARIABILITY AND YAM PRODUCTION IN THE EJURA SEKYEREDUMASE MUNICIPAL, GHANA

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The effects of rainfall variability on yam production has received little research attention. Therefore, the study was conducted to assess the perception of yam farmers on climate change (rainfall variability) and how it affects yam production in the Ejura Sekeyeredumase municipality, Ghana. Also, the study sought to investigate the relationship between the rainfall variability and yam production (2011- 2021) and to assess key adaptation strategies used by yam farmers in Ejura Sekyeredumase municipality. Both primary and secondary data were used for this study. For the primary data, a questionnaire was designed to assess the relationship between rainfall variability and yam yield in three communities (kasee, Nokoreasa and Mesuo) in the Ejura Sekyeredumase Municipal of the Ashanti Region of Ghana. The secondary data obtained was rainfall data (mm) and yam yield data (metric tons) and that was obtained from Ministry of Food and Agriculture (MoFA), Ejura, Ghana. At the end of the study, most of the farmers in the Ejura Sekyeredumase municipality reported a decrease in yield due to rainfall variability, with 95.7% of the farmers attributing the decrease to rainfall variability. Also, the perception of the farmers was consistent with the secondary data (yam yield and annual rainfall) collected from MoFA, Ejura. Rainfall and Yam Yield data showed a negative correlation, indicating that, as rainfall decreases, yam yield increases. Lastly, On-farm crop rotation and off-farm adaptation measures were practiced, but yam yield however was slightly decreasing.

Keywords: Rainfall variability; Climate change; Adaptation; On-farm; Off-farm

CLIMATE VARIABILITY ADAPTATION AND FOOD SECURITY IN LAMWO DISTRICT, NORTHERN UGANDA

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This paper examined the relationship between climate variability adaptation practices and food security in northern Uganda and specifically Lamwo district. It identified climate variability of the rainfall and temperature parameter for a period of twenty years, adaptation practices adopted by smallholder farmers and the effect of the adaptation practices on food availability, access, utilization and stability. The study was conducted in Lamwo district, one of the districts found in Northern Uganda involving 375 smallholder famers that were randomly selected. The methods used to collect data included documentary review for climate, direct observation of Adaptation Practices interview and questionnaire. The findings revealed that area experienced climate variability in the rainfall and temperature parameters. Early planting was found to be the most dominant on-farm practice followed by use of new crop varieties and drought resistant crops. The dominant off-farm practice was motor cycling, followed by operation of shops, brick laying and market vending. About 95.7% had moderate food availability while 3.1 % had adequate food availability. About 19.5% households had access to food while 63.2% had moderate access to food and 37.5% households had less dietary diversity while 58.2% had moderate dietary diversity. About 95% experienced unstable food stability. The study concluded that adaptation was better than non-adaptation. It therefore recommended that smallholder farmers should be encouraged to adapt to climate variability.

Keywords: climate variability; Adaptation; Smallholder farmer; Food security

DETERMINANTS OF LIVESTOCK FARMERS' ADAPTATIONS PRACTICES TO CLIMATE VARIABILITY IN NTOROKO DISTRICT, WESTERN UGANDA

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This study examined the determinants of livestock farmers' adaptation practices to climate change in Ntoroko District Western Uganda. The objective of this study was to establish social, economic and institutional factors influencing livestock farmers to adopt adaptation practices to mitigate the effects of climate change to their livelihoods. A cross-sectional survey design was used. A sample of 351 respondents were randomly selected from 4011 households. The data collection methods used included; questionnaire, documentary review, and observation. The collected data was analyzed using Cross-tabulation, and multivariate regression to establish the influence of social- economic and institutional factors on climate variability and change adaptation practices used by livestock farmers. The findings revealed that access to training on climate change and variability and change, level of income, access to information and membership to social groups were the most significant factors determining climate variability adaptation practices in the area. The least significant factor was farmers' level of education. It was concluded that successful mitigation of climate variability effects on livestock farming in Ntoroko will require increased training of the farmers on adaptation, access of information on climate change and variability, improved farmers' incomes and membership to social organizations. The study recommended that the significant factors should be considered in designing and implementing climate change adaptation strategies in the area.

Keywords: Climate variability; Factors; Adaptation practices; Livestock

ADOPTION OF MULTIPLE CLIMATE-SMART AGRICULTURE PRACTICES: A CASE OF SMALLHOLDER PEANUT FARMERS IN TAMBACOUNDA AND KOLDA, SENEGAL

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Peanut is one of the major cash crops in Senegal. It contributes close to 17% of Senegal's GDP and also provides income and livelihood to the smallholder farmers that grow it. Adoption of climate-smart practices is crucial for these smallholder farmers who heavily rely on rain-fed agriculture and are at the same time challenged by the semi-arid climate of the Sahel region. Using data from 294 randomly selected smallholder farmers, this study investigated the factors that influence the adoption of a combination of climate-smart agriculture practices among peanut smallholder farmers in the regions of Tambacounda and Kolda. The practices assessed were: crop rotation, improved seed varieties, reduced tillage, timely planting, fertilizer and manure application, intercropping, and diversified farming (animal and crop). With a multivariate probit model, simultaneous adoption decisions and determinants of adoption were examined, enabling the examination of synergies and trade-offs between the technologies. The study's results indicate that there was interconnectedness in the adoption of climate-smart agriculture practices. Factors like marital status, level of education, agricultural land owned, affiliation with a farmers' organization, access to agricultural inputs, interaction with agricultural extension staff, and access to and trust in meteorological information were found to influence the likelihood and extent of adoption of climate-smart practices. The study recommends increased and deliberate engagement between the government and various stakeholders along the peanut value chain. This will ensure improved adoption, which will lead to increased productivity, revenue, and improved quality of life, especially for smallholder farmers.

Keywords: Adoption; Climate-smart agriculture; Smallholder farmers; Senegal

EVALUATION OF MUSA ACCESSIONS INDIGENOUS TO BENIN REPUBLIC FOR RESISTANCE TO BLACK SIGATOKA DISEASE

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This study was to identify Musa accessions cultivated in Benin Republic that possess host resistance capacity to black sigatoka disease (BSD). A total of 72 Musa accessions were used in the study including 58 local accessions and 14 accessions from International Musa Transit Centre (ITC) in Belgium. The experiment was laid out using the Augmented Split Plot Design at Misserete, Benin Republic. Agro-phenotypic data collection commenced 9 months after planting according to standard evaluation method for the disease including; symptom appearance (SA, in days), rate of leaf death (%LD), youngest leaf spotted (YLS), number of standing leaves (NSL), index of non-spotted leaf (INSL), area under disease progress curve (AUDPC) and disease severity index (DSI). The presence of genes for black sigatoka resistance was evaluated using a BSD specific SSR marker (bs1) and another unspecified disease resistant gene (UDRG) in Musa. DNA sequencing was done using ABI sequencer. The results revealed high significant difference ($p<0.0001$) in sigatoka disease incidence and severity among the accessions with the rate of symptom appearance (SA) ranging from 10 to 36 days, NSL and YLS ranged from 3.0 to 14.0 and 2.0 to 6.0 respectively, while the values of INSL, DSI and AUDPC ranged from 12.5 to 60.0, 13.33 to 52.0 and 58.0 to 239.0, respectively. A dendogram based on disease sensitivity data showed 3 distinct clusters (A-C) with cluster A containing resistant accessions, cluster B contains susceptible accessions, and cluster C includes intermediate resistant accessions. Similarly, a dendogram of the amplified resistance gene sequences also clustered the Musa accessions into 3 groups. Multiple sequence alignment result based on UDRG sequences showed missing nucleotide sequence in some susceptible accession. Marker-trait association analysis revealed a mutual occurrence between UDRG_300 and the morphological indicators of resistance to the disease (YSL, NSL and INSL). The study therefore identified black sigatoka resistant Musa accessions among Benin Republic cultivars and provided a genetic tool (UDRG_300) which can be exploited for improvement of the crop for sigatoka disease resistance.

Keywords: Musa accessions; Black sigatoka disease; Disease resistance; Benin Republic

THE INFLUENCE OF FARMER PERCEIVED VALUE ON CHOICE OF CLIMATE-SMART AGRICULTURAL TECHNOLOGIES IN LANGO SUBREGION

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Agricultural production systems are challenged by increasing demand for food, degraded agricultural land and the changing climate that can simultaneously be addressed by Climate Smart Agriculture (CSA). Promoting CSA-Technologies calls for attention to Farmer Perceived Value (FPV) because FPV influences farmer behaviors. FPVs are goals that motivate farmers' choices. This study applied the Means-End Chain framework to explore the Hierarchical Value Maps of goals for CSA-Technologies in Lango sub-region. Thirty-nine farmers that had been introduced to CSA-Technologies participated in in-depth interviews. They comprised 16 females and 23 males, of whom 53.8% were categorized as young farmers below 39 years. Farmers were asked if they practiced legume-cereal cropping, residue retention, NPK application, and minimum tillage. The farmer verbalized their selection decision and these were followed with a series of “why-why” questions The study revealed goal constructs in three clusters: 1) Action goals like addressing dietary needs, spreading production risks, retaining soil moisture, retaining and adding soil nutrients; 2) Outcome goals like increasing yield, improving own health, producing for markets, and maintaining fertile soils; 3) Consequence goals like increasing farm income and availing own food. Results show that 97% had "increasing yield” as an outcome goal, 46% cared about maintaining soil fertility, women cared more about soil fertility and Young farmers selected more CSA technologies. These results suggest the need for proponents of CSA to target farmers by category because young farmers appear to embrace CSA technologies more than old farmers, while women could help rejuvenate soil fertility.

Keywords: Climate Smart Agricultural Technology; Perceived Value; Means-end Chain; Lango Sub region

INFLUENCE OF SOCIAL CAPITAL ON ADAPTATION TO CLIMATE VARIABILITY AND VULNERABILITY IN FARMING HOUSEHOLDS IN CHAMWINO DISTRICT, TANZANIA

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Adaptation to climate variability is a result of an interplay of livelihood capitals. These capitals (social, financial, physical, human and natural) prevail within climatic and non-climatic conditions. Moreover, vulnerability to climate variability intensifies when people are socially disadvantaged. The study on which the paper is based involved two villages in Chamwino district, Tanzania. The study assessed the influence of social capital on farming households' adaptation to climate variability and vulnerability. A cross-sectional research design was employed, whereby a pre-structured questionnaire was used to collect data from 160 randomly selected households. In addition, data was collected from 32 focus group participants and 5 key informants. Findings show that a farmer's adaptation strategy can influence the accumulation or depletion of capital to adapt to climate variability. And livelihood capitals used in adaptation strategies depend on a farmer's socio-economic group. Findings also shot that poor framing households (23.12%) had limited livelihood capitals and this led to adaptation failure and consequently, reliance on less paid agricultural adaptation-based contracts to adapt to climate variability. A chi-square test of independence also showed a lack of significant (p 0.05) association between adaptation strategies of poor households and increased household income. Therefore, it is concluded that adaptation to climate variability was complex and that availability of livelihood capital within the households was critical in their adaptation. It is also concluded that the poor use social capital to secure casual activities and barter trade to ensure their households survival. And while poor farmers are constrained with the funding gap with regards to adaptation, those well-off sustain multiple adaptation strategies. Therefore, public and private stakeholders should come up with suitable adaptation needs for every socio-economic group of farmers so as to enable them to adapt to climate variability.

Keywords: Social capital; Adaptation; Climate variability; Vulnerability; Farming household

FACTORS ASSOCIATED WITH JUSTIFICATION OF PHYSICAL VIOLENCE AGAINST WOMEN AMONG COMMUNITIES LIVING IN WETLANDS: IMPLICATIONS FOR PROMOTING ALTERNATIVE LIVELIHOODS IN THE CONTEXT OF CLIMATE CHANGE

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There is limited research on how existing gender unequal attitudes inter-act with alternative livelihood options to exacerbate violence against women and girls. We use both qualitative and quantitative data (186 males and 187 females) from a pre-intervention cross-sectional survey four sub-counties (Puti-Puti, Pallisa, Nkanga and Bumbaire) in two districts (Pallisa and Bushenyi) where Green Climate Fund (GCF) alternative livelihood works is ongoing. Results indicate that male respondents (OR=0.54; 95%CI=0.38-0.77), those who earn UGX 100,001 and UGX 150,000 (OR=2.13; 95%CI=1.09-4.14) and UGX 200,001 or above (OR=1.54; 95%CI=1.04-2.26), respondents with economic activities in wetlands (OR=0.66; 95%CI=0.47-0.92) and respondents in Pallisa (OR=2.27; 95%CI=1.58-3.27) were significantly associated with justification of violence against women. Respondents who disagreed that 'if a man beats his wife it shows that he loves her' (OR=0.55; 95%CI=0.36-0.82), 'if a wife does something wrong her husband has the right to punish her' (OR=0.67; 95%CI=0.46-0.97), 'if a man has paid bride price for his wife, he owns her' (OR=0.67; 95%CI=0.47-0.96) and 'my spouse gets angry if I speak to a person of different sex (OR=0.64; 95%CI=0.46-0.91) were all significantly associated with justification of violence against women. Justification of violence against women continues to be a serious challenge in areas affected by climate change especially wetlands in Uganda. Interventions aimed at addressing climate change through wetland restoration should take into account the existing attitudes and social/ gender norms that are likely to increase the risk of experiencing physical violence against women.

Keywords: Physical Violence; Women; Wetlands; Livelihoods; Climate Change

SMALLHOLDERS FARMERS ADAPTATION STRATEGIES TO CLIMATE CHANGE IN AFRICA

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Climate is the primary determinant of agricultural productivity. The changes in climate condition are a major risk for agriculture and food systems. Farmers adaption to climate change is crucial for combating food insecurity. This review (i) firstly collected adaptation strategies that farmers used to adapt locally in their cropping systems, (ii) secondly identified existing climate smart agriculture technologies to build farmers resilience, (iii) thirdly identified barriers and incentive mechanisms for scaling out technologies. In total, 52 publications were collected and analyzed using Web of Science, SCOPUS, Environment Index and google scholar; of which 14 make specific reference to literature review on the topic. There are many adaptation strategies that farmers can implement to reduce the risk of negative climate change. Strategies are categorized in four groups: technically related adaptation strategies, indigenous problem-solving adaptation strategies, socially related adaptation strategies and economics related adaptation strategies. Drought resistant varieties of crops, crop diversification, changes in cropping pattern and calendar of planting, conserving soil moisture through appropriate tillage methods and mulching, improving irrigation efficiency, and afforestation and agroforestry as the most common technical adaptation strategies used by farmers in Africa. However, many barriers are slowing down technologies' adoptions: lack on government support, lack of access to finance, poor extension services, low farmers, low awareness about the CSA technology, farmers reluctance to accept new technology and low access to inputs. Those barriers have to be leverage to enhance farmers resilience. To help mainstream adaptation into national policy, it is also importance to have realistic forecasts of expected climatic changes at the local and national level, and timeframes for these changes in order to increase farmer's resilience on climate change. Africa countries should build its resilience to avoid the 1990 event and its impact on crop production and food security, by making agriculture part of the solution through the widespread adoption of adaptation actions.

Keywords: Climate change; Smallholder farmers; Adaptation strategies; Africa

IMPACT OF CLIMATE CHANGE ON FOOD SECURITY IN UGANDA: A PANEL REGRESSION ANALYSIS

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Climate change is dampening the food security situation globally, and sub-Saharan Africa Uganda inclusive is among the most affected regions. This study used the Uganda National Panel Survey data (UNPS) covering 2013/2014, 2015/2016 and 2019/2020 from a sample of 438 households were obtained. The fixed effects Poisson and panel fixed effects logit models were employed to study the impact of climate change on food security in Uganda. The results revealed that climate change has no effect on the number of meals taken per day but accessing extension services significantly influences the number of meals taken per day by farming households in Uganda. Furthermore, climate change is significantly increasing food shortage among farming household in Uganda and the most affected reside in the Northern region whereas the number of livestock owned by a farming household significantly reduces food shortage. Thus all stakeholders should deliberately design more climate change adaptation interventions including improved access to extension services and ownership of livestock by farming households especially in Northern Uganda to ameliorate the status quo.

Keywords: Climate change; Food security; Fixed effects logit; Poisson regression; Uganda

SESSION 10: Nature-Based Systems in Mitigating Hydro-Meteorological Hazards and Disasters

LIVELIHOOD VULNERABILITY TO CLIMATE CHANGE AND VARIABILITY IN BORANA PASTORALIST SOUTHERN ETHIOPIA

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This study was conducted to measure the livelihood vulnerability of Borana pastoralists to climate change and variability in southern Ethiopia. Pastoralists' households were sampled using multistage sampling techniques. Quantitative and qualitative questionnaire surveys were employed to collect data at the household level. A total of 27 socio-economic and biophysical indicators were used to reflect vulnerability components: adaptive capacity, exposure and sensitivity. Vulnerability was measured as the net effect of adaptive capacity, sensitivity and exposure to climate change and variability. Principal Component Analysis (PCA) was used to develop weights for indicators and to produce Livelihood Vulnerability Index (LVI) to classify households according to their level of vulnerability. To understand the determinants of vulnerability to climate-induced stresses, an ordinal logistic regression model was employed with predictor variables. The results showed that 24.4% of households were highly vulnerable, 60.3% were moderately vulnerable and 15.3% of households were less vulnerable to climate-induced stresses. Factor estimates of the logistic model further revealed that early warning information, bush encroachment, coping strategy, temperature, drought frequency, provision of humanitarian services and food shortage during normal season of the year have significant influence on vulnerability in the study area. Therefore, policies that address these determinants of vulnerability likely enhance the resilience of pastoralist households in the study area.

Keywords: Borana pastoralist; Climate variability; Drought; Livelihood vulnerability; Vulnerability index

ERI BIRYA AMALHAMBO ['CLEANSING OF RIDGES']: THE IMPORTANCE OF INDIGENOUS FARMING SYSTEMS FOR SUSTAINABLE LIVELIHOODS AND CLIMATE RESILIENCE IN THE RWENZORI, UGANDA

Bosco Bwambale

Mountains of the Moon University, Uganda

There is a growing debate that sustainable farming as well as food systems, in the context of climate change, requires fundamental changes that incorporate Indigenous (often marginalized) communities: their knowledge, values, and practices. The research conducted in the Rwenzori, located on the border between Uganda and the Democratic Republic of the Congo, analyses a new case that contributes to this debate as well as to the future of the food system through the lens of Indigenous knowledge and practices. Using ethnographic research approaches, the specific Indigenous agrarian system practice researched, in one of the local dialectics, is termed eribiryaama lhambo ['mountain cleansing']. These under-researched practices have been recorded as central in the life of several Indigenous communities and facilitate not only sustainable food production and consumption but also foster community resilience by connecting people, their livelihoods, and the spiritual/supernatural. It is noted that the entanglement of livelihoods and spiritual practices highlights fundamental methodological challenges for developing the academic scholarship of Indigenous practices, but also the opportunity to contribute to the development of a specifically African eco-agrarian philosophy and scholarship. This research contributes to inclusive knowledge production and provides new pathways for transitioning toward more sustainable and equitable farming as well as a food system.

Keywords: Indigenous Knowledge; Indigenous Innovations; Indigenous Technology; Traditional Agrarian Knowledge

RISK ASSESSMENTS OF LONGEST DRY SPELLS PHENOMENON IN NORTHERN TUNISIA

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LRSTE at INAT, Tunisia

Climate variability and climate change in the longer term consequences of economic, social and environmental. It is likely that climate change increases the frequency and duration of droughts. This contribution focuses on an analysis by event of dry event, according to a predetermined threshold, from series of observations of the daily rainfall. The approach has been illustrated on a case study catchment localized in Northern Tunisia where the average rainfall is about 600 mm. The dry events are constituted of a series of dry days framed by the rainfall event. Rainfall events are defined themselves in the form a uninterrupted series of rainfall days understanding at least a day having received a precipitation superior or equal to a threshold of 3.6 mm. The rainfall events are defined by depth and duration, which are found to be correlated. An analysis of the depth per event conditioned on the event duration has been undertaken. The negative binomial distribution appears the best overall fit for the depth per event. The duration of the rainfall event follows a geometric distribution while that the dry event follows the negative binomial distribution. The length of the climatically cycle adjusts to the Incomplete Gamma. Event based analysis was used to study of the effects of climate change on water resources and crops and to calibrate precipitation models with little rainfall records. In relation to adaptation measures in response to long droughts in the basin, the drought management system is based on three phases: (i) before drought, preparedness and early warning; (ii) drought management, mitigation in the event of drought; and (iii) subsequent drought, when the drought is over. During each of the three phases, different measurements are applied and executed.

Keywords: Dry event; Rainfall event; Precipitation threshold; Climate vulnerability; Adaptation measures

UNDERSTANDING NATURAL HAZARDS IN A CHANGING LANDSCAPE: A CITIZEN SCIENCE APPROACH IN KIGEZI HIGHLANDS, SOUTHWESTERN UGANDA

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The Kigezi highlands, south-west Uganda, is a mountainous tropical region with a high population density, intense rainfall, alternating dry and wet seasons and high weathering rates. As a result, the region is regularly affected by multiple natural hazards such as landslides, floods, heavy storms, and earthquakes. In addition, deforestation and land use changes are assumed to have an influence on the patterns of natural hazards and their impacts in the region. Landscape characteristics and dynamics controlling the occurrence and the spatio-temporal distribution of natural hazards in the region remain poorly understood. In this study, citizen science has been employed to document and understand the spatial and temporal occurrence of natural hazards that affect the Kigezi highlands in relation to the multi-decadal landscape change of the region. We present the methodological research framework involving three categories of participatory citizen scientists. First, a network of 15 geo-observers (i.e., citizens of local communities distributed across representative landscapes of the study area) was established in December 2019. The geo-observers were trained at using smart phones to collect information (processes and impacts) on eight different natural hazards occurring across their parishes. In a second phase, eight river watchers were selected at watershed level to monitor the stream flow characteristics. These watchers record stream water levels once daily and make flood observations. Combining with high resolution rainfall monitoring using rain gauges installed in the watersheds, the data are expected to characterize catchment response to flash floods. Lastly, to reconstruct the historical landscape change and natural hazards occurrences in the region, 104 elderly citizens (>70 years of age) were engaged through interviews and focus group discussions to give an account of the evolution of their landscape over the past 60 years. During the first 24 months of the project, a substantial amount of information on natural hazards linked to environmental changes occurring in the region has been processed. The ongoing data collection involving detailed ground-based observations with citizens shows a promising trend in the generation of new knowledge about natural hazards in the region.

Keywords: Natural hazards; Citizen science; Landscape change

POSSIBLE IMPROVEMENTS FOR LANDSLIDE SUSCEPTIBILITY MAPPING USING HYBRID BIVARIATE STATISTICAL MODEL IN TSUME MICRO-CATCHMENT, MANAFWA WATERSHED. AN INTEGRATION OF FREQUENCY RATIO, SHANNON ENTROPY AND WEIGHTED OVERLAY METHODS

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Landslides are well-known disasters in Uganda, especially in the Mount Elgon region where their occurrence is abnormally frequent. Their prediction has been pre-dominated by statistical bivariate models, which are limited. The current study explored the efficacy of hybridizing models to improve landslide susceptibility prediction in Tsume micro catchment. A total of 15 conditioning factors categorized as biophysical, hydrological, and social-economical were used. The purpose of the study was to contribute towards the development of an Effective Landslide Eco-Engineering Mitigation and Resilience Plan (ELEMRP) by availing landslide risk information. A hybrid model comprising of Frequency ratio (FR), Index of Entropy (IoE), and weighted overlay was utilized to characterize landslide risk at the sub-catchment level. Model results showed that Tsume micro catchment was characterized as very high 4.70 km² (5.17%), high 22.62 km² (24.90%), moderate 32.84 km² (35.05%), low 29.94 km² (32.96%) and very low 1.75 km² (1.93%) km² . The interpretation of the hybrid model indicated that population density explained (12.05%) and soil type (10.86%) to landslide risk unlike slope with (3.40%) which has been suggested by many other researchers as the most predominant factor. The predictive capacity of the hybrid model was very good with ROC (AUC = 0.914) substantiating model hybridization. Therefore, to mitigate landslide risk Tsume, current development programs and interventions need to focus on checking population growth and promoting sustainable agronomic practices specifically tree and grass planting of species with high underground biomass and high tensile strength among farmers.

Keywords: Hybrid model; Landslide; Susceptibility; Mount Elgon; Tsume

AN ASSESSMENT OF LANDSLIDE DISASTER PREPAREDNESS OF SCHOOLS IN BUDUDA AND MANAFWA DISTRICTS, EASTERN UGANDA

Flavia Joy Akello, Bob R Nakileza, Fredrick Tumwine

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The study aimed at assessing the susceptibility of schools to landslide disasters and their level of preparedness. Coordinates of selected schools were captured using GPS receivers and loaded in ArcGIS to produce the spatial distribution of schools in the area, information on the level of preparedness of schools to landslide disasters were obtained through administering questionnaires to teachers, Key Informant interviews were conducted at district levels to provide information on policies and governance in schools that were at a high risk of landslide disasters. Weighted Overlay Analysis was undertaken to determine the susceptibility of schools to landslide disaster and a landslide disaster preparedness matrix was adopted and modified to measure the level of preparedness of schools to landslide disasters. Results indicated that 37% of schools were highly exposed to landslide disasters whereas 34% were at moderate and 29 at low exposure. Bukalasi sub-county, which has the highest number of learners (1381), highly exposed to landslide disasters followed by Bulecheke sub-county (543). Majority of school schools in Buwangani Town council, Kaato, and Wesswa were located in areas categorized as low susceptibility. The level of preparedness of schools to landslide disaster was at 16.4% while 83.6% were categorized as unprepared. Limited landslide disaster preparedness measures are on ground as tree planting was the most common practice.

Keywords: Landslides; Susceptibility; Exposure; Preparedness

RISK ASSESSMENTS OF LONGEST DRY SPELLS PHENOMENON IN NORTHERN TUNISIA

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Climate variability and climate change in the longer term consequences of economic, social and environmental. It is likely that climate change increases the frequency and duration of droughts. This contribution focuses on an analysis by event of dry event, according to a predetermined threshold, from series of observations of the daily rainfall. The approach has been illustrated on a case study catchment localized in Northern Tunisia where the average rainfall is about 600 mm. The dry events are constituted of a series of dry days framed by the rainfall event. Rainfall events are defined themselves in the form a uninterrupted series of rainfall days understanding at least a day having received a precipitation superior or equal to a threshold of 3.6 mm. The rainfall events are defined by depth and duration, which are found to be correlated. An analysis of the depth per event conditioned on the event duration has been undertaken. The negative binomial distribution appears the best overall fit for the depth per event. The duration of the rainfall event follows a geometric distribution while that the dry event follows the negative binomial distribution. The length of the climatically cycle adjusts to the Incomplete Gamma. Event based analysis was used to study of the effects of climate change on water resources and crops and to calibrate precipitation models with little rainfall records. In relation to adaptation measures in response to long droughts in the basin, the drought management system is based on three phases: (i) before drought, preparedness and early warning; (ii) drought management, mitigation in the event of drought; and (iii) subsequent drought, when the drought is over. During each of the three phases, different measurements are applied and executed.

Keywords: Dry event; Rainfall event; Precipitation threshold; Climate vulnerability; Adaptation measures

GEOTECHNICAL AND GIS-BASED ENVIRONMENTAL BASELINE AND VULNERABILITY STUDIES OF OKEMESI LANDSLIDE, SOUTH-WESTERN NIGERIA

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This study was carried out in Nigeria. The basement rocks of South-Western Nigeria, dating from the Precambrian to the late Proterozoic, make up the geology of the study area. This investigation was done to examine the environmental baseline analysis of the Okemesi landslide using geotechnical, geological, and GIS data. A vulnerability study was also conducted to pinpoint places with a high likelihood of recurrence and land slide vulnerability. Grain size analysis, direct shear strength resistance, rainfall data, wet density, surface and slope analysis, and aspect and GIS were used to study the Okemesis landslide. Based on physiographic features, most of the study area has steep and gentle slopes, with a mean slope of about 0–49o. The region's slope is low, with most areas recording less than 8o. The slope directions around were approximately South (157-202), Southwest (202-207), West (247-292) and North (0-22), whereas the highlands were bounded primarily by slope directions of North (0-22), North East (22-67), East (67-112) and South East (112-157), showing that matter movement would follow such directions. The landslide was precipitated by rain, which could have been responsible for the destruction of physical infrastructure. The landslide vulnerability analysis was divided into three zones: high, medium, and low, with percentage area coverage of 9.0%, 61.8%, and 29.2%, respectively. This study recommended nature-based (NbS) solutions within the Okemesi community to cushion the effect of a reoccurrence of the landslide. A nature -based solution will be useful to the government of Nigeria for documentation and planning purposes and also for environmental planners and policymakers for land-use planning in order to prepare for disaster management and preventive measures to avert dangers.

Keywords : Okemesi Ekiti; Landside; Geotechnical; GIS; Vulnerability; Rainfall

SHALLOW LANDSLIDE RISK MITIGATION THROUGH NATURE-BASED SOLUTIONS IN THE ELGON REGION

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Extreme shallow landslides continue to pose a significant threat to the social and economic well-being of the communities in the Elgon region yet the knowledge on preparedness and mitigation of these risks remains inadequate. This paper aimed at assessing shallow landslide risk-prone areas and developing a portfolio of nature-based solutions (NBS) to support and harness communities' resilience in mitigating landslide risks. A holistic risk assessment of shallow landslides followed an indicator-based approach considering risk elements of hazard, exposure, and vulnerability. The risk map was processed using a geographical information system (GIS). Conversely, 17 key experts and 57 participants were purposively selected from six sub-counties to provide information on the perceived effectiveness of NBS for risk reduction. As depicted by the risk map, 87.5% of the Elgon region is at risk of landslides. Out of 168 sub-counties, 11 are at very high risk, 81 at high risk, 35 at moderate, and 23 at low risk. Wanale, Gamogo, Bushika, Bulucheke are among the sub-counties that revealed high-risk levels. The use of NBS is still minimal. Besides its effectiveness is hampered by land tenure, limited financial resources, inadequate knowledge and awareness, and inadequate enforcement of regulations on the use of mountain resources among other challenges. The tailor-made portfolio of NBS developed responds to the above challenges and recommends other new possible strategies for adoption. With unprecedented climate change, landslide risks are projected to increase. These research outcomes are therefore critical for decision-makers in risk planning, preparedness, and mitigation as well as reducing vulnerabilities among the affected communities in related areas.

Keywords: Nature-based solutions; Shallow landslides; Risk reduction; Elgon region

DAM BREAK INUNDATION PREDICTION AND ITS IMPACT ON THE COMMUNITIES OF ISINGIRO DISTRICT, WESTERN UGANDA

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Globally, dams are indispensable in overcoming hindrances posed by climate change by ensuring a sustainable water supply for irrigation. However, in case of failure, Dam floods cause devastating effects in fatalities and financial losses. The study focused on predicting the flood extent due to dam failure, determining land use exposure, damages/losses, and establishing possible flood mitigation measures. The Hydrologic Engineering Center River Analysis System model was used to predict flow simulation and replacement values were considered for risk analysis. Geometry and digitized data were used for flood modeling and risk analysis respectively. Geo-spatial, descriptive statistics and Nvivo software were used for data analysis. The study revealed that in the eventuality of a dam failure, the spatial extent of floodwater would inundate approximately 1,745.65 hectares of land with flood velocity and a depth ranging between 11.99 m/s to 0 m/s and 0-8.4 m respectively. About 5, 756 people, 319.15 hectares of croplands, 178 roads, 8 schools, a police post, and a medical center are exposed to potential dam-break inundation and damage with a loss estimate totaling approximately 4,158,130,546 UGS. Flood preparedness will be more vital than response and recovery. Low flood zone and uphill regions are suggested as evacuation centers; river banks for forestry and flood fringe for crop cultivation. Conclusively, elevation within the flood plain determines water surface movement and damages while losses depend on flood velocity and depth. Flood emergency preparedness is a prerequisite for protecting the downstream population, reducing the damages and losses that would result from potential dam failure.

Keywords: Dam break inundation prediction; Damages, losses; Mitigation

FOREST ABOVE-GROUND BIOMASS ESTIMATION ALONG AN ELEVATION GRADIENT IN MT. RWENZORI, SOUTHWESTERN UGANDA

Sarah Namayengo and Sarah Namayengo

Makerere University, Uganda

Climate change and the associated hydro-meteorological risks are impacting the global economy, human well-being, and the environment. To reduce the chances of extreme events, effective climate change mitigation and adaptation strategies are required. Carbon sequestration through forest ecosystems is one strategy for lowering greenhouse gas levels in the atmosphere. In Uganda, information on aboveground biomass (AGB) estimates and carbon stocks of various land cover types, including mountainous areas, are typically scarce. To address the information gap, I will carry a study out to track changes in the AGB of forest cover types over the last 30 years and provide information on the AGB of forest cover types along elevation gradients in the Mountain Rwenzori landscape. Systematic sampling will be used, and I will measure field parameters in temporary sample plots. Individual trees with a diameter of 10 cm at breast height (dbh) will be identified in each plot, and their dbh, tree height, and crown width will be measured. Allometric equations will calculate AGB. The analysis of variance will compare AGB differences between forest cover types. To determine which groups differ, a post-hoc test with LSD will be performed. I will analyze a series of Landsat images to determine the trend in AGB. The information generated will provide regional stakeholders with critical baseline information on AGB estimates and the influence of altitude on biomass in order to develop sustainable management strategies. It will also assist policymakers in developing programs to mitigate the effects of climate change through the use of terrestrial ecosystems.

Keywords: Climate Change; Carbon sequestration; Forests; Aboveground biomass; Elevation gradient

THE RELATIONSHIPS BETWEEN CLIMATE CHANGE AND VECTOR BORNE DISEASES IN EAST AFRICA: A SYSTEMATIC LITERATURE REVIEW

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East Africa (EA) is disproportionately affected by vector borne diseases (VBDs), which will further be exacerbated by climate change. Although inter-annual and decadal climate variabilities have shown impact on the epidemiology of VBDs, limited review of such studies in the region do exist. This study systematically reviewed and synthesized existing literature on the relationship between climate change and VBDs in EA. Available general databases such as: Medline; PubMed, Google scholar, PLOS, and CAB Direct were searched and manual reviews conducted for gray literature for the period between 2009 and 2022 inclusive. Collected data were then systematically analyzed for common themes about climate change and VBDs among the East African communities (EAC). Preliminary results show a total of 506 articles were found, but only 39 had relevance with the study objectives. Overall, the analysis showed that climate change does influence VBDs, and there were considerable variations in the number of studies conducted in the countries within the region. There is an urgent need for the regional bodies and countries in the EAC to take proactive approaches in addressing the looming disasters and hazards of climate change to safeguard the health and wellbeing of their constituents and to reduce the increasing pressures of the already stressed health systems in the region.

Keywords: Climate change; Vector borne disease; East Africa; Sub-Saharan Africa

ADOPTION OF CLIMATE INFORMATION SERVICES AND ITS IMPACTS ON HOUSEHOLD FOOD SECURITY AMONG SMALLHOLDERS OF SEMIARID AREAS OF KITETO AND KONDOA TANZANIA

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Global food demand is expected to grow significantly caused of ever increased population while food productivity is compromised by climate variability. Climate Information Services (CIS) became the promise to support farmers' decision making. In this paper we examined the adoption of CIS and their impact on food security among farming households in Kiteto and Kondoa districts, Tanzania. A quasi-experimental design was adopted to study 360 farmer households through a household surveys using semi-structured questionnaires. The sample was obtained using multistage sampling techniques. The collected data were analysed using descriptive and inferential statistics. The Household Dietary Diversity Score per Adult Equivalent Unit (HDDS/AEU) used as indicators measuring household food security. A multinomial probit model was employed to estimate factors influencing the adoption of CIS. To examine the impact of using CIS, a multinomial endogenous treatment effect model is involved to control for both observed and unobserved heterogeneity. The result stipulated that usage of CIS significantly increases food variety score per adult equivalent unit. Estimation of treatment effects revealed that a combination of seasonal weather information, probability of occurrence of extreme weather and agronomic advisory services are associated with higher HDDS/AEU. We therefore, recommend that CIS be regarded as a necessary tool in dealing with climate variability uncertainty, consequently, increasing crop productivity while reducing food insecurity. The results of this study provide empirical data that are producing new evidence on CIS in crop contexts and focus on improving usability and support to increase food security.

Keywords: Climate variability; Climate information services; Household food security; Crop production

MODELLING STATIONARY AND NON-STATIONARY HYDROLOGICAL EXTREMES UNDER A CHANGING CLIMATE IN LAKE KYOGA CATCHMENTS, UGANDA

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Climate change has contributed to more extreme hydrological events such as floods and drought that are increasing community vulnerability. Currently, Uganda faces high risks associated to extreme events in mountainous regions like Elgon, where the worst floods on record occurred on 30th July 2022 in Mbale City, Mpologoma catchment in Lake Kyoga Basin, leaving 30 people dead and property lost. Such extremes underscore the relentless quest for information on the extremes to guide mitigation of risks under changing climatic conditions. To generate plausible information, some studies on the extremes have been carried out by assuming stationarity in the extremes. With global human activities and climate change, the stationarity assumption has been severely challenged and new studies advocate for consideration of non-stationary aspects. To contribute to knowledge about the extremes, a study will be conducted on stationary and non-stationary hydrological extremes under a changing climate in Lake Kyoga catchments. The study will assess catchment rainfall-runoff relationships under baseline and climate change scenarios using Soil and Water Assessment Tool (SWAT) model. The climate change scenario will be studied using downscaled Global Circulation Model (GCM) outputs under Representative Concentration Pathways (RCPs) 4.5 and 8.5 to run the SWAT model. Parametric and non-parametric trend analysis will be carried out to establish trends that could point to non-stationarity in the extremes. Analysis of extreme high and low rainfall intensities and river flows under stationary and non-stationary conditions will be carried out using Extreme Value Distributions (EVDs) to generate Intensity Duration Frequency (IDF) relationships and flood magnitudes at given return periods to quantify potential climate change impacts on the extremes. Hydraulic modelling of different flood magnitudes under the baseline and climate change scenarios will be carried out using Hydrologic Engineering Center - River Analysis System (HEC-RAS) model to establish the spatial extents of floodable areas. The key results of the study will be the IDFs, frequency, duration, magnitude and spatial extents of floods to guide design of structural interventions like culverts, bridges and water storage dams and inform policy directions regarding safe settlement areas to ensure reduction of the risks associated to occurrences of the extremes.

Keywords: Stationary; Non-Stationary; Hydrological Extremes; Climate change

WHAT CONTROLS PHYSICAL VULNERABILITY TO GEOHYDROLOGICAL HAZARDS? A QUANTITATIVE APPROACH FOR LANDSLIDES AND FLOODS IN THE RWENZORI AND ANKOLE SUB REGIONS, WESTERN UGANDA

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Geohydrological hazards (landslides and floods) are often associated with large damages on physical infrastructure like buildings and roads, rendering many affected people homeless, and without access to critical social services. Understanding the nature of exposure and what controls the extent of damage is a prerequisite for building resilient structures and reducing vulnerability. In this study we documented the impact of past landslide and flood events in four selected districts in the mid- and south-western part of Uganda for the period between May 2019 and March 2021 through extensive fieldwork. We quantify in economic value the physical damage of landslide and flood hazards on exposed buildings, roads and bridges. We then analyse the physical vulnerability based on damage ratios and determine the factors that control the degree of damages using fractional logistic regression. Out of the 91 buildings affected by landslides, 54% were totally destroyed, and only 10% not or minorly damaged, for an average damage cost of 3,179 USD/building. For the 212 documented buildings affected by floods, 35% were totally destroyed, 28% had severe to moderate damage and the rest were minorly or not affected, with an average damage cost of 1,755 USD/building. The damage on roads by landslides totaled to 494m worth 5,560 USD while that of floods totaled to 1,624m of roads worth 344,816 USD and 19 bridges worth 4,125,000 USD. The physical vulnerability of buildings to landslides depends on the size of the landslide, age of the building, type of building wall material and the steepness of the slope cut to establish an artificial foundation platform. On the other hand, the physical vulnerability of buildings to flood hazards is largely controlled by the flood depth, the distance from the river channel, and the type of building wall and floor material. Reducing the foundation cut slope angle for the buildings in the highlands and use of reinforced concrete retaining walls can reduce the physical vulnerability of buildings to landslides. On the other hand, ensuring no constructions are made within the would-be river buffer zones can reduce the exposure and risk of buildings being damaged by floods.

Keywords: Geohydrological hazards; Exposure; Floods; Landslides; Physical vulnerability

AN EVALUATION AND REVIEW OF THE UTILITY OF NATURE-BASED SOLUTIONS FOR DISASTER RISK REDUCTION AND RESILIENCE BUILDING IN AFRICA

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There has been advocacy on increasing the utility of nature-based solutions to enhance disaster resilience and contribute to the overall global development agenda. Global studies indicate that Nature Based Solutions (NBS) can sequester a significant proportion of carbon; 10-12bn tonnes CO_2 equivalent (GtCO2e/year) to mitigate climate change 10-12bn tonnes of and reduce hydro-meteorological hazards. Despite this potential, there is limited information and knowledge on the nature and extent of use of NBS for disaster risk reduction in Africa especially for disaster risk reduction. Thus, the thrust of this study was to evaluate the extent to which nature-based solutions have been utilized for disaster risk reduction vis-à-vis other uses in the African region. The study is premised on a desktop review of existing knowledge and information which was collected and collated from articles, online reports and projects. Requisite searches using standard procedures were undertaken using keywords with a bias on the African region. Preliminary findings depict a dismally low utility of nature-based solutions in less than 30 countries in Africa. Preliminary results reveal that nature-based solutions in Africa are being used for multiple strategic interventions and benefits with up to 10 different uses identified spanning hazard management, agricultural productivity and improvement, tourism, improving ecosystem services among others. Overall, the utility of NBS for disaster risk reduction in Africa constitutes about 38%. The emerging NBS DRR utility fields include flood control, drought management, water and climate related aspects. Interestingly, a substantial proportion is devoted for tourism purposes (24%), which has an equal proportion with agriculture. A geographic disparity in the nature and intensity of use can be visualized, with tourism uses more concentrated in southern Africa.

Keywords: Nature Based Solution, Disaster Risk, Natural Hazard, Ecosystems, Livelihoods

SPATIAL AND TEMPORAL PATTERNS OF FLOOD HAZARDS AND THEIR IMPACTS ON HOUSEHOLD FOOD SECURITY IN EASTERN UGANDA

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Understanding patterns of flood hazards is a prerequisite for adequate disaster risk management. Bulambuli district in Eastern Uganda is prone to re-occurrence of flood hazards, affecting livelihoods and food security. Spatial and temporal patterns of floods were determined using time-series Landsat satellite imagery data spanning 2007 to 2019. The extent of flood inundation was assessed using the Modified Normalized Difference Water Index and Flood Hazard Index. A cross-sectional household survey covering 300 respondents was administered through interviews and questionnaires for the prevalence of food security. Flood hazards depict a predominantly clustered pattern with hotspots in the study area's mid to the northern and south-eastern parts. The most prone areas are Bwikhonge, Bukhalu and Muyembe sub counties. The spatial coverage of floods in the study area from 2007 to 2019 varied from 7% to 22%, constituting 1199 ha and 3767 ha, respectively. Concerning temporal patterns, the magnitude of floods was highest in 2019 and more pronounced in SON rainfall season, with a duration between hours to more than a month. The flood hazards in the study area had peaks in September and November. The majority of the households (90%) were food insecure. The occurrence of floods ($X2 = 45.26$, $P = 0.000$), off-farm income ($X2 = 90.20$, $df = 3$, $P = 0.000$), dependence ratio ($X2 = 77.80$, $df = 3$, $P = 0.000$) and level of education ($X2 = 89.66$, $df = 3$, $P = 0.000$) were the significant factors that influenced the food security status of a household. In conclusion, floods hazards show a clustered pattern that are increasing in the north while reducing in other parts of the study area. Prevalence of food insecurity is high in flood hotspot areas. Detailed flood hazard mapping like this should be integrated in planning for local disaster preparedness for e.g. identify evacuation areas by the district.

Keywords: Flood hazards; Food security; Spatial; Temporal; Disasters

NATURE-BASED SOLUTIONS FOR CLIMATE CHANGE MITIGATION IN GRASSLANDS OF HORN OF AFRICA

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Nature-based solutions (NbS) are recognized as a readily available climate mitigation intervention because of its potential to sequestration CO2 from the atmosphere and store it as living biomass and dead organic matter. This paper summarizes current information on the potential of NbS to mitigate climate change in African grassland ecosystems. The available data are used to synthesize current understanding of available NbS in grasslands, NbS climate mitigation potential, outline knowledge gaps, and suggest future directions and strategies for NbS climate mitigation potential research. NbS climate mitigation data were gathered from 60 studies conducted in six horn of African countries (HoA). This review found that avoided grassland conversion, grazing management, grassland conservation, exclosure, enclosure, restoration, natural regeneration, fire management, oversowing legumes in pasture, agroforestry, conversion of abandoned cropland to grassland, soil and water conservation, and bush control are all reported NbS to mitigate climate change in African grasslands. Total carbon stock (TCS) and carbon dioxide (CO2) sequestered by the protected, managed and restored grassland through NbS climate mitigation were 4.17± 1.32 t C ha-1 yr-1 and 15.67 ± 4.99 t C ha-1 yr-1, 10.54± 1.31 t C ha-1 yr-1 and 38.67 ± 3.71 t C ha-1 yr-1 and 2.93±0.61 t C ha-1 yr-1 and 10.8 ± 2.25 t C ha-1 yr-1, respectively. Overall, the TCS and total CO2 sink from a verities of NbS intervention that enhance carbon capture in HoA grasslands were 5.88 ± 3.67 t ha-1 yr-1 and 21.72 ± 13.32 t ha-1 yr-1, respectively. Additional NbS climate mitigation potential measurements are urgently needed to reduce uncertainty in potential TCS and CO2 sequestered due to various NbS climate mitigation options and identify effective NbS climate mitigation options. Identifying priorities for data acquisition, utilizing appropriate technologies, and involving international networks and collaboration may be a common strategy for addressing this data gap.

Keywords: Greenhouse gas; Management; Preservation; Restoration; Sequestration

NATURE-BASED SOLUTIONS FOR DROUGHT RISK MITIGATION IN THE EERER SUB-BASIN, EASTERN ETHIOPIA

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Drought is one of the challenges in Ethiopia. Ecosystems can protect people from the effects of climate-related hazards including drought. For this reason, nature-based solutions (NbS) are becoming more prominent in climate change policy to manage climate-related impacts, particularly in developing countries, however, there is still limited empirical evidence which would inform NbS policy and practices, especially as regards the magnitude of the effectiveness of NbS. Thus, the aim of this study was to characterize droughts in Erer Sub-basin and assess the effectiveness of NbS for drought. The temporal changes in SMDI (agricultural drought) and SPEI (meteorological drought) at various timescales (1, 3, and 6) were analyzed in the five selected sites in the Sub-basin taking into consideration the growth period of major crops between 1981 and 2020. Qualitative analysis was used to categorize and evaluate the effectiveness of NbS to mitigate drought risk by adopting a Living Labs approach. Overall, the study revealed that droughts trends showed an increasing trend with more frequency, longevity, and severity. The drought analysis results showed that SPEI's variants were less reliable than SMDI0-5 and SMDI5-100. With an increase in rainfall, SPEI showed stronger relationships with SMDI0-5 at 1 and 2-month delays between May and July. SPEI and SMDI5-100 performed better in terms of capturing actual drought occurrences than SMDI0-5. The participants who participated in the focus group discussions (FGD) suggested NbS like habitat restoration, structural restoration, reforestation, rehabilitation, reconstruction, revegetation, land enclosures, private land conservation measures, reserves, conservancies, and locally managed areas with specific set-aside purposes. They also suggested rehabilitating the degraded lands with exotic species and practicing rainwater harvesting during the rainy season and then consuming during drought/moisture stress period. Overall, the study indicated that a new, comprehensive approach to reducing the risk of drought is urgently needed with special emphasis on climatic extenuation measures and management through nature-based solutions.

Keywords: Meteorological drought; Agricultural drought; NbS; Eerer sub-basin

ASSESSING COMMUNITY RESILIENCE TO FLOODS IN KAMPALA CITY

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Globally, floods are among the most recurring and devastating natural hazards, impacting human lives and causing severe economic damage. Developing countries in Africa have recently experienced severe flooding. Uganda as a country is vulnerable to climate variability, including increased frequency and intensity of floods. Three sub-regions, the Albertine in the western part of the country, Teso and Mt. Elgon in the east, suffer from recurrent floods, resulting into destruction of crops, infrastructure, water contamination, and disease outbreaks; this calls for flooding risk mitigation. Building community resilience has become a major concern of modern flood risk management as a result of the inadequacy of flood control infrastructure under uncertainties. Uganda has struggled with setting up flood control infrastructure with the aim of mitigating the negative impacts of floods, yet this infrastructure is ineffective under continuous seasonal occurrences of floods in periods of intense rainfall. Several studies on urban flooding in Kampala have been carried out (Nakabugo, 2019; Chereni et al., 2019; Kisembo et al., 2018). However, there is limited information on the effectiveness of the current structural interventions and the social and biophysical states of the communities in response to flood resilience. The study used a descriptive research design with both quantitative and qualitative approaches, and using the simple random probability sampling method, a sample of 384 households from the given population were selected. Questionnaires were used to collect data from the households on social loss, economic loss and environmental loss in relation to community resilience to floods and socio-demographic characteristics of the respondents. The data collected was analyzed using SPSS software. The analysis was done through three levels: uni variate, bi variate and multivariate analysis and a new model for enhancing community resilience to floods was proposed. The study revealed that the current building codes and spatial planning for the study area were not effective in promoting community resilience to floods. However, the land use policies were found to be very effective in promoting resilience to floods. It was revealed that this was due to lack of community involvement in the planning in the area.

Keywords: Community Resilience

LIGHTNING OCCURRENCE AND CASUALTIES IN UGANDA 2007-2020

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Uganda has two distinguishing features that affect its lightning distribution. First, due to its location at and near the equator, the Equatorial Trough passes over it twice a year. Second, Lake Victoria, on Uganda's southeast border with neighboring Kenya and Tanzania, has a strong nighttime lightning maximum. A lightning stroke density map at a 10-km resolution for the year using data from Vaisala's Global Lightning Dataset GLD360 network reflects the risk exposure to lightning across Uganda. Graphs show events by month, time of day, and other data of interest in planning interventions and public safety messages. Because Uganda does not maintain a comprehensive lightning casualty dataset, this summary was made from available web, newspaper, and other media reports during 2007-2020. Of 121 events, there were 212 deaths, 824 injuries for a death rate of 0.4 deaths per million population per year. Males made up nearly 60% of the deaths, and the decade of life during which the highest rate of injuries occurred was 10-19 years of age. For the reports where the location of injury was noted, 60% of the deaths occurred at schools with 27 primary and 8 secondary schools involved. Nineteen school events involved 11 or more lightning casualties. Additional cases involved groups of people gathered at churches and funerals, and workers outside in subsistence agriculture. As in other developing countries, loss of life continues to occur due to outdoor exposure during agricultural and other activities and inadequate infrastructure that does not offer people protection from lightning. This occurs even though lightning stroke density in Uganda is not especially large in most locations.

Keywords: Lightning injury; Lightning injury prevention; Lightning risk assessment; Schools; Lightning in Africa

HOW AFRICAN CENTRES FOR LIGHTNING AND ELECTROMAGNETICS NETWORK ADDRESSES LIGHTNING RISK IN UGANDA

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The African Centres for Lightning and Electromagnetics Network (ACLENet), was founded in Uganda in 2014 and incorporated as a nonprofit in both Uganda and the USA in 2016. ACLENet's mission is to decrease deaths, injuries and property damage from lightning across Africa. This paper describes ACLENet's activities in Uganda.There are many challenges to improving lightning injury prevention in the developing world. These include higher lightning density in the tropical and subtropical regions where developing countries tend to be located as well as the high risk exposure due to labor intense work, lack of lightning-safe areas, and non-code-compliant lightning protection techniques. Additionally, cultural beliefs, multiple languages, illiteracy, and inadequate national attention, often due to lack of funds, complicate efforts to decrease casualties. Since 2014, ACLENet has had increasing impact on lightning safety in Uganda. The signing of a Memo of Understanding with the Office of the Prime in Uganda in February 2022 has fostered partnership of ACLENet with the Ministry of Response, Disaster Preparedness and Refugees (MoRDPR), the Ministry of Education and Sports (MoES), and other organizations to adopt international lightning protection standards, to improve professional education in lightning protection design and installation, and to improve safety and lightning safety education at schools across Uganda. Additional ACLENet activities include; (1) Studies detailing the risk patterns for lightning injury in Uganda and across Africa with maintenance and ongoing input to the largest publicly available lightning injury database for over 35 countries in Africa. Reporting of this research at international meetings (2) Monthly newsletter since 2018 for international, national, and local education as well as fundraising, now in four languages (3) Formation of the Lightning Protection Working Group to design and install lightning protection systems at schools across Uganda that meets international standards, modifying locally available materials when possible (4) Public education in Lightning Safety including newspaper inserts, TV talk shows, and public service announcements (5) (6) Development of lightning safety signage for Uganda schools as well as signage to accommodate multiple languages and those who cannot read to be used internationally.

Keywords: Lightning injury; Lightning injury prevention; Lightning risk assessment; Lightning protection; School safety; Property damage from lightning; Education; Lightning in Africa

IMPACT OF CLIMATE CHANGE AND VARIABILITY ON FOREST VEGETATION ZONES IN MALAWI

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Adversative effect of climate variability on the environment has been extensively reported. Malawi has not been safe from the adversative effects of climate variability as evinced by recent floods and drought. This study was conducted to evaluate the influence of climate change and variability on forest type and forest living biomass. Three scenarios were used in the assessment. Namely: Near-century (2011-2040), mid-century (2041-2070), and end-century (2071-2100). Holdridge Life Zone model and GAP Formind modified were used for the assessment. The results show that three forest vegetation zones will be observed from near century to end century. These are: dry forest, very dry forest and thorn woodland forest. Under near-century climate conditions, there are two forest vegetation zones occurring in Malawi: dry forest and very dry forest. Under mid-century climate conditions thorn woodland forest will emerge and dry forest will disappear in the end-century climate conditions. There will be a significant decrease in forest living biomass (1,000 kgha-1yr-1) from near century to end-century. The study has demonstrated that future climate change will be conducive to growth and expansion of very dry forest vegetation zone, which causes positive effects on reforestation planning and adaptive strategies. Therefore, the study suggests the following as some possible strategies to adapt climate change: promotion of natural regeneration of tree species, promotion of tree site matching, production and promotion of new tree seed varieties; and seed banking for drought resistant tree species.

Keywords: Adaptation; Climate change; Vegetation zone; Forest biomass; Climate condition

ASSESSING THE ROLE OF INDIGENOUS AND LOCAL KNOWLEDGE (ILK) IN THE SUSTAINABLE MANAGEMENT OF MEDICINAL PLANTS IN THE RURAL COMMUNE OF BAMAFÉ LÉ , WESTERN MALI

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Rural communities often face problems of limited health care services, low income and sanitation, leading to a heavy reliance on medicinal plants for their health needs. However, indigenous and local communities often have knowledge, albeit undocumented, about the sustainable management of wild medicinal plants. An ethnobotanical study was therefore conducted in 100 households with 204 interviewees (102 males and 102 females) with at least childbearing age in 4 villages in the rural commune of Bamafélé in western Mali, to assess the role of ILK in sustainable management of medicinal plants with accordance to the NP and their healing practices. An itinerant floristic inventory method documented 70 medicinal plants (woody and herbaceous) belonging to 63 genera and 34 families. The family Fabaceae was dominant (12 species) followed by Combretaceae (8 species). The most cited species were Mytraginainermis (83), Anogeissusleiocarpa (41), Sarcocephaluslatifolius (35). The leaves were the most used part for therapeutic purposes. The most frequently treated diseases were malaria, urinary tract infections, respiratory infections and gastro-enteritis. The knowledge of indigenous and local people about PM plays an important role in the sustainable management of PM species. Their management methods are part of a SM dynamic in the absence of knowledge about the NP ratified by Mali in 2014. The results obtained can be used in scientific research, phytochemistry and pharmacology to advance the improvement of traditional medicines and establishing a clear pathway for the implementation of the NP in the country can promote the sustainability of wild PM.

Keywords: Medicinal plants; Indigenous and local knowledge; Sustainable management; Nagoya protocol

COMPARATIVE STUDY OF THE IMPACT OF CLIMATE CHANGE ON THE BIODIVERSITY OF THE SOIL MACRO-FAUNA IN SEMI-ARID AREAS: SPECIFIC RICHNESS, ECOLOGY AND IMPACT OF AGRICULTURE ON THE SOIL

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This work will focus on the study of the macro-fauna of the soil, then the analysis of the impact of agricultural activity and climate change on the soil. The objective of this work is to inventory the different animal species present on the sites and understand their distribution according to the soil and climatic conditions of the two environments. The disappearance of soil biodiversity has been identified by the European Commission as one of the major risks to soils, as well as erosion, organic stock reduction or compaction. Sampling will be done at the two different sites (forest and agricultural plot). In addition, soil samples will be collected and analyzed in the laboratory to determine the physicochemical parameters of soils. The determination of the physicochemical parameters of soils will allow to correlate the specific richness of the soil with the nature of the soil. The decline of soil biodiversity has been identified by the European Commission as one of the major risks to soils, as well as erosion, organic stock reduction or compaction, and the "decline of biodiversity Has thus been introduced in the draft Framework Directive on Soils.

Keywords: Biodiversity; Soil; Macro-fauna; Ecosystem; Climate change

FOREST COMPOSITION AND STRUCTURE OF WEST BUGWE CENTRAL FOREST RESERVE

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Knowledge on woody plant composition and diversity is vital in promoting sustainable use of resources and designing strategies to halt biodiversity loss. We undertook this study to generate information to guide the management of West Bugwe Central Forest Reserve (WBCFR) and similar protected areas. We specifically determined the community composition, species composition and structure of woody species in three different land cover units (forest, shrubland and grassland) of WBCFR. We established 30 plots in each of the land cover. We determined species composition (using the importance value index (IVI)), species diversity (using Shannon-Weiner (H') and Complement of Simpson Diversity index (1-D), and rank abundance curves), species richness and indicator species using (Indicator Species Analysis procedure). Lastly, we established the regenerative potential of the dominant and indicator species using size class distributions analysis. We documented 59 species in this study. Ten species Antiaristoxicaria, Celtis gomphophylla, Albizia glaberrima, Albizia grandibracteata, Blighiaunijugata, Vepris nobilis, Senna siamea, Trichiliaprieurean, Celtis africana and Chaetacmearistata are dominant and some also indicator species. The indicator species were restricted to the forest land-cover. Most species had a J-shaped size class distribution indicating population structures dominated by mature individuals and may thus not be regenerating. However, Blighiaunijugata, A. toxicaria, V. nobilis, C. gomphophylla and Psydrax parviflora had inverse J-shaped size class distributions indicative of healthy regeneration. Our results suggest declining diversity and richness of woody species in WBCFR due to forest conversion.

Keywords: Land cover, Community composition, Species composition, Species structure, Indicator species

LAND USE AND LAND COVER DYNAMICS AND TRADITIONAL AGROFORESTRY PRACTICES IN WONCHI DISTRICT, ETHIOPIA

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Background: Investigating the land use and land cover (LULC) dynamics and the status of traditional agroforestry practices provide important data for policymakers. The main objective of this study was to assess the LULC dynamics and traditional agroforestry practices among smallholder farmers across the two agro-ecological zones in Wonchi District of Ethiopia. Methods: Landsat images were acquired from Earth Explorer, and changes in LULC were quantified with three Landsat sensors in the three time-series (1985, 2001, and 2019). Supervised classification with maximum likelihood technique was employed using ERDAS Imagine and ArcGIS. A ground survey was conducted with 100 key informants who were selected from 10 sites using a purposive sampling method. The collected data were subjected to direct matrix ranking, use-value analysis of most important multipurpose plant species, and semi-structured interviews were conducted for qualitative analysis. Results: In total, 103 agroforestry plant species belonging to 44 families were identified in Wonchi District, of which 74 were indigenous including seven endemic and 29 exotic species. The highest species (13) were recorded in the Fabaceae family. About 61% of species were reported in the midland agro-ecological zone. A mixed farming system was the most frequently (56%) reported source of income. The results of LULC changes from 1985 to 2019 showed that the agroforestry cover increased from 31.1% to 34.9% and settlement including road construction increased from 12.5% to 31.6% of the total area with an annual rate change of 0.3% and 2.7%, respectively. These changes corresponded with a decreasing trend of the forest, cropland, water body, and shrub at a rate of 4.7%, 1.3%, 0.8%, and 0.5%, respectively. The LULC changes were more pronounced in the highlands than in the midlands of Wonchi District. Expansion of settlement and tenure policy change are the main drivers for these changes in the area. The authors recommended that protecting and planting indigenous and multipurpose plant species is essential as restoration techniques for all degraded land-use types. Therefore, strengthening agroforestry practices and land-use planning is urgently needed for achieving multiple goals.

Keywords: Agroforestry; Crop species; LULC change; Multipurpose species; Supervised classification

THE ROLE INDIGENOUS TREE PLANTS IN ECOSYSTEM AND BIODIVERSITY CONSERVATION: A CASE IN GEDEO AGRO FORESTRY ECOSYSTEM, IN SOUTH ETHIOPIA

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This study was conducted to investigate the indigenous tree plant species diversity, and their role in ecosystem and biodiversity conservation in Gedeo Agroforestry ecosystem. The objectives for this study were assessing indigenous tree plant species diversity, identifying their ecosystem and biodiversity conservation roles, evaluating their role in landscape restoration and investigating the threats to indigenous tree plant species in the area. Systematic sampling method was used to collect the data from 20× 20m based quadrats. Environmental variables such as altitudinal aspect, slope, human and grazing impacts were recorded in each sample plots. A total of 21 indigenous plants belonging to 19 genera and 17 families were identified. Fabaceae had the highest number of taxa followed by Asteraceae. Indigenous trees and their restoration found to have various benefits like promoting water quality and quantity, regeneration and stabilization of the soil, etc. In addition, landscape restoration using indigenous trees contributes to the sustainable production of nutritious foods, provision of medicinal plants, availing fresh water, promoting ecotourism and economic situation and helping climate change mitigation. The finding from the study area also indicated the presence of threats like agricultural expansion which is the major challenge for natural habitat and indigenous plants destruction in Gedeo agroforestry ecosystem. Therefore, activities like awareness creation through training and education with the participation of government and nongovernmental organizations on sustainable use and conservation of indigenous tree plant species are recommended for the sustainable management of indigenous tree species in the area.

Keywords: Indigenous tree; Gedeo Agro Forestry; Biodiversity; Ecosystem; Conservation

EFFECTS OF POLYAROMATIC HYDROCARBONS (PAHS) ON THE SELECTED ENZYME SYSTEMS IN LAND SNAIL (ACHATINA FULICA)

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The objective of this study was to investigate the enzyme response in land snail Achatina fulica exposed to benzo(a)pyrene + pyrene spiked soil and polluted soil. The snails were exposed for a maximum of 11 days and sampling done after 3 days and day 11 days of exposure. The snails were analysed for their carbohydrate metabolising enzymes and enzymatic defence system, antioxidant and phase II enzyme activities, to evaluate the exposure toxicity of pollutants. The benzo(a)pyrene, pyrene and polluted soil affected antioxidant enzymes and glutathione-mediated detoxification as an enzyme defence system and also the carbohydrate metabolism. Antioxidant enzymes, superoxide dismutase and catalase activities were markedly elevated after 11 days of exposure, also glutathione and lactate dehydrogenase activities were elevated after 11 days of exposure. Succinate dehydrogenase activity was markedly inhibited after 11 days of exposure. These enzyme activities of the land snail A. fulica seem to be a convenient approach for monitoring pollution in terrestrial biota against polycyclic aromatic hydrocarbon pollution including benzo(a)pyrene and pyrene.

Keywords: Polyaromatic hydrocarbons; Antioxidative deffence; Xenobiotics; Biomonitoring

THE CHANGING NATURAL LANDSCAPE IN ZAMBIA: IMPLICATIONS AND CHALLENGES TO ECOSYSTEM SERVICES IN URBAN AREAS

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The growth in population is most of the cities and urban centres in sub-Saharan Africa has presented insurmountable challenges in the provision of municipal services, especially housing. In Zambia the current housing stock is estimated at 2.5 million houses serving 16 million people. It has a deficit of 2 million houses, implying that there is overcrowding in the existing housing stock. This housing deficit has been compounded by a shortage of cheap urban land for housing. Consequently, houses are being constructed in fragile environments including urban wetlands. These freshwater wetlands which are being drained for house construction are among the most valuable ecosystems providing services such as the buffering of floods, water filtration, water supply, waste treatment and are also important inland sink of carbon. The fate of wetlands is also being suffered by termite mounds whose density is decreasing through the destruction by the urban population which using them as a source of clay bricks for housing construction. Yet these mounds also provide several ecosystem services including the distribution of natural resources such as water and nutrients in the landscape and consequently the diversity of soil microbes, plants and animals. The degradation of these ecosystems also contributes to soil degradation, increased water runoff and accumulation of excess water, which promote mosquito breeding sites. This paper examines the impact of housing developments in the urban areas of Zambia and their role in changing urban natural ecosystems.

Keywords: Ecosystem Services; Wetlands; Urban Landscapes; Challenges

MAPPING WATER HYACINTH INFESTATION IN THE MURCHISON BAY, LAKE VICTORIA BASIN -UGANDA

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Water hyacinth is among the invasive species on planet Earth, causing adverse economic and ecological impact especially in compromising the quality of water in colonized areas. Despite its aggressive nature, its extent and pattern of distribution within the Murchison Bay is not well documented. The invasive nature of this weed justifies the need for reliable estimates of its biomass and pattern of distribution so as to determine the severity of the problem and identify water bodies which needs urgent management. The Murchison Bay was selected for this study basing on its being the abstraction point for the water which serves a population of over five million people. This study involved mapping the extent and pattern of water hyacinth distribution between 2016 and 2019. Sentinel 2A images of the study area for the period, 2016-2019 were used to map the water hyacinth extent and distribution pattern. Images selected were those of less than 10% cloud cover, as images analysis was based on mainly the visible bands (RGB & IR) and atmospherically corrected using DOSI MODEL embedded in QGIS 3.12 software. Post processing involved computation of areal statistics for the cover classes for the images corresponding to the study period, and with the use of discriminant analysis (DA) various changes of water hyacinth visa vi other covers in the bay were determined. The results revealed that in 2016, water hyacinth covered a land area of 511 km2 (1%) which increased to 2,434 km2 (4%) in 2017. The coverage dropped to 1,542 km2 (3%) in 2018.Water hyacinth spatial extent however increased again in 2019 to 2138.43km2, representing 4% of the total areal coverage. It was concluded that: (i) the extent and distribution of water hyacinth in Murchison Bay varies over space and time but concentration is mainly on the northern shores. (ii) Continuous monitoring of areas of chronic infestation is important for formulation of effective control strategies for this fast spreading water weed. Thus, Water resources management departments in the country should put up practical measures to control proliferation of the water hyacinth on water bodies.

Keywords: Water hyacinth; Murchison Bay; Lake Victoria; Sentinel 2A; Mapping

PLANT CONSERVATION IN MEDITERRANEAN REGION: CASE STUDY IMPORTANT PLANT AREAS (IPAS) IN MOROCCO

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Located in the extreme northwest of Africa, between 21° and 36° north latitude and 1° and 17° west longitude, Morocco covers an area of 710 850 km2. Its privileged location with a double coastline and its diverse mountain with four major mountain ranges: the Rif, Middle Atlas, High Atlas and Anti Atlas with altitudes exceeding 2000 m in the Rif, 3000 m in the Middle Atlas and 4000 m in the High Atlas gives an exceptional range of climates from Saharan climate to high mountain climate passing through arid, semi arid, humid and subhumid climates. This climate and orographic diversity offers very varied ecological conditions which allowed installation of diverse ecosystem and various Important Plant Areas (hotspots) rich in rare and endemic species. However, these Important Plant Areas are subjected to many natural pressures (climate change, parasitic attacks…) and antropic (clearing, overgrazing,…). This presentation will give an overview about plant conservation in Mediterranean region and be focused on the Moroccan Important Plant Areas and biodiversity conservation strategies and the assessment of the climate change impacts on the degradation and the dysfunction of ecosystems as well as the rarefaction and the disappearance of species.

Keywords: Plant; Conservation; IPA; Mediterranean region; Morocco

URBAN ECOSYSTEM SERVICES AND MOST DETERMINANT VARIABLES OF STAKEHOLDER'S PERCEPTION IN COTONOU CITY

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[1] Regional Excellence Centre on Sustainable Cities in Africa

[2] University of Lomé, Republic of Togo

Anarchic urbanization and the artificialization of soils expose urban ecosystems and ecosystem services (ES) to the threat of dysfunction and disappearance. An evaluation of the determining socio-ecological factors of the perception of the actors allows the good design and planning of ecological urban policies, guarantee of sustainable cities development in Africa. In this study, we evaluated the perception as well as the discriminating variables of the different stakeholders of urban ES provided by plant diversity in the city of Cotonou. Thus, 380 city dwellers were individually interviewed after statistical sampling. Focus discussions with the stakeholders also made it possible to highlight the SEs delivered in the different urban Land Use Units (US). The hierarchical classification shows two homogeneous groups of collectors with age, ethnic group and education as statistically discriminating sociological variables ($pv<0.001$). The perception of the existence of five urban SEs is not statistically significant ($pv>0.001$) in the lot. Contrary to group 2, the dispersion coefficient ($CV<50\%$) reveals a homogeneity in the perception of ES by the city dwellers of group 1. The principal component analysis (PCA) reveals that the availability of ES varies according to the different US from the city. This study brings scientific added value in the application of urban ecology through its contribution to the existence of scientific data for decision-making by local governments, municipalities and prefectures in planning and development policies for future Benin cities.

Keywords: Urban trees diversity; Urban ecosystem services; Stakeholder's perception; Discriminants socio-demograp

BIODIVERSITY CONSERVATION THROUGH SUSTAINABLE MANAGEMENT OF AGRICULTURE PRODUCTION SYSTEMS: A CASE OF HOME GARDEN PLANT DIVERSITY

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Producing enough amounts of food while protecting both environmental quality and the economic well-being of communities is a main challenge to agricultural production, therefore there is need for research on better production systems that can enhance continuous production without compromising environmental quality. This study was conducted in Thies region of Senegal with the objective of assessing how garden management and conservation practices affect the conservation of plant diversity in home gardens. A sample of 30 home gardens were selected from the three main departments of the region and was used to collect plant species data. Data were collected from informants who were selected basing on recommendations from the village leaders. Techniques used were participatory observations and individual interviews. Data was analysed in analytical software R using simple linear regression. Garden management is by both men (73%) and women (27%).A total of 96 plant species were recorded and out of these, 80(83%) species were managed (with at least one management practice) and 16 (17%) were completely not managed. The planting materials are mainly sourced from friends/neighbors through seed sharing 62(64%) species. The mostly applied management practice was watering with 77(80%) species being watered, no soil moisture conservation practice was observed in all the studied home gardens. The study indicates that management affects the conservation of plants in home gardens (P value <0.001). The study concludes that management and conservation practices are essential for on farm conservation of biological diversity. Training of gardeners is needed to fill the knowledge and skill gap on soil water conservation.

Keywords: Sustainable biodiversity conservation; Plant species diversity; Home Garden; Management

SPATIAL-TEMPORAL DYNAMICS OF THE KAMPALA CAPITAL CITY URBAN FOREST

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Makerere University, Uganda

The urban forest is rapidly changing in Kampala, causing a variety of land-use dynamics. The sustainability of the urban forest is critical based on known values such as carbon sequestration, biodiversity conservation, flood control and among others to the City. The Kampala capital city urban forest comprises individual and groupings of trees that grow within the city limits. It should be noted that the city is losing trees individually and in groups along streets, parks, private gardens, and residential areas. Understanding the changes in time and size of the Kampala urban forest is therefore critical for monitoring and making sustainability decisions. This is also crucial for achieving the United Nations SDG 11, 13, and 15. Sentinel 2A Image classifications for 2016, 2018, and 2021 for Kampala central division were performed using a remote sensing hybrid classification approach of landuse landcover change within a 5-year period to determine the change dynamics. During this time, the built-up area decreased by 3% from 2016 to 2018 and increased by 2% from 2018 to 2021. As a result, 144.5ha of trees, grass, and shrubs were lost in order to build. However, 169ha of built land was converted to tree cover, indicating a 7.6% net increase in tree cover. The distribution of tree cover is uneven, and the net gain is insufficient for the city to adequately enjoy the tree cover benefits such as mitigating environmental risks, implying that efforts must be increased if the city's sustainability goals are to be met.

Keywords: Remote sensing; Kampala Capital City; Urban Forest; SDGs

PEST STATUS OF KEY MANGO PESTS IN AMACH SUB-COUNTY, LIRA DISTRICT UGANDA

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Ugandan mangoes (Mangifera indica) face potentially serious problems from fruit flies (Diptera: Tephritidae) and mango seed weevil (Sternochetusmangiferae (Fabricius) which cause significant economic losses especially in hindering their shipment. However, despite their economic importance, management in Lira district has been hampered by the limited knowledge of their prevalence and the extent of damage caused. Therefore, this study aimed to assess the prevalence and extent of damage caused by the two pests among the different mango varieties. To monitor the adult fruit fly population among six farmers, locally made 1-liter rectangular recyclable yellow plastic containers were baited with Methyl-eugenol Capsule (ME), Trimmed (TML), Methyl-eugenol Block, Terpinyl Acetate and Cue lures from August 2020 to July 2021.To determine the infestation of fruit flies and mango weevil, mango fruits from eleven mango varieties were randomly sampled in different orchards and dissected to determine pests' incidence. A total of nine tephritid fruit fly species were recovered from 4 genera of Bactrocera, Ceratitis, Trirhithrum, and Dacus. The trap catches were highly significant (P 0.001) during the trapping period. Bactrocera dorsalis had the highest species recovery at 85.39%, while C. fasciventris had the lowest at 0.01%. The exotic variety Kent had the highest fruitfly infestation (53.00 ± 15.00) fruit fly larvae per fruit compared to the local variety Kagwogwa (1.31 ± 0.35) fruit fly larvae. In addition, Apple, Keit, Zillet, Kagogwa and Kent cultivars had the highest mango seed weevil infestation rates at 100%, 100%, 80%, 79%, 63% and 79%, respectively, while Bire, Dodo, Kifuta and Takataka had the lowest infection rates of 7.29%, 15.20%, 17.65% and 17.65%. The findings show that fruit flies and seed weevil are serious pests of mangoes with the severest infestation among the exotic varieties and in orchards with poor orchard management practices. However, since no single management tactic can eliminate these pests, control tactics should focus on integrated pest management of both pests to ensure effective management.

Keywords: Mangifera indica; Bactrocera dorsalis; Mango seed weevil

THE ASSESSMENT OF THE GEOLOGICAL AND GEOMORPHOLOGICAL ELEMENTS FROM GLAMEIA SCARP, ROMANIA-IMPLICATIONS IN GEOPROTECTION

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DimitrieCantemir University, Romania

The assessment of the geological and geomorphological elements has been used to argument the protection of Glameia Scarp, located outside the network of designated natural protected areas from România. Scarp protection can be obtained by declaring this area, through a decision of the Local Council of Bosorod, as natural protected area of local interest. In this way Glameia Scarp will be incorporated into local politics of sustainable development.

Keywords: Scarp; Geological; Geomorphological elements; Geoprotection

BIODIVERSITY OFFSETTING IN UGANDA'S PROTECTED AREAS: A PATHWAY TO ATTAINING BIODIVERSITY AND LIVELIHOOD BENEFITS?

RitahKigonya, Haakon Lein, Charlotte Nakakaawa

Norwegian University of Science and Technology

The concept of 'political forests' was first coined up by Peter Vandergeest and Nancy Peluso to emphasize the social-political dimensions of forests as opposed to their classification as natural entities. Forests are created and constantly in the process of being created through politics and cultural ways of seeing, as well as through nature's agency. Drawing on empirical data from forest cover change analysis, forest inventories, community surveys and interviews, we use the concept to examine the ongoing co-production and internal territorialization of Gangu Central Forest Reserve into conservation and economic/production zones as part of the struggle to implement and secure permanency of a biodiversity offset site. In the process, we unpack the interactions between the diverse state and non-state actors, that lead to a transformation in forest materiality, forest access, use and management. We argue that in order to be able to implement the biodiversity offset site successfully the forest management authorities have accepted previously unaccepted forest activities such as crop farming, thus reshaping forest use, access and management. In addition, the forest management authorities are embracing the transformation of parts of the reserve forest into forest plantations as a management strategy to drive out 'encroachers' from the forest. The paper amplifies the concept of political forests as social natural spaces continuously in the process of coproduction as a result of exerting, resisting and modifying forest use and access rights among state and non-state actors.

Keywords: Political forests; Biodiversity offsetting; Collaborative Forest Management; Uganda

CREATING AND TRANSFORMING POLITICAL FORESTS: CHANGING MATERIALITY, ACCESS AND USE OF GANGU FOREST RESERVE IN CENTRAL UGANDA

Ritah Kigonya, Haakon Lein, Charlotte Nakakaawa

Norwegian University of Science and Technology

The concept of 'political forests' was first coined up by Peter Vandergeest and Nancy Peluso to emphasize the social-political dimensions of forests as opposed to their classification as natural entities. Forests are created and constantly in the process of being created through politics and cultural ways of seeing, as well as through nature's agency. Drawing on empirical data from forest cover change analysis, forest inventories, community surveys and interviews, we use the concept to examine the ongoing co-production and internal territorialization of Gangu Central Forest Reserve into conservation and economic/production zones as part of the struggle to implement and secure permanency of a biodiversity offset site. In the process, we unpack the interactions between the diverse state and non-state actors, that lead to a transformation in forest materiality, forest access, use and management. We argue that in order to be able to implement the biodiversity offset site successfully the forest management authorities have accepted previously unaccepted forest activities such as crop farming, thus reshaping forest use, access and management. In addition, the forest management authorities are embracing the transformation of parts of the reserve forest into forest plantations as a management strategy to drive out 'encroachers' from the forest. The paper amplifies the concept of political forests as social natural spaces continuously in the process of coproduction as a result of exerting, resisting and modifying forest use and access rights among state and non-state actors.

Keywords: Political forests; Biodiversity offsetting; Collaborative Forest Management; Uganda

EVIDENCE OF MICROPLASTIC CONTAMINATION OF NILE TILAPIA (OREOCHROMIS NILOTICUS) AND NILE PERCH (LATES NILOTICUS) FROM THE INNER MURCHISON BAY OF LAKE VICTORIA IN UGANDA

Sandra Mutesi

Makerere University, Uganda

Microplastic contamination in African freshwater bodies and their inhabiting organisms is still under-reported, even with the strides microplastic research has taken. This study was conducted in the Inner Murchison Bay, located near the Northern shores of Lake Victoria in Uganda. A total of 42 locally fished Nile perch (Lates niloticus) and Nile tilapia (Oreochromis niloticus) were taken for the study. Gastrointestinal tracts and gills of the Nile perch (Lates niloticus) and Nile tilapia (Oreochromis niloticus) were examined for microplastics. Microscopy and the hot needle test were used to identify the plastic particles. Microplastics were identified in 70.46% of all the fish collected. Although further research is required to fully assess the specific type of microplastics in the fish and the impact of plastic pollution in Uganda, this research provides evidence of the presence of microplastics in the fish consumed in the country.

Keywords: Microplastics; Oreochromis niloticus; Lates niloticus; Lake Victoria; Uganda

HEADING TOWARDS A 21ST CENTURY URBANIZED AFRICA

Tayo Anthony Adeyinka

University of Lagos, Nigeria

Architecture is an art and as such it is in some way expressive of the men and women who build. In the last quarter of a century Africa has not been the only source of breezes freshening the development of contemporary architecture, but Africa has been the pointer to that rise. This research is going to explore a space conception, which is as much a part of the emotional as it is of its spiritual attitude, it is not the independent unrelated form that is the overall of architecture today but the organization of forms in space, that is space conception. This research looks at the present space –time conception ,the way volumes are placed in space and relate to one another, the way interior space is separated from exterior space, or is preferred by it to bring about an interpretation is a universal attribute which is the basis of all contemporary architecture.

Keywords: Design; Urbanisation

MARKET SYSTEM ANALYSIS OF BAMBOO PRODUCTS IN TANZANIA

Jumanne Moshi Abdallah, Romanus C. Ishengoma, Lilian Magafu

Sokoine University of Agriculture, Tanzania

Globally bamboos is considered pro poor and contribute significantly to communities along value chain. The aim of this study was to conduct market system analysis of bamboo products in Tanzania. Underlying causes of market failures. Seventy producers, two processors and twenty-five traders were sampled to collect data in Mbinga and Songea districts in Ruvuma region. Questionnaire survey, key informant interviews and participant observation were the key methods for data collection. Descriptive, trend and inferential analyses were used as data analysis methods. Key actors were producers, processors, traders and input suppliers. Main products manufactured were winnowing trays, baskets, jamanda and barbeque sticks. Prices for the products ranged from TZS 550 to 6000 per item. Markets for these products were within the villages and some in towns (Songea, Mbinga and Nyasa). Only barbeque sticks accessed far markets in cities e.g. Dar es Salaam. Producers gross margins ranged from 4% to 44% depending on product dealt. However, when producers were in groups gross margin was 78% which was higher than that of traders and processors (60% and 40% respectively). This imply that working in groups reduced costs and increased efficiency. Weak policy attention to bamboo limited value chain development. INBAR, SUA and TFS roles were observed in improving bamboo management through supplying support services. However, there were little efforts on skills improvement and value addition. The study suggests that producers should organize themselves in groups to increase access to market information and support for profit maximization.

Keywords: Bamboo; Songea; Market system

EVALUATION OF TROPICAL WHITE MAIZE (ZEA MAYS L.) GENOTYPES FOR TOLERANCE TO FALL ARMYWORM (SPODOPTERA FRUGIPERDA J.E. SMITH) INFESTATION

Nesma Alaa ElDin Zakaria Moussa

Paulesi Institute

Maize (Zea mays L.) is an important food, feed and fuel crop. Fall armyworm, a pest that reduces grain yields and threats its production. Availability of varieties tolerant to FAW is the most economical and sustainable option to enhance maize productivity in sub-Saharan Africa. This study aimed to evaluate 29 white maize genotypes, identify FAW tolerant genotypes and determine the relations between grain yield and FAW damage traits. 29 stem borer-tolerant white maize genotypes were evaluated in 2 seasons at UI experimental field and were laid out in RCBD with 3 replicates. Grain yield and agronomic traits were collected under both conditions, while FAW damage traits were only collected under infested conditions. Data were subjected to analysis of variance and correlation. Base index was used to select tolerant genotypes. Significant differences were obtained for all the traits under both conditions. Grain yield ranged from 3.44 t/ha FAWTH-8 to 5.81 t/ha FAWTH-1 and from 3.42 t/ha FAWTH-25 to 6.85 t/ha FAWTH-18 under both conditions, respectively. Grain yield under infested conditions was negatively and significantly associated with FAWLD and FAWCD. 6 genotypes (FAWTH-1, 13, 4, 10, 23 and 6) which had grain yields 5.13 tonnes/ha and positive BI 4.0 under FAW infestation were identified. Genetic variation exists among the genotypes evaluated. Low FAW damage scores could be used as selection criteria for FAW tolerance and high grain yields. The identified genotypes are recommended as candidates for further evaluation and development of FAW tolerant genotypes.

Keywords: Base index; Fall armyworm leaf damage; Fall armyworm cob damage; Grain yield; Zea mays

Post Conference Field Excursion

Exploring the diverse captivating Elgon Landscape

Dates: 10-12th December 2022

Introduction: A three-day post GORILLA conference excursion is being organized to mountain Elgon in Eastern Uganda. The gist of the conference is to elicit a range of sustainability issues as stipulated in the Global Development Agenda 2030 distilling challenges and opportunities premised on field conditions. The post GORILLA conference excursion intends to further the sharing of knowledge on emerging issues in the context of a hotspot region with great contrast; degradation, diverse ecosystems, restoration and livelihoods. While, the major concentration is on mountain Elgon, which also hosts the Biosphere Reserve. The exciting field excursion is planned for 3 days and will cap the conference series of activities to be held in Kampala. Mt Elgon region is one of the most beautiful and interesting sites in Uganda. The excursion will expose the participants to a range of visual catching landscape scenery and developments within the region. The region's population is dependent on a range of livelihoods largely involving exploitation of ecosystems and landscape resources. This has, however, paused socio-ecological problems amidst changing climate conditions. Interesting to note is the increasing efforts by the government and various development partners to address the problems through a multitude of innovations. These innovations are worthy witnessing and drawing lessons as professionals in our respective capacities (e.g. researchers, practitioners, tourists).

The time of excursion also coincides with key UN international celebrations of the International Mountain Day (IMD) and the International Year of Sustainable Mountain Development (IYSMD). This year as well marks the 20th anniversary of the first International Year devoted to mountains (International Year of Mountains 2002) and the 20th anniversary of the Mountain Partnership. It is therefore humbling that we join with the rest of the international community and the local partners in celebrating these two special occasions in order to create awareness about the importance of mountains including the challenges faced and thus bolster the agenda towards Sustainable Mountain Development (SMD) in Uganda.

Objectives of the excursion

1. To acquaint the participants with the existing local problems and on-going initiatives pertaining to the theme of the conference

2. Provide opportunity for participants to tour and enjoy the beautiful unique features transcending the region

Outcome: Improved understanding of the varied ecosystem problems and challenges, and existing interventions by different stakeholders in line with the GORILLA conference issues

Excursion Planned Activities

Day I: Saturday 10th December 2022	
Thisis largely a travel day. However, we shall have one main and brief stopover at selected sites largely for roadside observations and briefings. The first stop over at Mabira forest Reserve- Lugazi Sugar cane landscape, is a land mark site of convergence for conservation and economic interests. Another brief stopover will be an Jinja city historical landmark; the source of the Nile River	**1**
Day II: Sunday 11th December 2022	
Travel to the field in the mountain (Sipi falls and associated cave complexes plus Atari Integrated Landscape Management project pilot sites) for half day and converge for IMD/IYSMD celebrations in the afternoon at Wash and Willis Hotel.*	**2**
Day III: Monday 12th December	
Travel back to Kampala with stopovers via Tororo and Busitema	**3**

To register for the excursion, please contact:

Dr. Bob Nakileza
Department of Geography, Geo-Informatics and Climatic Sciences
nakilezabob@gmail.com
Tel: 0782 470 344

Food and Agriculture Organization of the United Nations

THE EUROPEAN UNION

THE REPUBLIC OF UGANDA

GLOBAL CLIMATE CHANGE ALLIANCE PLUS (GCCA+)

SCALING UP AGRICULTURE ADAPTATION TO CLIMATE CHANGE IN UGANDA

Dr. Kennedy Igbokwe, Project Manager and Team Lead- FAO Uganda Climate Change Program

Background:

The Global Climate Change Alliance Plus (GCCA+) is the second phase of the GCCA project in Uganda. GCCA+ is a Project of the Government of Uganda, funded by the European Union and implemented by FAO, to contribute to making rural households more resilient to climate change effects and food insecurity by promoting sustainable and gender transformative actions. Implemented from December 2018 to December 2023, GCCA+ builds on the success and achievement of the first phase of the GCCA programme whose focus was resilience-building with a particular interest in addressing gender gaps in the agriculture sector. This second phase of the project recognises that women and men face different risks and vulnerabilities due to their different roles, needs, capacities and social positioning; these affecting how men and women anticipate, respond to or mitigate climate change.

Drawing from lessons and successes of the first phase of the Project, GCCA+ focuses on:

a) the need for improvement in climate resilience in Uganda's Cattle Corridor, with emphasis on water supply, organisation of Farmer Field Schools (FFS), and gender equality;

b) the need to scale up best practices emerging from the first phase e.g. production of drought-tolerant crops and fodder, and combinations of coffee with shade trees, mulching, irrigation, trenches and organic composting; and

c) utilizing the opportunities available within GCCA+ to advance the progress made so far

Project objectives:

- To contribute to the sustainable and gender transformative improvement of resilient livelihoods and food security for rural populations in Uganda
- To strengthen the inclusive and gender-responsive resilience to climate change, of rural populations and agricultural production systems in the central cattle corridor.

Project implementation:

GCCA+ is implemented in nine "cattle corridor" districts of Uganda, namely: Nakasongola, Luwero, Nakaseke, Mubende, Kiboga and Sembabule (beneficiaries from the previous Phase) and three newly-added adjacent vulnerable districts of Kalungu, Gomba and Lyantonde.

The Cattle Corridor remains one of Uganda's most vulnerable regions to climate change, dominated by pastoral rangelands where livestock is raised with scarce water and pasture, due to

environmental degradation, partially related to the opening of new land for pasture, fuelwood and charcoal production.

Implementing Partners:

1. Ministry of Water and Environment (MWE)
2. Ministry of Agriculture, Animal Industry and Fisheries (MAAIF)
3. Ministry of Local Government (MoLG)

Duration: December 2018 - December 2023 (60 Months) Donor to the European Union.

Budget: USD $10,036,800

The number of beneficiaries: 235,200 people (33,600 H.H)

Delivery Mechanisms

1. **Gender approaches:**Gender Action Learning Systems & Gender Household Approach / Male engagement and Male Champions and Gender Responsive & transformative interventions
2. **Farmer Field School (FFS) approaches:**Developing Knowledge and skills on climate change adaptation planning, implementation, monitoring and evaluation
3. **Ecosystem/Nature-based approaches:**Watershed Management approaches / watershed protection and rehabilitation, Catchment management/Ecosystem Based Adaptation and Mitigation; Integrated Natural Resources Management; and Climate risk assessment and Preparedness
4. **Value chain developmentandPrivate sector engagement:** Market oriented production systems; and Basic infrastructure to enable production for value chain addition: water for irrigation, Credit and Savings, Loans, skills development, processing technologies
5. **Knowledge management and communications:**Documentation of best practices; Participatory action research; and Participatory monitoring, evaluation and learning.

Result areas:

1. ***Knowledge and institutional capacities for gender-responsive climate change adaptation and mitigation strengthened***
   - Capacities of national government institutions and DLG for gender-transformative climate change adaptation and mitigation developed
   - Capacities of non-state actors to support climate change adaptation and mitigation developed
   - Lessons learned and best practices are generated and shared among stakeholders.
2. ***Household income and climate-resilient livelihood capacities improved in a gender-responsive manner***
   - Sustainable and gender-responsive climate-resilient agriculture production practices promoted
   - Appropriate small and medium scale agricultural water management system established and rehabilitated to support crop and livestock. For instance in 2020/21, about 11 small-scale solar powered irrigation systems have been completed to irrigate 83 acres of farm land, with 49 small scale systems at various stages of implementation.
   - Agro-based gender-responsive income-generating opportunities and linkages with the private sector are promoted along selected value chains

- Household dynamics on gender equality and gender relations are enhanced, to support climate-resilient production.
- About 100 (80% female) were trained on mushroom production in the Central Cattle Corridor, each provided with a starter pack for commercial mushroom production and market linkages for both fresh and dry mushrooms provided.

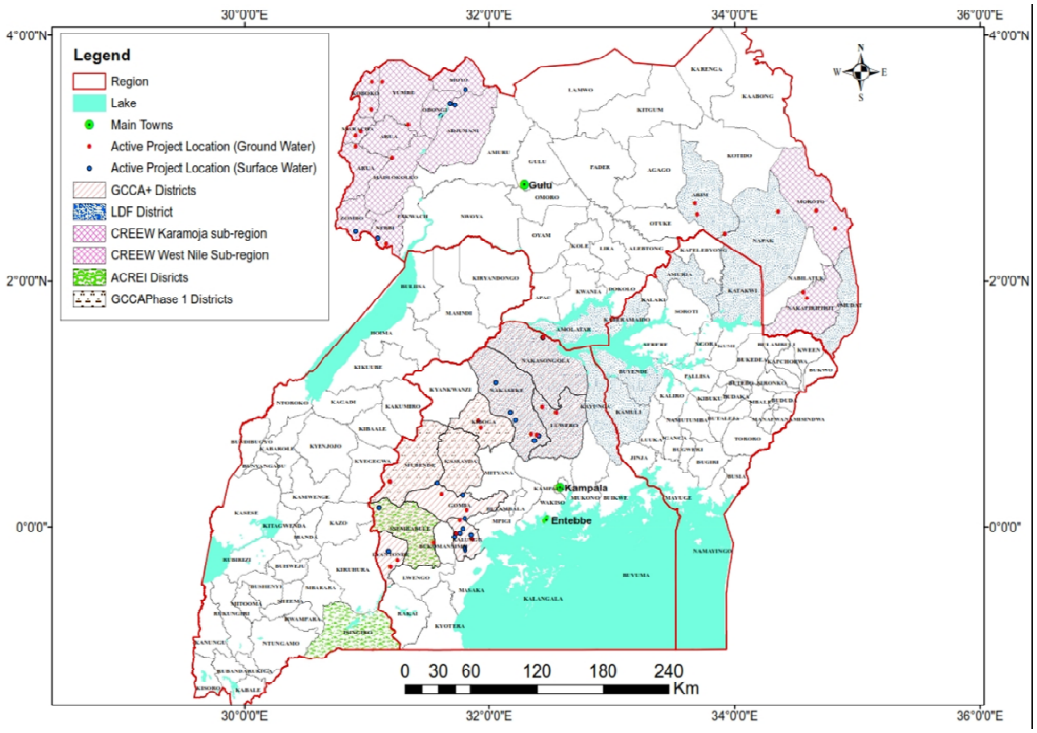


3. Ecosystem adaptive and mitigation capacities enhanced

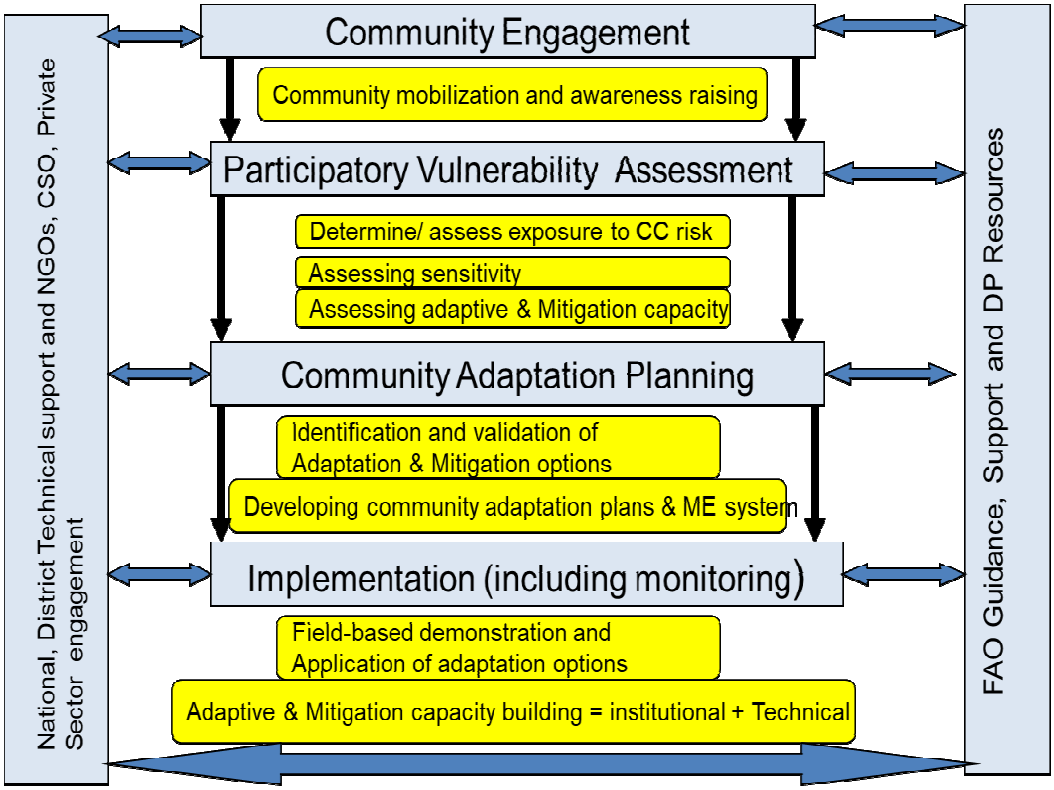
- 350 hectares of bioenergy plantations established, biogas models, and energy saving technologies promoted.
- Capacities of District Local Governments, NGOs, and local communities to plan, implement and mobilize resources for ecosystem based adaptation and mitigation developed
- 24 micro-watersheds have been mapped and assessed by the communities in the central cattle corridor and 24 community based watershed management plans developed for implementation
- 14 tree nurseries have been established by the some District Farmers Associations and more than 289 635 tree seedlings raised for planting in some watershed areas. Most of the tree species raised are indigenous tree species that include: Afrizeria Africana, Indian tick, Soursop, Pawpaws, Jackfruit, Maesopsis eminii.
- 157 ha of degraded areas have been put under integrated natural resources management including establishment of improved pasture
- A total of 22 micro-watershed associations have been established to facilitate the implementation of restoration of about 1800 ha of crop lands and 2400 ha of forest areas in line with the land use plans using FFS and Watershed management approaches
- 170 community members trained as artisans for fabrication/molding energy saving cook stoves and 1492 energy saving cook stoves fabricated/molded.



Other FAO Climate Resilient Agriculture Projects in Uganda



FAO Uganda Community-Based Adaptation & Mitigation Planning and Capacity building Process



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