



# 3rd GDR Rift Interdisciplinary colloquium

May 13th-17th, 2024  
#AfricanRiftValley



AMBASSADE DE FRANCE  
AU KENYA

Nairobi  
**IFRA**



## MESSAGE FROM THE COLLOQUIUM CHAIR



Prof Christel Tiberi (Nashipae)  
Chair, GDR Rift Colloquium

A warm welcome to all of our participants worldwide as we cordially invite you to the 3<sup>rd</sup> GDR Rift colloquium. We are particularly proud that this edition is in Kenya, hosted by the Maasai Mara University. This signifies that the GDR is finally taking the international dimension we all aspired for, a testament to the hard work and dedication of our committee members. I personally extend my heartfelt thanks to each and every one of them, for the cheerful and constructive atmosphere we worked in. I hope you will enjoy those five days at least as much as we did to prepare it.

## MESSAGE FROM THE COLLOQUIUM SECRETARY



Prof Jean-Baptiste Eczet (Lemayian)  
Secretary, GDR Rift Colloquium  
Collège de France/EHESS/EPHE,  
France

Welcome everyone to this magnificent Maasai Mara University, which is hosting us this year!

The number and quality of abstracts perfectly demonstrate the relevance of creating a structure like the Rift GDR: many people dedicate themselves every day to studying the multiple aspects of the Rift, both in natural sciences and social sciences, and we needed to find occasions to gather everyone for a general scientific discussion.

May these days, which are the culmination of a long process of joint preparation between members of the Rift GDR and Maasai Mara University, be only the beginning of long-term exchanges between researchers from all countries and disciplines!



## COLLOQUIUM ORGANIZING COMMITTEE



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# PARTICIPANTS' ABSTRACTS

## SETTLEMENT



*The Rock Art of Dakka, North of Gobaad basin, Djibouti*



## Stone Tool Production Strategies and Functional Properties in Middle Pleistocene Herto, Middle Awash, Ethiopia

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The Bouri Formation located on the western side of the Awash River in Middle Awash research area Ethiopia yielded Pleistocene deposits spanning from 2.5 to 0.165 Ma. The Bouri formation is subdivided into three temporally divided members: Hataye, Dakanylo and Herto. The Herto Member, the youngest of all, was first discovered in 1992 and was studied in the following years. With deposits up to 20 meters thick, the member is classified into Lower and Upper units. Chronologically, the Lower Herto is tentatively placed to approximately ~400 to 216 ka. Whereas the Upper Herto is dated between 160 to 154 ka. We have studied surface and in situ lithic artifacts from two localities namely BOUA8 and BOU-A10 of the Lower Herto which resulted from field work conducted in the mid and late 90's. Based on classical technological analysis and techno-functional and 3D Geometric Morphometrics studies, we identified the chaînes opératoires and different groups of Large Cutting Tools (LCTs) based on their functional properties. Preliminary data indicate prevalence of LCT production, whereas small debitage products are relatively rare. The small debitage items were produced unsystematically, using opportunistic knapping on small-sized cores primarily aimed at creating an active edge on the resulting flakes. Interestingly, tool modification, common on the LCTs, is sporadic in the small debitage. These behavioral patterns might have been influenced by the site's function or other factors that will further be explored in subsequent analyses.

## Reduction Sequence and Toth Analysis of the Ledi-Geraru Oldowan Lithics from Bokol Dora 1 (BD1) Assemblage

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The Bokol Dora 1 (BD1) assemblage is one of the oldest Oldowan record in East Africa and in the world that contributed the earliest material culture of our ancestors. Until the discovery of oldest Oldowan dated to 3.032 to 2.581 Ma from Nyayanga 1 (NY1), Kenya; BD1 with an age of 2.58 Ma was used as a firm date for the earliest Oldowan technology in human lineage. The BD1 artifacts were discovered by the 2013 and 2015 field works conducted by the Legi-geraru Research Project (LGRP). Analyzing core reduction intensity is one among the ways to understand hominid stone tool production behavior, variation in stone tool production and technological adaptations of hominids. Thus, the main objective of this thesis was to investigate the reduction intensity of BD1 Oldowan artifacts. I applied multiple methods, including attribute analysis to get a better understanding of reduction sequence and techniques. Reduction intensity and raw material comparisons were made with contemporaneous early Oldowan assemblages from Gona dated to 2.5 Ma and Nyayanga dated to ~ 2.581 – 3.032 Ma. The result of this study indicates that the BD1 hominids were discarded cores at early stage of reduction. The frequency of flake scars on BD1 core ending with step fractures indicates that the hominids had not yet mastered the skills of systematic production of sharp edges when compared to Gona hominids that were reported for mastered skill of systematic flaking. Thus, the older site was less reduced than the younger sites; however the BD1 and NY1 assemblages shared many results



indicating related reduction intensity regardless of their chronological difference. In addition, raw material preferences were appeared in the BD1 and Gona assemblage, although it is not clearly reported for NY1 assemblage.

### **Preliminary Survey Results from a Medieval Islamic Settlement Site in Eastern Ethiopia: First Archaeological Insight from Fedis**

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Islam has a long history in Ethiopia, beginning with its introduction in the Kingdom of Aksum around 615 CE with what became known as the “first hijra”. From the 10th century CE onward, it developed in other regions along the great Rift, allowing the emergence and consolidation of Muslim polities and sultanates around the 12th century. However, until recent times, Islamic history and archaeology in Ethiopia have been historically understudied despite the enduring influence of Islam in shaping Ethiopia's cultural and historical landscape over the centuries. This poster presents the preliminary results of surveys conducted by the authors in and around the site of Fedis located south of Harar. The site is mentioned in several historical written sources in Ge'ez and Arabic, including the chronicle of Amda Seyon (14th -15th century) and the Futuh alHabasha (16th century). It stands out as one of the Islamic polities in the south-eastern region of the Rift and appears on old maps revealing several ruined settlements south of Harar. Although regularly mentioned in the historiography, the site of Fedis had not been thoroughly examined until the completion of this research. The 2021 and 2022 survey allowed the identification of various remains that confirmed the archaeological potential of the site. Notable

findings during the fieldworks included the ruins of an elaborate stone-built defensive wall, a series of mosques, a monumental stepwell, storage pits of different sizes and burials. Material culture collected from the surface by local inhabitants was also documented for the first time. It includes a carnelian-made seal with an Arabic inscription, beads of various kinds and pottery providing parallels with other Islamic sites in the region among many other discoveries. This pilot research has provided new and essential archaeological insights into the medieval Islamic site of Fedis in eastern Ethiopia, offering a foundational understanding of its historical significance and cultural heritage. It is hoped that future work on the site will allow for a better understanding of the Islamization process in eastern Africa and the condition of emergence of the medieval Muslim principalities of Ethiopia.

### **Early agropastoralist societies in the Gobaad basin (Republic of Djibouti): biological diversity, funerary practices and prospects on human-environment interactions and societal transformations during the Middle Holocene**

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In the Horn of Africa, the Neolithic transition occurred between the 5th and 3rd millennia BCE, in a context of regression of the Rift great lake systems and the abrupt aridification of the region at the end of the African Humid Period, around 13 000 BCE. After several thousands of years during which the lake basins offered hunter-gatherer populations an abundance of plant and animal resources, the reduction in such wild resources and the shrinking of territories and ecological niches created a need for adaptation in terms of social, economic and cultural strategies. To date, our understanding of the spread of the



neolithic lifestyle, as well as the ways in which the first agropastoral communities adapted to climatic changes that drastically reshaped their environment, is still incomplete. Among other evidence of the major shift in the hierarchical social system occurring at that time, the development of monumental funerary architecture reflects functions of commemorating the deceased, but also of demonstrating political and/or economic power. Our research seeks to employ biological anthropology methods to approach the funerary practices of the first herders and, through them, to discuss their societal organization. We also aim to provide new data to characterize the biological diversity of these human groups and integrate them into the evolutionary history of the region, in order to address settlement dynamics and the interactions between the first herders and the last hunter-gatherers. Finally, we seek to study the bio-cultural interaction and adaptation of these communities in relation to their geographical and climatic environment. To initiate this reflection, we are conducting a bioanthropological study on human burials of the site of Antakari 3, located in the Gobaad basin (Republic of Djibouti). This site is a circular monument built of basalt blocks, under which are buried between 300 and 400 individuals. Radiocarbon dating places the use of this necropolis between 2848 and 2475 cal. BCE, which corresponds to the transition period between the last hunter-gatherers and the first herders in the Gobaad basin. Here, we present the preliminary results of the study of the skeletal remains of 155 individuals excavated during the archaeological fieldworks. These burials include individuals of both sexes and various ages from birth to adulthood, corresponding so far to the demographic profile of a normal population. We present the different phases of use of the necropolis and management of burial space, as

well as first insights on the biological diversity of these human groups. Particularly, we discuss the morphological robustness observed on some of the individuals and present future prospects to better characterize, through morphology, the identity, migrations and adaptation of these populations during the Neolithic transition.

### **Ethnoarchaeology: Landscape and Materiality of Gadaa Ritual Practices of Borana Pastoral Communities in East Africa**

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This study is concerned with an ethnoarchaeological investigation of landscape and material cultures of the Gadaa ritual performances of Borana pastoral communities of East Africa. Gadaa is a traditional system of governance used by the Oromo people in Ethiopia developed from knowledge gained by community practice over generations. It was inscribed as an intangible heritage of humanity by UNESCO in 2016. Through various research works conducted on the indigenous knowledge and culture of the Oromo people, the focus of an archaeological study aimed at recording the landscape and the material cultures was limited. Expounding their historical, cultural, symbolic, religious, and political values became imperative before the replacement of these material cultures and ritual spaces by modern technology and urban development. The study drew mainly on the qualitative research approach of ethnographic data. A purposive sampling technique was employed to select the sacred landscape and material cultures of the Gadaa ritual performance. Participant observation, semi-structured interviews, focus group discussions, and archaeological surveys were the major tools for generating primary data. Secondary sources related to the topic of the study were thoroughly reviewed to bridge the existing knowledge gap.



The findings of the study indicated the Gadaa ritual objects are value-laden. The result also showed that semantically, the ritual objects in the study area have social, philosophical, historical, and political significance. The result confirms a change and a continuation in the use, production, functions, and discard of traditional ritual objects of Gadaa ritual performances among the people. Changes are drawn from the influence of the modern form of governance and the expansion of plastic and metallic objects. The other changes concerning the sacred landscape are attached to demographic expansion. Currently, material cultures of Gadaa ritual performances are available and used at various Gadaa ceremonial times even though there are changes within this practice. The durable continuance is that Gadaa officials use material cultures of Gadaa ritual performances and their symbolic meaning in the day-to-day life of the community in the study area. The post-processual approach to interpreting material culture and phenomenological interpretation of landscape are fruitful in this study. Indeed, the study recommends further archaeological investigation to detail the documentation and preservation of Gadaa ritual performances and the formation process of archaeological records.

### **Are the soul and skills of Ethiopian potters in danger?**

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The question raised in our presentation's title will serve to bring out the salient and complex points related to the social identity of potters and the dynamics of the technical traditions they perpetuate. This reflection will be based on existing literature and on ethnographic data collected along the Ethiopian Rift Valley between 2015 and 2018. Who are the Ethiopian artisan potters? The very special status of artisans in

Ethiopia-characterized by their and marginality leads to an endogamy that reinforces the singularity of their professional category. We will start by looking at the vagueness of this social category, which raises several ambivalences: how are potters denigrated and at the same time placed at the heart of society? We will then question the endogamy's reality through the rare genetic studies conducted among artisans and their related linguistic group. We will finally attempt to define the historical questions raised by the technical convergences and divergences between groups of craftsmen. In which socio-economic contexts do artisan potters evolve? A brief description of the socio-economic conditions of our survey: urban, peri-urban and rural contexts, as well as craftsmen monasteries, and whether or not they own land, will enable us to discuss the need and difficulty of taking these socio-economical contexts into account when tackling questions of resource management and pottery production. What are the challenges threatening pottery skills? In relation to the two previous points: socio-cultural identity and socio-economic category, we will list all the factors that weigh on pottery practice: restricted access to essential natural resources, partial upgrading of social status, changes of the market's demand in the light of competition from the global market, and the transformation of lifestyles and religious concepts in Ethiopian societies. We will then present the responses to these dynamics, more particularly through the question of the transmission of know-how, between rupture and adaptation. In conclusion, we will look at the consequences of the disappearance of pottery practices in economic, environmental, health and aesthetic terms. In terms of aesthetic and the cultural value that its vehicles, the loss is obvious. The fact that pottery is mainly replaced by plastic





of unknown quality is a real long term public health question. On the environment, the impact of the national and foreign industrial production is obvious negative compared to the natural production of pottery. Even if progressive, the deliquescence of the activity and its economy will impact the more fragilized rural potters who do not own land. In crisis time, like war, local pottery stays a source of resilience when no more merchandise circulates, unfortunately, crisis time also encourage deforestation. We will then attempt to outline the unstudied aspects of the potters role in biodiversity: how they have been able to manage since decades the natural resources of their surroundings? do they really encourage the deforestation? Do they really degrade the land, what are the benefits of fired earth returning to earth? Are there unique microcosms developed in potter's carrier sites, their firing places, in the fermentation of the clay in danger? We will finally question the room of negotiation that does or does not exist to conserve and enhance this cultural heritage.

**Human-Environment Interactions During the Holocene: An Analysis of Archaeological Charcoals from Kumali archaeological sites; Southwest Ethiopia**

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This PhD study is situated in the Kefa region of southwest Ethiopia, where the influence of altitude and the area's dense forest cover result in a mild climate. This study focuses on athracological studies collected from Kumali site, Holocene occupation phase spanning the time period from 4780±110bp to present. This period in southwest Ethiopian archaeology saw a number of significant ecological, sociocultural, and economic changes

that framed the emergence of early settled life, the beginning of plant cultivation, and the beginning of animal herding. The anthracological collection coming from this site, therefore, shed light on the history of the vegetation in southwest Ethiopia at this time and how prehistoric communities managed it. By comparing the results of this study with other earlier athracological studies in southern Ethiopia (Bale Mountains, Mochena Borago, and Sodicho), this study also significantly contributes to understanding the overall human and environmental interactions in this region. The Main objectives of this study are (A) To understand how these forests develop in relation to climate change and human impact during the Late Pleistocene and the Holocene (B) Documenting the ancient vegetation for assessing its potential for resource exploitation, (C) To shed a new light on SW Ethiopian sites on Holocene land use intensification, and collecting modern wood samples to establish wood anatomy of (Moist Afro Montane forest (MAF) of southwest Ethiopia. To achieve the objectives of this studies different methods including taxa identification, the taphonomic assessment of charcoal densities, standard taxon frequency and ubiquity quantitative analyses, and the quantitative and qualitative analysis of wood calibre and modern comparative wood sample collection will be conducted. This proposed field and laboratory-based research based on new comparative wood collections and charcoal remaining from Kumali archaeological in south-west Ethiopia are expected to provide new results into rare human and environmental archives for mid- Holocene to present time a little known about the peleoenviroment of the region and important period, archaeologically speaking. The excavated site also yielded several anthracological remains collected from the early mid-Holocene to the early arrival of pastoralists in Southwest Ethiopia covering a period between 4780 BP. Based on the charcoal remains from these sites the proposed study will aim to diachronically reconstruct



firewood collection strategies used by prehistoric groups in southern Ethiopia, investigate the nature of vegetation history, and shed new light on the poorly understood environmental conditions during human occupation phases in the region. Ultimately the result of this study is also expected to provide evidence of how humans interacted with their environment in African high-altitude ecozones.

**Risk assessment and recovery trajectories of a social-ecological system with a discrete-event model after a volcanic eruption**

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A risk assessment for disasters is usually composed of hazard, vulnerability and exposure variables, which are hardly studied and modelled simultaneously. In volcanology, it remains ambitious to anticipate risk trajectories of pre- and post-eruption regimes. The interdependencies and feedback loops of the system's components, between geological, ecological, social and economic ones, give rise to trade-offs and synergies that should be disentangled for supporting decisionmakers and helping local communities to face the risks. We developed here an innovative discrete-event and possibilistic model based on a dynamical network representation to assess volcanological multi-risk and long-term post-eruption impacts of such a multifactorial system. We illustrated our method with the region around Mount Meru (Northern Tanzania), a strato-volcano with various eruption styles, located in a growing economic and touristic region (>1M.inh.). We used qualitative and rule-based Petri nets, still largely unused in environmental sciences, for an integrated assessment of the overall system dynamics and associated risks. As a central result, we showed that the region could recover from a blast

eruption, irrespective of the timescale. Our study highlights the fact that agriculture and pastoralism remain key activities to favour the recovery of this region. Yet, as soon as subsidies from governmental and non-governmental organizations are lacking, the modelled region remains isolated from national and international activities and shifts to rural dynamics. Our case study can equip environmental risk assessment with innovative models, new dynamical indices (e.g., desirable and non-desirable trajectories), and rigorous reasoning for an ultimate integrated management of social-ecological systems at stake.

**Wildlife-Human Coexistence Among the Maasai of Kenya. Skills for Infusion in the school Curriculum for Ecosystem Enrichment**

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The ecosystem is central to survival of earth inhabitants; its destruction spells out peril to life. All human beings of all ages should be prepared for its conservation, which should become a duty and commitment by all. Biodiversity and ecosystem's role in human progress and prosperity therefore can't be overestimated, yet there is indication that it is endangered. The United Nations Secretary General, in a Biodiversity Summit address, pointed out that we are part of a fragile web and that the rate of species extinction is accelerating with some one million species currently threatened or endangered (United Nations, 30<sup>th</sup> Sep 2020). There is therefore need to rethink safety of our nature for our existence and posterity. The coexistence of human beings with wild animals in the same environment need to be lauded and



studied in order to generate enriched knowledge and skills for innovative protection of the ecosystem and biodiversity. This case study was conducted among the Maasai, a nomadic community, living around Maasai Mara Game Reserve- a protected area, in Kenya. Others live in different parts of the country and share common conduct; they coexist with wild animals in grassland and shrubs. They move to any part of country in search of pasture. This study sought to find out the knowledge, skills and values that enable the Maasai to coexist with wild animals and their domestic animals; and the role this plays in ecosystem advancement. It also sought to find out how the current human activities affect the environment. The findings were used to suggest innovative approaches that could be employed to promote sensitivity and commitment to protection of the ecosystem in dynamic times. Content analysis and case studies were employed. It was established that wild animals, human beings, domestic animals coexist in natural environments. Values embodied in Maasai culture and a kind of mutual understanding between the human and animal parties governed the coexistence where violation occurring would lead to be human animal conflict. However, the Maasai culture is changing affecting their way of life and view of the animals; the land is getting subdivided, sold to agricultural communities and towns are coming up. Some of the communities have little value for wild animals, environment and sometimes are unfriendly to their domestic animals; all these threaten the ecosystem and the wildlife. This requires innovative address. Education has been identified as an important tool that empowers individuals and is a catalyst for development in all spheres of life; it was declared by United Nations a human right where every child has a right to free quality education. Curriculum delivers education and the findings of

this study could inform school curriculum and all children could develop skills of expressing kindness to animals and the interdependence of the biodiversity to carefully, safely and productively coexist with animals and nature. The communities living around the wild animals could be educated on coexisting with animals and care of the ecosystem. The report could inform government policies.

### **Techno-typological Analysis of Middle Stone Age Assemblages from Gotera, Southern Ethiopia**

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The Middle Stone Age (MSA) techno-complexes in African archaeological record are currently linked to the emergence and the presence of early representatives of *Homo sapiens* in the continent. Gotera is one of the MSA stratified sites in East Africa, in an area and it is dense in evidence of human occupation. The archaeological records of the site have been documented more recently at GOT 1-S locality (Fusco et al., 2018; 2021). A stratigraphic deposit called GOT10 rich in artifacts and fauna corresponding to MIS 3 during the Late Pleistocene occupation was discovered in 2018. It offers a testing ground for understanding environmental and technological dynamisms. In this work we will present the analysis of an important part of the surface material (Cluster A), which is the result of the archaeological layers that have freshly eroded from the stratigraphy (Mound1). The main objective of this research is to investigate the



behavioural implications and occupation dynamics of human groups in the East African Pleistocene through their techno-typological characteristics. This study also applied common techno-typological analysis which is - chaîne opératoire approaches, that will be associated with attribute analyses in order to get a better understanding of production techniques and to establish a correlation with the lithics from the in-situ layers. The examination of MSA lithic materials leads to the understanding of the reduction sequence employed for the lithic production. The Cluster (A) MSA lithic assemblage demonstrates advanced human technological, typological, and behavioural developmental markers, notably through different lithic production methods including Levallois technology, blade, and bladelet and anvil percussion. Quantitative and functional analyses are ongoing. This research offers some preliminary comparisons between the artifacts from Gotera GOT10 and those from three different MSA sites, namely Mochena Borago, Goda Buticha, and Porc Epic. The Levallois method and opportunistic flaking reduction techniques are used more on quartz raw materials than at these three MSA sites. Despite this, there are similarities between these sites in terms of cultural preference as well as variations in technology and morphological characteristics. However, due to a variety of circumstances, such as classification methods, differences in contexts, and differences in raw materials, it is generally difficult to identify meaningful comparisons. Quantitative analyses are ongoing in order to better assess these insights.

### **Rivers, lakes, ponds, swamps and other wetlands: what does the Rift change for fish**

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The Great Rift structures hydrographic networks that include the great iconic lakes, but also smaller lakes, swamps, rivers, more or less perennial pools and a wide variety of wetlands. These environments host a great diversity of fish, a crucial resource for many riverside populations, but also of interest to aquarologists... and researchers in the evolutionary sciences. Over millions of years, the dynamics of rifting have had an impact on aquatic biodiversity, both by shaping the available aquatic environments and by modifying their connections. To understand this impact, paleontological archives are an essential resource beside extant biodiversity data. Exploiting them involves identifying taxa and understanding their ecology, in particular the extent to which a taxon or a fossil assemblage reflects the inhabited environment and its connectivity. Based on specific cases, the presentation will take stock of established knowledge and available data and archives to address the long-term controls of rift dynamics on aquatic biodiversity. These include paleontology, the study of paleoenvironments and aquatic paleoecosystems, evolutionary biology, ecology and macroecology. The aim is the discussion of future research actions on long term freshwater biodiversity drivers in the Great Rift.



## **A Typological Classification and Analysis of Potsherds from Mariam Nazret, Tigray, Ethiopia**

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Pottery is one of the most studied objects as it exists in almost every site all over the world, regardless of its period. Pottery gives multiple information about the past society: their way of life, social strata, site function, and technological development. This research deals with the pottery analysis from Maryam Nazret. It is located in Southeastern Tigray, in the village of Addi Awona. The site is named after the church of Saint Mary and the river adjacent to it called Gereb Nazret. The study is based on surface collection from the church compound and outside the compound from the southeast, south and west areas. Evidences show that the site of Maryam Nazret has been occupied since at least Aksumite period. Pottery analysis and architectural observation point out that the site has been occupied several times in ancient time, spanning from Aksumite through post-Aksumite periods

## **The North Tanzania ecosystem: how to link geo-science with environmental, education and social sciences**

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North Tanzania is the location of strong geodynamical processes leading to seismic and volcanic activities. The associated contrasted relief also contributes to slope instabilities, mineral localisation, surface and groundwater flow. Those factors impact the populations (fauna and flora), and may drive some economic and social issues (mineral and water resources

extraction, sanitation, touristic exploitation, smallholder agriculture, livestock keeping, transport...) at different time scale (year, decade, century...). Through a pluri-annual project, researchers from didactic, environmental, human and Earth sciences have collaborated to estimate how the geodynamics influence and act on the socio-eco-biosystem. We would like to present here some of our main results in North Tanzania and to discuss the ways researchers from different scientific communities and countries could gather their data and results. In particular, we will consider two distinct, yet complementary, approaches. Firstly, we will present how a training side could help to build strong interconnection and extend community-researcher engagement. Secondly, we will also focus on specific questions for each discipline in this active and evolutive region. Adopting an integrative approach can help the actors to actively participate and discover innovative tools and methodologies for their research. We would like this presentation to provide the opportunity to address questions about the best practices that can facilitate the organization and the building of a scientific and collaborative framework (projects, observatory, international networks).



## ENERGY



*Geothermal energy drilling in the proximity of marginalized communities, Olkaria, Kenya*



## Prospects for geothermal studies using muography in Kenya

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Muon imaging or muography has emerged as a powerful non-invasive method to complement standard tools in Earth Sciences and is nowadays applied to a growing number of fields such as industrial controls, homeland security, civil engineering. It consists of using the muon flux created by the interaction of cosmic rays, essentially protons and helium nuclei expelled by stars, with atoms of the outer atmosphere, as a source of radiation to map the internal structure of large objects. In the same way that in medicine, X-ray absorption is measured to obtain an internal image of the patient's body, muon absorption can be used to detect density variations inside any large and dense structures, from volcanic domes to mountains, or anthropic buildings, which remain opaque to the standard investigation methods. Moreover, as muons are available nights and days all over the year, muography is an excellent tool to monitor the variation of density with time. Muon detectors have first been developed in the context of fundamental elementary-particle physics. They range from cheap and simple detectors to cutting-edge and expensive technologies. When it comes to applying muography to Earth science, robust detectors such as plastic scintillators, associated with low-cost and low-consumption read-out electronics, are in order. The requirements include facing any weather conditions, being operated through autonomous power system (such as solar panels), and sending the data to a remote data centre through GSM and satellite communications. Such equipment has been successfully operated for example at the

Soufrière of Guadeloupe over the last decade and proved to be very powerful to understand the hydrothermal system of the volcano for surveillance purposes. Muography is currently being introduced in Kenya through the collaboration of French and Kenyan scientific teams. The first application that is foreseen is the study of the Chyulu Hills to understand the dynamics of water resources, and in particular of the Mzima Springs, which are of utmost importance. Indeed, the Mzima Springs are not only crucial for the surrounding wildlife conservation and human activities, but also up to the cost, as a significant fraction of the water in Mombasa is actually extracted from there. More applications are under study, especially those dealing with geothermal energy in the Rift Valley. A promising site of study in the Menengai Crater. Muography could prove very suitable for understanding the impact of the exploitation of geothermal sources on the environment.

## Analysis of the Kenyan Power System and its Integration into the Eastern Africa Power Pool

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Power is a crucial source of economic growth as many production and consumption activities involve energy as a primary input. Governments in developing countries are worried that previous attempts to create national power grids to provide dependable power to their people at reasonable costs have fallen short of expectations. Emerging initiatives focus on regional power pools, allowing member nations to organize their integrated power generation and transmission. One such regional power pool is the Eastern Africa Power Pool (EAPP). The objective of the



study is to establish how visioning (plans and policies), institutional context, and local knowledge inform the current Eastern Africa Power Pool. The study will be limited to the Kenyan power system and its integration into the Eastern Africa Power Pool. The study will be guided by the policy process theory. The research design for this study will be exploratory. The target population for this study will be thirty-one (31) senior management from three (3) electricity utility firms in Kenya (KenGen, KPLC, and KETRACO) who are members of the EAPP. The study will use census. The study will use primary data. Primary data will be collected using a semi-structured questionnaire. Qualitative data analysis will be used to analyze the data. Mean and standard deviations will be used to summarize and classify the data. The study is significant to scholars, government, policymakers and the private sector. To the scholars, the study will go a long way in adding to the body of knowledge in power pooling. The study is relevant to the government and policymakers as it will inform the government on diversifying its energy sources and reducing reliance on a single energy generation method or location. The study will also inform the sector players to align their business strategies with environmental goals and respond to consumer demands for eco-friendly energy solutions.

### **Gravitational Water Vortex Energy Generation from Small Water Bodies for Isolated Settlements in the Great Rift Valley**

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The Great Rift Valley is a region of East Africa that is home to many isolated settlements. These settlements often lack access to reliable sources

of electricity, which can make it difficult to power essential infrastructure and improve living conditions. This proposal aims to address this issue by exploring the potential of gravitational water vortex energy generation from small water bodies such as run-off rivers and irrigation schemes. The proposed system would use the natural flow of water to generate electricity without the need for large dams or reservoirs. This would make it an ideal solution for isolated settlements that lack access to traditional sources of energy. The proposed system would be designed to be scalable and adaptable to different environments, making it a versatile solution for a wide range of communities. By harnessing the power of water, this proposal aims to improve the quality of life for people living in isolated settlements in the Great Rift Valley. Moreover, the initiative aims to address the energy needs of isolated settlements, providing a sustainable and eco-friendly solution to power these remote areas. The innovative system capitalizes on the natural flow of water in run-off rivers and irrigation channels, utilizing gravitational forces to create powerful water vortices. These vortices, generated through a carefully designed infrastructure, will serve as a source of kinetic energy, subsequently converted into electrical power through turbines. The proposed technology offers several advantages for energy generation in isolated settlements. Firstly, its scalability ensures adaptability to various water body sizes, making it suitable for both run-off rivers and small-scale irrigation channels. Additionally, the gravitational water vortex system requires minimal environmental impact, preserving the delicate ecosystems of these water bodies. This project not only addresses the energy deficit in isolated settlements but also promotes sustainable development by reducing reliance on non-renewable energy sources. By utilizing





locally available water resources, the proposed gravitational water vortex technology has the potential to transform the energy landscape of remote areas, fostering economic growth and improving the quality of life for inhabitants.

### **Anaerobic Digestion Process Enhancement Through the Exploration of Iron Waste Nanoparticles from Grinding Machines**

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In recent years, significant strides have been made in the realm of anaerobic digestion (AD) research, with particular attention given to the potential benefits of incorporating iron, iron oxide, and zerovalent iron nanoparticles into these processes. The clear objective is to optimize the performance of anaerobic digestion, enhance the generation of valuable biogas, and maximize methane production from organic waste. Among the nanoparticles under investigation, zerovalent iron (ZVI) stands out for its remarkable impact on AD. Studies have consistently shown that the supplementation of ZVI accelerates the transformation of organic compounds, mitigates the acidification process, and ultimately promotes the enrichment of key microbial communities essential for efficient methanogenesis. The addition of ZVI has been shown to enhance methane yields, offering a potential avenue for improving the overall efficiency of anaerobic digestion systems. Particularly noteworthy is the observation that ZVI nanoparticles stimulate crucial metabolic pathways, including oxidative phosphorylation, citrate cycle, coenzyme biosynthesis, and the metabolisms of amino acids, carbohydrates, and methane. The temporary nature of the methane enhancement,

coupled with the enrichment of syntrophic genera and primary acetate-dependent methanogens, underscores the dynamic interplay between ZVI nanoparticles and the microbial consortium during anaerobic digestion. This dynamic nature suggests that temporal considerations are crucial when assessing the impact of ZVI on AD processes. Iron oxide ( $\text{Fe}_3\text{O}_4$ ) nanoparticles have also emerged as valuable additives in the context of anaerobic digestion, particularly in the co-digestion of complex substrates such as cow manure and sewage sludge. The findings from recent investigations reveal that  $\text{Fe}_3\text{O}_4$  nanoparticles positively influence the hydrolysis process, leading to subsequent enhancements in methane production. Even at relatively low concentrations of  $\text{Fe}_3\text{O}_4$  nanoparticles exhibit a significant effect on biodegradability, resulting in a substantial increase in methane production when compared to control conditions. Further exploration, involving the addition of  $\text{Fe}_3\text{O}_4$  nanoparticles in mixtures with varying ratios, demonstrates sustained positive effects on both hydrolysis and methane production. This versatility positions  $\text{Fe}_3\text{O}_4$  nanoparticles as promising candidates for optimizing the intricate dynamics of anaerobic co-digestion processes. Additionally, synthesizing iron nanoparticles using waste scrap metals introduces an ecofriendly approach to nanoparticle supplementation in anaerobic digestion systems. The results indicate that the addition of iron nanoparticles significantly increases biogas and methane yields, offering a sustainable solution for optimizing energy production from organic waste. The incorporation of iron, iron oxide, and zerovalent iron nanoparticles into anaerobic digestion processes holds tremendous promise for advancing the efficiency and sustainability of waste treatment systems. Each type of nanoparticle plays a crucial role in the various



stages of anaerobic digestion, from accelerating hydrolysis to promoting methanogenesis. These nanoparticles not only offer avenues for increased biogas and methane production but also provide environmentally friendly alternatives for waste treatment, aligning with the broader goals of sustainable and efficient resource utilization. As research in this area continues to evolve, a deeper understanding of the nuanced interactions between nanoparticles and microbial consortia in AD systems will undoubtedly contribute to the development of optimized and eco-friendly waste-to-energy solutions.

### **Improving Insulation Capability in a Performance Analysis of a Solar Cooler for Postharvest Storage Products**

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Rising global temperatures and economies will continue to drive the need for large new cold chain infrastructure. Perishable items, such as fresh vegetables, are sensitive biological substances that lose their potency and effectiveness when exposed to higher temperatures than advised. Postharvest food storage is a significant issue in Sub-Saharan Africa agricultural activities, particularly in off-grid isolated areas. This study explores the innovative concept of perishable food storage in cold chain facilities to reduce postharvest loss in off-grid, rural places. The idea employs solar technology to create portable, locally built devices that improve the cooling performance of postharvest agricultural goods via a vapour compression mechanism. The present study simulates the performance of the insulative material for postharvest storage products. Five insulative materials used for the cold chain were

analyzed. Computational Fluid Dynamics using steady-state analysis compared five insulative materials on cooling performance. The results indicate that the polyurethane foam scores 20.2%, feather fiber scores 20.1%, fly ash scores 20.0%, fiberglass scores 20.0% and coconut fiber scores 19.8%. Furthermore, the insulative heat transfer performance indicates that the polyurethane foam scores 14.3%, feather fiber scores 18.7%, fly ash scores 19.8%, fiberglass scores 21.9%, and coconut fiber scores 25.3%. However, polyurethane foam has become the best insulative material to use. The findings revealed that when thermal conductivity is low, heat transmitted through the walls of the cold chain container is also low, resulting in more excellent thermal insulation of the perishable food container. This research advances our understanding of thermal insulation, and the results can be used to design better postharvest storage product containers with improved thermal insulation. Conversely, the impacts of insulative material thickness are more critical. Insulative materials of thinner thicknesses are less recommended than thicker ones. The simulation results are crucial for container design to improve product storage quality using less energy. The cold chain insulative material reduces the risk of quality degradation and uncontrolled freshness while enhancing the storage period and functions of fresh foods and postharvest items. Furthermore, reducing perishable food waste and storing perishable foodstuffs will boost smallholder farmers production and income.



## Innovative Rock-Based Solar Collectors for Drying Applications

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Governments across Africa are endeavoring to combat poverty by increasing agricultural production to achieve food security. Despite these efforts, many regions, including the Rift Valley, continue to suffer from food insecurity. Consequently, addressing this problem is imperative. Moreover, while the number of food-insecure people in the Rift Valley remains excessively high, large quantities of food are wasted annually due to spoilage, infestations, and inadequate infrastructure. Undoubtedly, reducing these losses is crucial for improving food security. One solution is food preservation, with drying technology being a promising approach to enhance food safety. However, to preserve nutrients, agricultural products must be dried using appropriate methods. Open sun drying, prevalent in most rural areas of the Rift Valley, has proven ineffective in retaining nutrients. Consequently, many researchers advocate for passive solar dryers to mitigate this issue. Despite their role in reducing postharvest losses, the intermittent nature of solar energy poses a significant challenge to these dryers. Hence, incorporating thermal energy storage can mitigate intermittence and increase drying efficiency. Therefore, the primary objective of this study is to develop and evaluate the performance of a novel solar dryer integrated with thermal energy storage, employing soapstone as the storage material. The developed dryer was experimentally tested by drying 50 kg of fresh pineapple and carrots in two modes: with and without thermal energy storage materials. The

results were then compared to open sun drying. Furthermore, proximate analysis was conducted to assess the quality of the dried products using the developed dryer. The findings revealed that pineapples dried for 13, 24, and 52 hours in the dryer with thermal energy storage, without thermal energy storage, and in the open sun drying, respectively. Carrots, on the other hand, required 12 hours to dry in the dryer with energy storage, 23 hours in the dryer without energy storage, and 50 hours in open sun drying. Additionally, the dryer with thermal energy storage could continue to supply heat for about three to four hours after sunset. The study also found that the thermal efficiency of the thermal energy storage system, the collector efficiency, and the dryer & its thermal efficiency were 45%, 43%, and 74.5%, respectively. The proximate analysis results revealed that, in comparison to an open sun dryer, the dryer integrated with thermal energy storage effectively retained nutrients in the dried products. Therefore, the developed dryer shows significant potential as an efficient method to diminish postharvest losses and enhance food security.

### The beneficial effect of Fe addition in Pb Te-Ni diffusion bonded thermoelectric contact interfaces

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Thermoelectric power conversion techniques have attracted wide interest as an environmentally friendly and reliable technology for power generation, waste heat utilization, and temperature control. Thermoelectric (TE) devices cater to a broad spectrum of technological applications in different temperature ranges, however, thermoelectric generators suffer from



low-conversion efficiency, even though significant progress has been attained in the development of high efficiency thermoelectric compounds, the development of thermoelectric modules to take advantage of these materials has not been rapid so far only low temperature (<200) thermoelectric materials such as Bi<sub>2</sub>Te<sub>3</sub>-based alloys, have been widely developed and incorporated in commercial cooling or heating devices. The development of reliable interconnects in thermoelectric (TE) modules is essential for the durability and serviceability of these solid-state devices. PbTe based devices are used in mid-temperature range applications, with Ni being the most preferred interconnect. Ni reacts with PbTe to form a binary intermetallic, Ni<sub>3</sub>Te<sub>2</sub>(β<sub>2</sub>). The sustained growth of this phase at higher service temperatures is adversarial to the long-term reliability of interconnects. Our work reports and discusses the beneficiary role of minor Fe-addition in the Ni contact alloy to arrest such unwarranted chemical interaction while ensuring proper bonding. PbTe and NiFe (Fe = 1 at. %, 5 at. %) Discs are diffusion bonded at 700 °C for various holding times. The current investigation leads to three noteworthy observations: 1) the formation of Fe-enriched Ni-Fe phase islands at the interface at micro scale (1 - 10 μm), (2) Fe-segregation at the local interfaces (~ 10 nm), and (3) the growth of a Ni-rich metastable Ni<sub>3-x</sub>Te phase, not present in Ni-Te binary phase diagram. Detailed examinations of these phenomena and crystallographic relations (β<sub>2</sub> and Ni<sub>3-x</sub>Te) are conducted through advanced analytical TEM/STEM techniques. Our work becomes especially relevant in light of the Rift's enormous energy resources Since it tackles the urgent need for sustainable and effective energy extraction methods. The Rift area must carefully combine the generation of clean energy with the preservation of other vital resources due to its diversified energy potential, all while addressing the issues brought on by climate change. Our emphasis on thermoelectric power

conversion methods contributes significantly to the multidisciplinary approach needed for complete energy and resource management in the gap and is in line with the search for accessible, Inexpensive, and climate-friendly solutions.

**The study investigated the pesticide, fertilizer, and liquid fuel molecules that were present in the bio-slurry in the selected biogas systems in Narok County**

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In today's global scenario, the economic challenges facing the world are exacerbated by soaring prices of both fossil fuels and crop production. This predicament arises from the dual burdens of high crop production costs and depleting reserves of fossil fuels. Concomitantly, the escalating costs of conventional pesticides are coupled with diminishing efficacy and adverse environmental repercussions. Compounding these issues is the environmental menace posed by bio-slurry, notorious for releasing methane and other potent greenhouse gases that contribute to global warming. Additionally, this slurry serves as a breeding ground for disease vectors such as flies, posing a significant threat to public health. To address these concerns, a study was conducted to explore the elemental composition of bio-slurry derived from various biogas systems in Narok County, Kenya. Employing systematic sampling techniques, the collected samples underwent analysis using XRF technology. The study's revelations shed light on the elemental makeup of the bio-slurry, particularly emphasizing the presence of crucial metallic elements conducive to plant growth. Notably, potassium emerged as the most abundant metal in the samples, underscoring its potential as a valuable component for fertilization. Conversely, lead was identified as the least abundant metal in



the bio-slurry. This investigation holds promise for sustainable agricultural practices in Narok County located in the Rift Valley region and beyond, offering insights into harnessing bio-slurry as an environmentally friendly fertilizer. By identifying and understanding the elemental composition, the study provides a foundation for optimizing the use of bio-slurry in agriculture, promoting eco-friendly alternatives in the Rift Valley region amidst the challenges posed by high production costs, dwindling fossil fuel reserves, and the adverse impacts of traditional pesticides on both crops and the environment. Furthermore, the discussion of the environmental menace posed by bio-slurry and its potential implications for public health aligns with the colloquium's holistic approach to addressing interconnected challenges in the Rift Valley region.

### Synthesis and Characterization of Copper-Doped Photocatalyst for Hydrogen Production

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This study presents the synthesis and characterization of a novel copper-doped photocatalyst designed for enhanced hydrogen production through photocatalytic water splitting. The development of efficient and sustainable methods for hydrogen generation is of paramount importance in the pursuit of clean energy sources. Photocatalysis, utilizing semiconductor materials, stands out as a promising avenue for harnessing solar energy to drive the water splitting reaction. In this context, copper-doped photocatalysts offer intriguing possibilities due to the unique electronic properties introduced by copper ions. The synthesis involved the preparation of the photocatalyst through a hydrothermal method, incorporating copper ions into the crystal lattice of the chosen semiconductor material. The results indicate a

successful synthesis process, supported by various characterization techniques. X-ray diffraction (XRD) analysis reveals distinct diffraction peaks corresponding to the crystalline structure of the photocatalyst. The presence of copper is confirmed by energy dispersive X-ray spectroscopy (EDS), indicating its uniform distribution within the material. The surface morphology and particle size distribution of the photocatalyst are examined through scanning electron microscopy (SEM) and transmission electron microscopy (TEM). The images showcase well-defined nanoparticles with a uniform distribution of copper dopants, contributing to increased active sites for photocatalytic reactions. The results suggest a well dispersed and structurally stable photocatalyst with a high surface area, essential for efficient light absorption and catalytic activity. The optical properties of the copper-doped photocatalyst are explored using UV-visible spectroscopy. The absorption spectra exhibit a redshift compared to the undoped counterpart, indicating the successful incorporation of copper ions and broadening the absorption range into the visible region. This extended absorption spectrum implies enhanced utilization of solar irradiance, potentially boosting the photocatalytic efficiency for hydrogen production. The photocatalytic activity of the synthesized material is assessed through hydrogen evolution experiments under simulated sunlight. The results anticipate an augmented hydrogen production rate compared to the undoped photocatalyst, affirming the positive influence of copper doping on photocatalytic water splitting. The transient photocurrent response, measured by electrochemical techniques, further validates the improved charge separation and migration within the semiconductor material, emphasizing the potential of copper-doped photocatalysts for sustainable hydrogen production. In conclusion, this study introduces a copper-doped



photocatalyst synthesized through a hydrothermal method for enhanced hydrogen production via photocatalytic water splitting. The results suggest successful synthesis, uniform distribution of copper dopants, and improved optical and photocatalytic properties. These findings contribute to the growing body of knowledge on advanced materials for sustainable energy applications, paving the way for further exploration and optimization of copper-doped photocatalysts in the realm of renewable energy research.

### **Enhancing Biogas Production from Anaerobic Digesters through Magnetic Nanoparticles: A Comprehensive Review**

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Anaerobic digestion is a widely used process for producing biogas, an important renewable energy source. However, challenges such as low substrate availability and poor microbial activity can limit its efficiency. One potential solution is the use of magnetic nanoparticles, which have been shown to enhance biogas production in anaerobic digesters. This review provides an overview of the potential applications of magnetic nanoparticles in anaerobic digestion, including their properties, mechanisms of action, and experimental studies conducted to date. It also discusses the benefits and limitations of using magnetic nanoparticles, as well as future research directions and areas of improvement. The study's relevance to the Rift lies in the potential for enhancing biogas production from abundant biomass resources in the region, contributing to a balanced approach to clean energy extraction and addressing climate change challenges. Investigating cost-effective, readily available, efficient, and environmentally friendly technologies like magnetic nanoparticles, this

research aims to support the sustainable utilization of the Rift's vast supplies of biomass energy.

### **Green Energy Demand in the Great Rift: Progress and Sustainable Pathways**

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Access to modern energy is remains an essential for socioeconomic development yet facing significant challenges in the Great African Rift (GAR). . For instance, it is marked by economic underdevelopment, poor hygiene and poverty largely due to the use of non-environmentally friendly energy use such as wood, charcoal, and limited access to modern energy resources. However, the Rift presents vast supplies of geothermal, solar, wind, hydro and biomass energy. Consequently, there is need to strike a balance between extraction of clean and other sources of energy. This calls for new technologies in the production and use of new and renewable energies. The solar energy is the best choice due to its abundance in GAF regions. The current commercial panels are made of silicon faces numerous aspects of challenges such as increasing the production yield, stability, reliability, cost, and sustainability. Organic photovoltaics (OPVs) made of donor: acceptor materials are promising due to their affinity for chemical modification (via chemical synthesis techniques), their low manufacturing cost, and the potential for large-scale manufacture. Recent discovery of non-fullerene acceptors (NFAs) are becoming a serious contender to the widely researched fullerene-based electron acceptors due to their structural versatility and easily tunable optical and electronic properties. However, a comprehensive analysis of factors limiting the efficiency of these devices such as exciton



diffusion and dissociation, light absorption, charge collection and electron-hole recombination at ultralow temperature still remains missing. Therefore, the study focuses on a comprehensive probe of structural, morphological, electrical, optical and photoluminescence properties of organic solar cells based on two non-fullerene acceptor material CO<sub>8</sub>DFIC and ITIC-4F blended separately with donor polymers PBDB-T-2CL and PM6 at both low and room temperature. It is expected that the optimized properties of the active layers of the OSCs will help improve their performance. This forms a good fundamental study aimed at improving device performance that if commercialized will reduce the over-dependence on grid electricity for most of the domestic and industrial use within and beyond the GAF regions.

**Enhancing Biodiesel Stability through Natural Antioxidants: A Sustainable Approach towards Renewable Energy**

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With an increasing global demand for sustainable and renewable energy sources, biodiesel has emerged as a promising alternative to traditional fossil fuels. The motivation for renewable energy stems from environmental concerns, climate change mitigation, and the finite nature of conventional fossil fuels. Biodiesel, derived from renewable resources such as plant seed oils, animal fats, and waste cooking oils, offers a cleaner and more sustainable energy option. Nonetheless, its susceptibility to oxidative degradation limits its shelf life and overall performance efficiency. The purpose of this

research is to investigate the effectiveness of natural antioxidants, particularly those sourced from plant extracts (underutilized African plants), in stabilizing biodiesel. The study utilized a systematic methodology, which included selecting appropriate antioxidants through evaluating the phenolic content and antioxidant activities of the extract. The Folin-Ciocalteu method was used to determine the total phenolic content, whereas the DPPH (2,2-diphenyl-1-picrylhydrazyl) assay was used to measure the ability of the antioxidants to scavenge free radicals. The study also involved optimizing the dosage amount of antioxidants in biodiesel through the development of a predictive model and evaluating their influence on the stability of biodiesel. Analytical techniques such as OXITEST (oxidation test reactor) were employed to monitor oxidative changes in biodiesel samples over time. The findings indicate that the plant extract exhibited a total phenolic content of up to 452.38 mg GAE/g, and it displayed an impressive antioxidant inhibition rate of 93.33%. Moreover, results from the study demonstrated that the incorporation of natural antioxidants significantly enhances the stability of biodiesel by inhibiting oxidative reactions. The tested biodiesel sample exhibited an induction period (IP) extending to 15:00 hours, surpassing the minimum induction period requirement of 8 hours set by both the European Standard EN 14112 and the American Society for Testing and Materials ASTM D6751. These findings have broad implications for the biodiesel industry, offering a sustainable solution to improve the shelf life and performance of biodiesel fuels. The use of natural antioxidants not only addresses the technical challenges of biodiesel stabilization but also aligns with the global shift towards environmentally friendly and renewable energy sources. The implications extend to the broader goal of advancing



renewable energy solutions, fostering sustainability, and mitigating the environmental impact associated with conventional energy sources. This research holds significance for the Rift Valley as it delves into pioneering energy technologies for biofuel production. This includes the exploration of solid catalysts, particularly heterogeneous catalysts from biomass available within the region, offering advantages such as simplified separation and recyclability. Additionally, the study underscores the adoption of bio-based fuel sourced from abundant materials like biomass and oil-rich plant seeds, such as Croton, prevalent in the Rift Valley. In prioritizing these technologies, our focus is on solutions that are not only cost-effective, easily accessible, and efficient but also environmentally sustainable. Moreover, the research actively contributes to promoting sustainable energy practices in the Rift Valley by advocating for the use of locally available resources. This extends to the extraction of antioxidants for biodiesel storage from underutilized plants indigenous to the region.

### **Comparison of the Photo-Absorption Ability of P<sub>3</sub>HT - PC<sub>6</sub>1BM Blend Vs P<sub>3</sub>HT – COi<sub>8</sub>DFIC Blend for Solar Cell Applications**

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This research was a study on Polymer Solar Cells (PSCs) based on the bulk hetero junction (BHJ) structure due to their potential in championing low-cost, environmental harmless, non-complex and flexible large area devices. Based on the energy demands in the Rift Valley region, there has been increased quest to develop affordable and environmental friendly energy sources. This study dealt with solar energy as one of the clean energy sources. Different materials that can be

used to develop organic solar cells were studied with the aim of developing OSCs which will serve as an alternative to inorganic solar cells. The organic polymer P<sub>3</sub>HT was blended with fullerene acceptor PC<sub>6</sub>1BM and then the BHJ formed was compared to the BHJ of the P<sub>3</sub>HT/non-fullerene acceptor (COi<sub>8</sub>DFIC) blend. The optical differences in the blends were investigated with the aim of determining optimized device performance. The blends were sequentially processed through spin coating onto a clean glass substrate. Characterization was performed using UV-VIS-NIR and Photoluminescence spectroscopy and the results were as follows: The UV-VIS-NIR spectra showed that the polymer blend P<sub>3</sub>HT:PC<sub>6</sub>1BM shows the absorption stronger at 337nm and slightly less intense absorption peak at 490nm and the polymer blend of P<sub>3</sub>HT:COi<sub>8</sub>DFIC has stronger absorption peak at 301nm, 531nm and 754nm wavelengths. The extended absorption window of COi<sub>8</sub>DFIC characterized by three peaks, within the visible range around 470nm and in the near Infrared around 749nm and in the Ultraviolet region around 329nm is much broader compared to that of PC<sub>6</sub>1BM with peaks only around the ultraviolet region at 305nm and 336nm. Thus, the spectral broadening characteristic of NFA (COi<sub>8</sub>DFIC) is superior compared to that of the fullerene acceptor PC<sub>6</sub>1BM. The PL spectrum of P<sub>3</sub>HT showed an intense emission at a wavelength range around 300nm, 400nm and 475nm. PC<sub>6</sub>1BM has lesser intense PL intensity while COi<sub>8</sub>DFIC showed intense emission at wavelength >300nm but <400nm. On blend formation, the intensity of PL is greatly lowered in the P<sub>3</sub>HT: COi<sub>8</sub>DFIC, compared to the P<sub>3</sub>HT: PC<sub>6</sub>1BM blend. High intensity of PL indicates high rate charge carrier recombination and a lower PL intensity suggests a higher charge carrier separation and this efficiently contributes to photo-catalytic performance. The highest recombination of the photo-generated charge carriers is depicted by the





donor material (P3HT), followed by the NFA (CO<sub>18</sub>DFIC), then the fullerene acceptor (PC<sub>61</sub>BM), then P<sub>3</sub>HT: PC<sub>61</sub>BM blend and lowest in P<sub>3</sub>HT: CO<sub>18</sub>DFIC. In the case of optimal mixing of the donor and acceptor material to form an optimal BHJ, the PL intensity is highly quenched due to maximum charge carrier separation. This is the case of P<sub>3</sub>HT: CO<sub>18</sub>DFIC, there is maximum charge carrier separation. The results obtained gave detailed comparison of the donor – acceptor blends for determination of the best combination of D-A materials for organic solar cell applications. P<sub>3</sub>HT blended with the NFA (CO<sub>18</sub>DFIC) showed better results where there was an extended light absorption window and maximum charge carrier separation compared to the P<sub>3</sub>HT – Fullerene (PC<sub>61</sub>BM) Blend which had a narrower absorption window and higher charge recombination.

### **Energy poverty, pastoralism and low tech: a path towards strong sustainability?**

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East African countries are striving to significantly reduce their carbon emissions and are promoting a growth model oriented towards “zero carbon emissions”. In the energy sector, this development has resulted in the rise of “technical macro systems” in which the infrastructure corresponds to a combination of technical systems (geothermal energy, wind fields, solar fields, etc.) linked to the within a single, all-encompassing network. These projects, implemented in the pastoral landscapes of the Rift Valley, particularly in Maasai communities, do not, however, benefit the populations of these areas. A still significant portion of the population in the Eastern Rift of Kenya and Tanzania has

limited access to energy for heating and lighting. It continues to depend on firewood and charcoal for cooking and lighting, that is to say on biomass for domestic needs, defining a category of population in a situation of “energy poverty”. Questioning this emerging configuration of “energy poverty”, this communication describes the socio-ecological consequences of this situation on biodiversity, the way of life and the health of residents, especially for the women. Based on fundamental research Embodied energy. Socializing low-tech and resources into alternative energy production, we suggest that 'off-grid' energy supply, rooted in the logic of pastoral economies, could provide a pathway into sustainable energy supply. Pastoral economies indeed have adequate resources for the exploitation of biomethane and solar energy. They call for a fairer “transition” towards cleaner and more reliable energy sources, technology adapted, efficient and consistent with domestic needs.

### **A numerical investigation into the effects of local surface plasmon resonance (LSPR) to enhance optical absorption of organic solar cell (OSC)**

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This study aimed to investigate the effects of metallic nanoparticles (MNPs) on the optical properties of nanoparticles (NPs), including aluminum (Al), copper (Cu), gold (Au), and silver (Ag). The investigation was conducted both theoretically and numerically/FDTD/. For both the shell thickness Ag@ metal oxide (Ag@TiO<sub>2</sub>, Ag@SnO<sub>2</sub>, and Ag@ZnO) and Ag@SiO<sub>2</sub> the spherical shape of the Ag NP core, dielectric materials (TiO<sub>2</sub>, SnO<sub>2</sub>, ZnO, and SiO<sub>2</sub>)



were utilized. And different shapes of Ag NPs (spherical, ellipsoid, spherical, rod-shaped, cylindrical, and rectangular) were examined for local surface plasmon resonance (LSPR) in order to enhance organic solar cells' (OSCs') optical absorption. From this study electric field enhancement  $\left[\frac{E}{E_0}\right]^2$  is 10 for Ag, 5 for Au, 6 for 4 for Cu and 6 for Al. Therefore, Ag NPs is the best to improve the absorption of light in organic solar cells (OSC). Among to the electron transport layer such as (TiO<sub>2</sub>, ZnO and SnO<sub>2</sub> and SiO<sub>2</sub>), TiO<sub>2</sub> is the best dielectric material to enhance light absorption by scattering light at (2nm shell thickness). And also rod-shaped Ag NP is the best among the other to enhance the absorption of OSCs at wavelength ( $\lambda = 402.72nm$ ). Thus, energy is a broad and vital subject in the Rift that covers a wide range of topics, from the improvement of renewable energy resources to the production and distribution of electricity and fossil fuels. Therefore, solar energy is among the greatest ways to replace non-renewable energy sources, particularly for the Rift. This article addresses the Rift's focus on replacing silicon thin-film-based solar cells with organic ones that don't pollute the air and are reasonably priced.



## CAUSES & EFFECTS



*A village in Tanzania*



## Maasai Mau Complex Degradation: Effects on Maasai Culture and Human Wildlife Conflict

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The larger Mau Forest complex comprises of twenty-two (22) forest blocks. In 1990, Kenya Forest service reported 273 300 hectares as compared to 160 000 hectares in the 2018. The forest complex has faced persistent threats of logging, charcoal burning and both illegal and legal settlements through de-gazetement of forest reserves. The larger Mau Forest complex has played major roles in; fresh water provisioning, river flow regulation, flood mitigation, recharge of ground water, soil erosion control, water purification, biodiversity conservation and microclimate regulation. With continuous degradation, this has been compromised with notable rise in greenhouse gases largely contributing to climate change which has impact on the environment and human health. This is evidenced by recurrent floods, increased human wildlife conflict incidences and rise in water levels in the lakes whose tributaries originate in the complex. Maasai Mau forest is one of the twenty-two blocks of the larger Mau Forest complex and largely lies in the Narok County bordering Nakuru and Bomet Counties. It is the source of Amalo River, Ewaso Ng'iro River and the Mara River which flows to the Maasai Mara reserve in Kenya and the Serengeti in Tanzania, hence impactful to the Mara reserve and the Serengeti eco systems. This complex has not been spared from the degradation in the past years. It has faced illegal settlement from communities which are largely farmers who have

cleared the forest through logging and charcoal burning to create fields for food production. These activities and on the highlands of the forest has resulted to reduced flows and siltation in the rivers. We investigate the effects of degradation of the Maasai Mau Forest complex on the Maasai culture, who inhabits the lowlands in the complex, where Maasai Mara game reserve and the Serengeti National Park largely lies, with emphasis on the effects of degradation to the nomadic pastoralism culture of the Maasai community and the resultant human wildlife conflicts incidences. We seek to draw a nexus between the Maasai Mau complex degradation and the Human wildlife conflict, climate change and species extinction within the Mau ecosystem and identify whether the Maasai culture, in light of this degradation, has been a victim or a villain in the conservation effects of the Maasai Mara reserve ecosystem.

## Molo in the North Western Region in Kenya

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One of the key hurdles facing indigenous peoples in their pursuit to have their fundamental rights and freedoms protected is the lack of official recognition of them as groups with specific needs, cultures and ways of life. The purpose of this project was to identify and map the El- Molo community in Turkana County through identification of the structure within which the target groups coordinate and engage themselves in laying claim to their rights and in the pursuance of their development agenda, documenting differentials in levels of marginalization among women, children, youth, elderly, and persons with



disabilities. The study targeted 1,104 El Molo residents in Kalokol, Longech and Kapua. The study adopted descriptive research design. In addition, structured and semi-structured interviews were undertaken as well as Focus Group Discussions with participants. A triangulation of methods was applied during this study including literature review, Focus Group Discussions with women and women groups; Youth, and elderly. Face to face interviews with local chiefs, ministry officials, FBOs officials in Central Turkana. The use of checklist facilitated the discussion during both public Baraza and FGD. The El-Molo community is the smallest ethnic group in Kenya. It is in danger of being absorbed into surrounding tribal units, particularly through marriage. In addition, the El-Molo are slowly and effectively absorbing western ways and cultural practices from neighbouring tribes. This leads to a loss of their traditions. In the near future, the El-Molo community will have no traditional staple food, no traditional dress code, and no traditional huts and most obviously no customs or traditional culture. It is therefore important that the community be exposed to ways of preserving their culture, which includes material culture, music and dance.

### Uses and representations of water by pastoralists in East Africa

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The arid Sahelian zones of East Africa are home to pastoral communities with a strong tripartite relationship « people - animals - water ». Jean-Baptiste Eczet (2020) speaks of the astonishing "emotional commitment" that pastoralists have developed for their animals, a love that would be difficult to describe. Water is doubly vital for these pastoralists, both for their own survival and for the continuity of their pastoral way of life and culture. Here, however, available water resources are limited, and herders and their families face major challenges in terms of mobilising water. In this context, it is therefore interesting to have an anthropological approach to the heuristic notion of the hydro-social cycle (Linton, 2020), which describes the incorporation of the hydrological cycle into networks of social and cultural relations of a social formation. Such an objective necessarily requires a broader analysis of the evolution of the uses and representations of water, in relation to the transformation of pastoralism and the changes brought about by the climate, sedentarization, urbanisation and the action of NGOs or government institutions. This also involves studying the evolution not only of water supply methods from the tula of the Borana and the singing wells of the Gabra, but also of the rules for distributing, apportioning and sharing water, its possible consequences, the power relationships it reveals, the social relations it



gives to rise and the social problems it causes. The evolution of these systems is leading to significant changes in practices, such as the introduction of modern wells, pumping systems and pipes, and in some cases the commodification of water (Hazard et al., 2013). This develops the concept of modern water, which refers to chemical composition and designates an unchanging liquid (Linton, 2010). The democratisation of water supply infrastructures is changing the way in which water is daily used, leading to new uses and new representations of water, and calling into question the anthropology of water. Its transdisciplinary approach (Brelet, 2012) implies, as any study in an African environment requires, the fullest possible integration of the various social sciences, and must cooperate with the natural sciences. These changes and innovations have repercussions on the traditional dynamics between pastoral communities, their livestock and water.

### **Investigation and Analysis of Conflict among Pastoralist in Baragoi Area Samburu County Using Regression**

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Conflict is a natural disagreement resulting from individuals or groups that differ in attitudes, beliefs, values, or needs. It can also originate from past rivalries and personal differences. The study aimed to identify causes of conflicts among pastoralists in the area of study. Baragoi is primarily occupied by two plain Nilotes communities, Samburu and Turkana. Conflict has existed amongst them since their forefathers existed until the new era, where it has worsened

due to the increase of firearms ownership, competition for scarce resources, etc. The research also considered factors influencing conflict (availability of firearms, need for dowry, and competition for scarce resources). A stratified sampling was used in the project, and questionnaires were administered to obtain primary data. People were grouped depending on whether they agreed or disagreed with the view of conflict in the area. A total of 64 people were sampled from a target population of 375 people in a population of 6,000 residents. Descriptive statistics and a logistic regression analysis model were employed in the study and analysis done using SPSS software. The study findings conclude that competition over scarce resources is a major contributing factor to the conflict in the area. The study also produced a significant relationship between conflict and the factors influencing it.

### **A summer school for geological hazards assessment and risk evaluation in North Tanzania**

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Northern Tanzania has various natural hazards: seismic, volcanic, floods... We propose a training program co-directed by French and Tanzanian institutions to raise awareness of students on these hazards, their characterization, and the up-to-date materials to study them. We have built the program on a recurring 2-year basis, with content that can evolve with the focus on specific issues or the integration of new themes (social sciences, education, chemistry) depending on the interest of the institutions involved. This interdisciplinary course aims to enhance Tanzanian and French students' knowledge and practical skills in



assessing geological hazards and managing associated risks. It also aims to strengthen and promote bilateral collaboration on these scientific issues, which have a significant societal impact. The first edition of this training will occur north of Tanzania, in the Manyara region. This area is experiencing significant demographic and economic growth, making the local population vulnerable to geological hazards. Recent disasters in the Hanang district (December 2023) underline the need for better training and communication on these risks and their potential consequences, whether direct (earthquakes, volcanic eruptions) or indirect (slope instabilities, flooding). The seven-day program includes seminars, practical courses, and field training. It covers geodynamics, geomorphology, seismology, volcanology, cartography, and data acquisition and analysis. The project's originality lies in its combination of theoretical aspects with practical applications to train participants to estimate geological hazards on a concrete case. The training involves digital mapping and georeferencing tools, seismological instruments, field observations, sample collection, and the presentation of geochemical analysis techniques.

**Methodology for studying volcanic aquifers combining geophysics, geology and hydrogeology: towards an application in the Rift GDR (Tanzania)**

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Responsible management of groundwater reservoirs is essential to ensure reliable water supplies, preserve ecosystems, and meet current and future water needs. It requires a thorough understanding of aquifers, which can be strongly

impacted by crustal deformation processes and human activities. For example, tectonics and volcanism can induce significant changes in the physical (permeability; Lachassagne et al., 2011; Strelow et al., 2020) and chemical (contamination of pore water by magmatic fluids or ash; Ligate et al., 2021) properties of aquifers. However, due to their heterogeneity and inaccessibility, the functioning of these reservoirs remains poorly understood. This is the case for the East African Rift (EAR), which provides an exceptional laboratory for studying the impact of volcanism and tectonics on groundwater reservoirs, and is also concerned by water-related issues due to the increasing exploitation of groundwater and major problems of geogenic (natural) and anthropogenic pollution. Multidisciplinary studies combining geology, geophysics and hydrogeology can be carried out to investigate the impact of geogenic and anthropogenic factors on hydrodynamics and water quality. The aim of this paper is to present the results obtained by our teams at sites with the same geological characteristics and/or similar water quality issues as those in Tanzania, with a view to develop collaborations within the GDR Rift.

**Carbon sequestration as influenced by different plant diversity at Dedan Kimathi University coffee farm in comparison to selected farmers in Central Kenya**

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Carbon sequestration plays an important role in mitigating anthropogenic increases in atmospheric CO<sub>2</sub> concentrations. However, the contribution of plant species diversity on



carbon storage in coffee farming ecosystems has not been well studied, and the potential interaction mechanisms are yet to be clearly understood. Coffee, one of the world's most traded commodities, is grown in a variety of agroecosystems, ranging from traditional shade-grown systems to intensive sun monocultures. The sustainability of coffee production systems is closely linked to soil health, which, in turn, is influenced by the diversity and activity of soil and plant macrofauna. Globally, coffee production is declining due to various factors including effects of climate change. This study focused on assessment of plant biodiversity at Dedan Kimathi University coffee farm as compared to selected coffee growing farmers of Central Kenya. The main objective was to understand how carbon sequestration is affected by the current coffee production systems among the small-scale farmers. These results will help in estimating the amount of carbon stored by the tree species; an indicative measure that can be used in understanding climate change. Results indicate a wide diversity of plant species both artificially planted and naturally growing within the farms. Further results indicate significant diversity in their wood density, life forms, phyto-types and girth circumferences. The findings of this study will enhance our understanding of the coffee production systems that contribute greatly to carbon capture and storage hence presenting strategies for application in mitigating climate change.

**Evaluate the effect of stocking density on the physicochemical characteristics of pond water and survival rate of male Nile tilapia (*Oreochromis Niloticus*) Bahir Dar, Ethiopia**

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The performance of fish in aquaculture is extremely dependent on the water quality. For fish to effectively feed, grow, excrete wastes, and reproduce in a water body, its aquatic environment has to be optimum and conducive. Increased fish density can compromise water quality in fish ponds which also can compromise the survival rate of the fish. This study aimed to evaluate the effect of stocking density on the physico-chemical characteristics of pond water and the survival rate of male Nile tilapia (*O. niloticus*). Throughout the culture period, different physico-chemical parameters in each pond were measured monthly two times a day and Ammonia (NH<sub>3</sub>), and other nutrients were done by using a watch photometer 5000. Planktons in the experimental ponds were identified at the species level. The chlorophyll-a (Chl-a) was measured based on the appropriate procedure and standard formula. The survival rate of the fingerlings was also determined after the final harvesting of fingerlings. The temperature, DO, pH, conductivity, and salinity ranged between 22.07 °C up to 29.43°C, 3 mg/L to 8.15 mg/L, 6.4 to 10.39, 178 µS/cm to 241µS/cm, and 0.035 psu to 0.12 psu respectively. Except for temperature and salinity other physical water quality parameters showed significant differences in stocking density and the number of fish





increased the quality of the pond water decreased. The transparency of the pond water (Secchi depth) and concentration of phytoplankton measured a chlorophyll-a (Chl-a) ranged between 22 cm to 39 cm and 0.053 $\mu$ g/L and 0.013  $\mu$ g/L. The stocking density increased; the concentration of phytoplankton measured as chlorophyll-a (Chl-a) was low. It might be the algal biomass was eaten by fish in the highest stocking density. The species composition of both phytoplankton and zooplankton communities was similar in all the treatment groups and not density dependents it might be the source of the pond water similar. The ammonia (NH<sub>3</sub>) ranged between 0.01 mg/L to 0.31 mg/L, the concentration of ammonia was increased with increasing the density of the fish due to increased biomass resulting in the release of high waste products into the pond water (feed offered and the excretion of the fish). On the other hand, total alkalinity, and hardness ranged between 79.75 to 81.87 mg/l CaCO<sub>3</sub>, and 67.12 to 73.75 CaCO<sub>3</sub>, respectively. The nitrate (NO<sub>3</sub>), and nitrite concentrations (NO<sub>2</sub>) ranged between 13.75 to 31.25 and from 0 up to 0.0014, respectively. There were slight variations between treatments and the quality of the pond water deteriorated as increased the number of fish but there were no significant differences between treatments. Even if most of the Physico-chemical water quality parameters were significant differences between stocking densities. However, the mean ranges were under the recommended requirement of tilapia culture. The survival rate of male *O niloticus* under different stocking densities was higher and not density-dependent. Therefore, further

investigation will be needed to identify what number of stoking densities compromise the physicochemical parameter of the pond water and the survival rate of the fish.

### **Impact of anthropogenic pollution and artisanal fishing on the population of Tilapia fish (*Oreochromis niloticus* and *Oreochromis amphimelas*) in Lake Manyara, northern Tanzania.**

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Lakes are among the main sources of protein and livelihood to huge communities of rural people, and some of them house endemic fish species. The livelihood of about 200,000 rural people in the lake Manyara basin in Tanzania depends on Lake Manyara resources which also houses a population of the endemic and endangered fish, the Manyara Tilapia (*Oreochromis amphimelas*). Despite this importance, fishery in the lake is nearly under open access and it is not known how this has affected fish stocks. The lake is also under strong influence from overgrazing and poor farming practices in the highlands and adjacent areas which are polluting the lake. However, it is also not known how this has affected the growth and survival of fish in the lake. We assessed the impact of artisanal fishing and anthropogenic pollution on the stock of Manyara Tilapia and Nile Tilapia in Lake Manyara. We found that fish stocks in the lake are under heavy fishing pressure. Nearly all harvested Nile Tilapia were immature, and the majority of Manyara Tilapia were first time spawners caught at the length of



their first maturity. This prevented the fishes from spawning at least once in their lifetime. Anthropogenic pollution has also hypereutrophied the lake and degraded the ecological quality for growth of Tilapia fish. Therefore, urgent site-specific mitigation measures and conservation actions are required to safeguard community livelihood and continued existence of the endangered Manyara Tilapia.

### **Biodiversity survey of fresh water fishes within Gurungoa National Park, Central Mozambique**

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Gorongosa National Park is a conservation area beaded in Central Mozambique with a rich diversity of species and landscapes, and actually an example of successful restoration of biodiversity in Africa destroyed by civil war and poaching. This park is situated at the southern most extension of the East African Rift system, within the Urema drainage basin, that is a major sub-catchment of the Pungwe River that support a diversity of fish and other organisms. Many studies are being developed to document the rich diversity of flora and fauna, however, most of this research is centered on terrestrial biodiversity. In order to cover this lack of information on aquatic biodiversity comprehensive surveys were performed in November 2021 and comprehensive surveys were performed in November 2021 and July-August 2022, to establish on inventory of the freshwater fishes of the park applying an

integrate taxonomic approaches by using a combination of molecular, morphological, ecological, geographical data to solve some of the specie-level taxonomic problems. A total 36 species of freshwater fishes belonging to IS family, being represented by 10 species. Taxonomic revision and genetic analysis are ongoing for some species collected particularly for *Chiloglan's Neuman*, *Labeobarbus Mareguengis*, *Enteromius* and *Marcuse,us Macrolopdotes* in order to determine whatever they potentially represent new species or conspecific with the lineages identified in the upper Pungwe. The Gorongosa National Park remains under sampled and thus its aquatic biodiversity is poorly documented. There is need for setting up a long-term research program to undertake fine scale geographical surveys to inventory the aquatic fauna of this park and its surrounding areas for better conservation and management of the freshwater systems within the Urema Basin.

### **Minimizing Human-Wildlife Conflict through Exploitation of Solid Plastic Wastes to develop 3D Printing Biodegradable Polymeric Filtration Membranes**

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With the surge in cases of human-wildlife conflicts in the sub-Saharan region, significantly in the Rift segment. The issue of solid plastic pollution in wildlife conservation/habitats has never been addressed fully. To mitigate this, a lot of focus need to be diverted towards developing



novel materials by exploiting these solid wastes, which have also been reported to be the cause of climate change through additive manufacturing. In this context, a low-cost, novel biodegradable polymeric cellulose nanocrystals/nylon 6/magnetic iron oxide nanoparticles and chitosan (CNCs/N<sub>6</sub>@Fe<sub>3</sub>O<sub>4</sub>-CT) nanocomposite membrane was successfully synthesized using cellulose nanocrystals from pulp and paper sludge, and plastic wastes (Nylon 6), through in situ incorporation of Fe<sub>3</sub>O<sub>4</sub> nanoparticles and capping with chitosan nanoparticles. This multiphase 3D membrane provides a workable substitute for the non-biodegradable membranes used in air/water purification and soil remediation technologies. The materials favorable characteristic is its biodegradability, unlike non-biodegradable plastic wastes that cause harm to the wildlife and general ecosystem. By presenting a cost-effective, biodegradable alternative to traditional non-biodegradable filtration membranes, this study aligns with the colloquium's theme of promoting sustainable practices and innovative solutions for the challenges facing the African Rift region. This research contributes significantly to the discourse on human-wildlife conflict resolution and sustainable environmental conservation within the unique context of the Great African Rift. Additionally, the integration of 3D printing technology further emphasizes the potential scalability and practical application of this innovative approach within the context of the Great African Rift's energy and resource challenges.

**Exploring Urban Green Space Visitation Patterns in Slum Dwelling Area: A Socio-Demographic Analysis. A case Dandora, Nairobi County, Kenya**

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This study investigates the relationship between demographic characteristics and visitation patterns of residents to Urban Green Spaces (UGS) in slum dwelling areas using Dandora as case study. The demographic information analysis reveals a gender-balanced respondent pool, with a predominant youth population thirty to forty years (30-40 years old), largely educated up to secondary level, and primarily self-employed. The majority of respondents have been residents for one to ten years (1-10 years), mainly in Phase two (II) and four (IV) of Dandora. A significant proportion eighty-four percent (84%) of respondents visit UGS, citing weekly visits forty-one percent (41%) and daily visits thirty-four percent (34%) as the most common frequencies. In contrast, sixteen percent 16% do not visit UGS primarily due to concerns about insecurity and other reasons. The study employs a multinomial regression model to examine the relationship between socio-demographic characteristics and frequency of UGS visitation. The results indicate a significant relationship, with place of residence being a key factor influencing visitation frequency. Specifically, residents in Phase II show a significant impact on daily and weekly visitation, while residents in Phase III and IV influence monthly visitation.



The findings suggest that socio-demographic factors play a crucial role in influencing residents' UGS visitation patterns. Understanding these relationships can inform urban planning strategies to enhance accessibility and engagement with green spaces in Dandora.

**Assessment Of Land Cover Change Due  
Stone Quarrying Activities in Narok town  
Ward, Narok County**

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Land cover change is described as the dynamic change in the terrestrial surface of the earth induced by human activities. Changes in land cover include urbanization, agricultural activities, and increased mining activities/quarrying activities which result in the alteration of initial land surface status. For the past few years many regions in the Rift Valley have been hit by extreme climatic conditions for instance North Rift region where drought and famine are linked to the effects of climate change. These climatic changes are directly linked to human activities in the environment like emissions and alteration of vegetation. Quarrying activities in Narok is one of these human activities contributing to emission and vegetation degradation contributing to extreme drought in the north rift .This study therefore stands in to assess the effects of this activity on vegetation cover in the region. Quarrying operations have been reported to cause alteration in vegetation cover and landscape, open cast methods used in stone mining lead to destruction of land resources including

denudation of vegetation cover, loss of soil fertility and soil erosion. Remote sensing and Geographical Information System (GIS) techniques were used to assess land cover changes due to stone mining in the study area. Satellite images covering the study area were downloaded from United States Geographical (USGS) Earth Explorer (<https://earthexplorer.usgs.gov>) for four epochs 1985, 1995, 2010 and 2022 for analysis. Spatial analysis of land cover changes was conducted by processing and analysis of remotely sensed images from Landsat and Sentinel 2 satellite data. Supervised classification was performed on the images into vegetation and non-vegetation cover classes using environmental visualization software, version 5.3. Findings were presented descriptively in tables, charts, graphs and textual forms. The study found that non-vegetation cover class had increased by 18.70% between the year 1985 and 1995. There was an increase in vegetation cover class between the years 1995 and 2010 by 37.81 %. Between the year 2010 and 2022 vegetation cover was reduced by 18.24 %. More than half (57.65%) of household heads noted that the previously vegetated landscape was now scarred and exposed. Moderate correlation was found between landscape degradation and vegetation loss ( $R^2=0.384$ ). The study concluded that quarrying activities has led to land cover changes resulting negative environmental outcomes.



**Enhancing Procurement Performance  
through Supplier Evaluation in the Steel  
Manufacturing Sector: A Case Study of  
Nairobi, Kenya**

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The steel manufacturing sector in Nairobi, Kenya, confronts intense competition driven by globalization and innovation, necessitating adept supply chain management. This research delves into the impact of supplier development, with a specific focus on supplier evaluation, on the procurement performance of steel manufacturing firms in Nairobi. Employing a mixed-method research design with a positivist approach, the study investigates supplier selection, supplier partnership, supplier training, and supplier evaluation as key components influencing procurement performance. A purposive sampling of 360 employees across ten steel firms facilitates data collection through questionnaires and a data collection sheet. SPSS V26.0 and SmartPLS 4.0 are employed for analysis to assess both direct and joint effects of these variables. The study conducted a rigorous examination of supplier evaluation and its impact on procurement performance within the steel manufacturing sector, with Nairobi, Kenya, as a representative case. To ensure the validity and reliability of data, exploratory factor analysis was employed, confirming the robustness of the constructs under investigation. Utilizing Partial Least Squares Structural Equation Modelling (PLS-SEM), the research scrutinized direct relationships between various supplier integration strategies and key

indicators of procurement performance. The findings underscore the positive and significant effects of supplier evaluation on the procurement performance of steel manufacturing firms in Nairobi. The study emphasizes the pivotal role of supplier evaluation in enhancing procurement performance within the steel manufacturing sector in Nairobi, Kenya. Recommendations advocate for strategic enhancements in supplier evaluation practices, providing training to procurement personnel in risk management, and integration of technology-enabled procurement solutions for optimized procurement operations. These recommendations collectively aim to empower steel manufacturing firms, fostering more informed procurement decisions, mitigating risks, and enhancing overall competitiveness in the evolving business landscape.

**Continuity and Change in Traditional  
Terracing and the Agricultural economy in  
Konso, Southern Ethiopia**

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In the Konso agricultural system, terracing is one of the most significant traditional techniques used to protect soil from erosion and to accumulate water in agricultural fields. This has been studied by several academic scholars and practitioners from various disciplines; however, they have not shed light on the role of terrace construction in the agricultural economy behind the formation process of the archaeological record. This study aimed to examine continuity and change in traditional agricultural terraces in Konso.



Ethnobotanic observations and ethno-archaeological investigations were conducted in different parts of the local area of Konso. Based on archaeological surveys, ancient terraced agricultural areas such as Docketu, Gamole, Fasha, Kolme, Katota, and Sagan were identified and mapped. The collected results indicate that *Moringa stenopetala* (cabbage tree), *Terminalia Birownii*, *Eragrostis* (teff), *Sorghum bicolor* (sorghum), *Zea mays* (maize), *Eleusine coracana* (finger millet), *Cajanus Caja* (Pigeon pea), *Glycine max* (soybean), *Linum usitatissimum* (linseed), *Rhamnus prinoide* (Gesho), *Catha edulis* (chat), coffee Arabica (coffee) and others are the plants and crops that are cultivated and grown on the agricultural terraced land of the Konso. The area of terraced agricultural land in Konso, predominantly from 1400 to 2000m above sea level on stony and steep slopes that are very fragile and susceptible to erosion, is the rightful perception. Technologically, the Konso tradition of terrace construction depends on altitude and topography. I concluded that the Konso people have endured hostile conditions, difficult terrain, and unpredictable rain; however, through terrace farming methods, they have changed their fragile ecology and difficult mountainous topography.



## PRESERVATION



*Elephants in Okavango Delta, Botswana*



# Impacts of Anthropogenic Habitat Modification on Mammal Diversity at The Mau Forest Complex, Kenya

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Anthropogenic influence on biodiversity results from the burgeoning human population and the associated human agricultural and infrastructural needs. The Mau Forest Complex (MFC) is a biodiversity hotspot; however, species are predicted to be declining at unprecedented rates due to loss of habitats. Using camera traps, this study investigated the abundance and species richness of non-volant small to medium-sized mammals (including small carnivores) along a gradient of human disturbance of three treatments (adjacent farmlands – AFs, secondary forest – SFs, and primary forest – PFs) at the Transmara and Maasai Mau Forest blocks of the MFC. Mammals were recorded at 181 camera-trap locations from 246 camera deployments and 5,509 sampling days. From 302,997 images, 47,345 were of wildlife species. A total of 53 species belonging to 8 mammal orders were recorded, with 20 species belonging to the order Carnivora representing seven families. Additionally, 15 species of the order Artiodactyla, 1 species of Lagomorpha, 1 species of Hyracoidea, 1 species of Proboscidea, 9 species of Rodentia, 7 species of Primates and 1 species of Tubulidentata were recorded. While Alpha diversity, as measured by Shannon's entropy, was not significantly different between Transmara and Maasai Mau Forest blocks ( $P > 0.05$ ), it differed significantly among treatments, with AFs showing lower diversity than both PFs and SFs, and the former having significantly higher diversity than the latter at both forest blocks. Beta diversity differed significantly between primary and secondary forests ( $df = 1, P < 0.05$ ), primary forests and adjacent farmlands, and adjacent

farmlands and secondary forests and this trend was the same for the two forest blocks. In terms of occupancy of small carnivores, overall occupancy (mean  $\psi$ ) was highest in PFs and least in AFs. At the individual species level, Jackson's mongoose (*Bdeogale jacksoni*), a known forest specialist, had highest occupancy in PFs and the least in AFs. Detection rates for various functional groups were similar across treatments for Afrotherians, Carnivora, and small rodents but differed significantly for large rodents, primates, and ungulates. This study demonstrates the adverse negative influence of anthropogenic disturbance on the persistence of a range of small to medium-sized mammalian communities at the Mau Forest Complex, with different species and functional groups responding differently to human land-use practices. Particularly important is that the less-disturbed primary forests supported more habitat specialists or forest-dependent mammals, and should be preserved for supporting overall and forest specialist species richness.

## Safeguarding Our Shared Heritage: A Comprehensive Study of Cultural, Human, and Wildlife Contributions to Biodiversity Conservation in the Rift

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The research initiative titled "Safeguarding Our Shared Heritage: A Comprehensive Study of Cultural, Human, and Wildlife Contributions to Biodiversity Conservation in the Rift" seeks to unravel the intricate web of relationships among cultural heritage, human evolution, and wildlife dynamics in the Rift region, with a primary focus on fostering biodiversity conservation. The Rift, a geologically significant area, is not only home to diverse ecosystems but also encapsulates a rich tapestry of cultural heritage. This study endeavors





to explore how these two aspects, often considered distinct, are interlinked and contribute synergistically to the conservation of biodiversity. Cultural heritage is an integral part of the human experience, and its influence on biodiversity conservation is profound. By delving into the practices, traditions, and belief systems of local communities in the Rift, the research aims to uncover the ways in which cultural heritage shapes human interactions with the environment. Understanding these connections is crucial for developing effective conservation strategies that respect and incorporate local customs and values. The study also delves into the evolutionary aspects of both humans and wildlife in the Rift. Through an interdisciplinary approach, researchers aim to trace the historical interactions between humans and their environment, exploring how evolutionary processes have shaped not only the physical characteristics of species but also their behaviors and adaptations. This evolutionary perspective provides valuable insights into the coevolution of humans and wildlife and how these dynamics influence the biodiversity of the region. Wildlife plays a pivotal role in the biodiversity equation, and the research scrutinizes the complex relationships between species in the Rift. By investigating the interactions between different wildlife populations and their habitats, researchers aim to identify key ecological drivers that contribute to the maintenance of biodiversity. Understanding the intricacies of these relationships is paramount for implementing conservation measures that address the needs of both human communities and the diverse array of species in the region. The comprehensive nature of this study is underscored by its holistic approach, recognizing that successful biodiversity conservation in the Rift requires a nuanced understanding of the interconnectedness

of cultural heritage, human evolution, and wildlife dynamics. By acknowledging and respecting the intricate balance between these elements, the research aspires to formulate conservation strategies that are not only scientifically sound but also culturally sensitive and socially inclusive. In summary, "Safeguarding Our Shared Heritage" seeks to illuminate the intricate threads that bind cultural heritage, human evolution, and wildlife dynamics in the Rift. Through a thorough examination of these interconnections, the research aims to pave the way for conservation initiatives that resonate with the diverse fabric of this region, ensuring the preservation of its rich biodiversity for future generations.

**An Assessment of Ecosystem-Based  
Adaptation Approach in Flood Risk  
Management in Upper Suswa-Magadi  
Catchment Area of Narok County, Kenya**

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Flood control can be challenging for most catchments because of structurally complex habitats and poor landscapes. The emergence of ecosystem-based adaptation (EbA) has created a shift from the mechanical-engineered approaches associated with a high cost to control floods. EbA presents a cost-effective with multiple beneficial measures in flood risk management. Essentially, EbA combines' biodiversity and ecosystem services for climate change adaptation and flood risk reduction. To achieve the aim of the study, flood impacts and potential structural and Ecosystem- based mitigation strategies for the catchment were highlighted, with the level of Ecosystem-based adaptation assessed. This study adopted mix methods since it is social research and combines qualitative and quantitative elements to assessing the Ecosystem-based



Adaptation approach in flood risk management in the upper Suswa Magadi catchment, Narok, Kenya. Three wards of the Upper Suswa-Magadi basin were chosen using proportional and deliberate sampling techniques. Suswa, Keekonyokie, and Mosiro. Eight thousand ninety-four households totaled the population at the sites, providing a sample size of 370. Results indicated that most respondents (95.1%) agreed that flash floods cause soil erosion. Similarly, it was noted that 61% respondents agreed that application of EbA measures was effective in reducing run-off. This study showed that EbA measures might be implemented locally, regionally, and nationally to provide flood-prone communities with resilience and adaptability to the danger of flooding. By creating creative EbA plans, EbA can typically reduce the environmental effects of floods and the harm they do to a property. From the hypothesis finding, it was evident that there is a positive connection between the use of EbA and its efficacy in managing flood risk; this indicates that anytime there is an improvement in the use of EbA measures, there is an improvement in flood risk control. Therefore, the study recommends an increased awareness of Ecosystem-based adaptation measures and community involvement for the same.

**Ethnobotany towards Biodiversity conservation and food security from Ethnobotanical survey of wild edible plants among the Mursi, Bodi and Bacha communities in lower Omo valley of South Omo zone, Southern Ethiopia**

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African rainforests are highly complex environments in which plant and animal species have evolved under specific conditions and in

diverse forms. Wild edible plants (WEPs) in Africa account for more than 1200 species. Ethiopia is one of the countries with varied topography and a wide range of habitats, presenting a large number of endemic plants and animals, however, food insecurity is a major concern where deforestation, drought, conflict and climate change are claimed as the main responsible challenges. In such contexts, WEPs that are more resilient to environmental challenges are a much needed alternative to fill the gap and improve the quality of life in averting malnutrition through their nutritional treasure that could be unlocked over time. Moreover, the use of these neglected crops is also a cost-effective, safe and environmentally friendly solution for crop diversification and ecological stability. The Mursi, Bodi and Bacha communities are agro-pastoralist ethnic groups in the Lower Omo Valley of Ethiopia. The livelihoods of the first two depend on the integration of floodplain farming, livestock, and rain-fed agriculture. Bacha communities, on the other hand, depend mainly on foraging for wild animals and plants, fishing, and beekeeping in the Omo Riverine Forest. All groups live in a similar environment and have quite similar interests in multidimensional management issues in interaction with their ecosystems. Wild plants are the main focus and play an important role in their daily diet throughout the year. Beyond the fact that we know and share the truth, the diversity of plant species and associated knowledge is not well documented. Moreover, these people emphasize the catastrophic decline and damage to their environment over the last three decades, which urgently needs ethnobotanical assessment and related measures to alleviate the problem. Thus, the objectives of this study were to survey and document the WEPs and associated indigenous knowledge, to identify WEPs with medicinal and cultural significance and to discuss the role of WEPs in food security and biodiversity management of Omo Valley. Prior informed



consent, semi-structured interviews, discussions, and field visits were the methods used in the study. The results of this study reported 49 edible plants that belonging to 43 genera and 28 families; forty (40) plants were common to the three groups, seven (7) were reported only by Mursi and two (2) were unique to the Bacha. In addition, *Sesuvium portulacastrum*, *Amaranthus hypocondriacus*, *Cyathula orthacantha*, *Achyranthes aspera*, *Bidens biternata*, *Capparis spinosa*, *Senegalia mellifera*, *Echinochloa pyramidalis*, and *Physalis ixocarpa* are 9 edible plants newly reported in the country database. Majority of the plants mentioned in the community were in multipurpose use; in which 16 WEP species were claimed as nutraceutical. This ongoing study showed that the area is rich in WEPs and knowledge about them that could help in food security and biodiversity conservation. Continuous inventory and documentation as a key for promotion and conservation of indigenous knowledge and ecology, coupled with isolation and preservation of buffer areas accessible to the inhabitants are highly recommended.

### **Appreciating Traditional Knowledge in Nature-Based Solutions to Climate Change**

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Traditional and Indigenous Knowledge plays a role in predicting the weather, understanding climate risks, coping with climate impacts, informing and improving responses to climate change and variability, and identifying adaptation options (Leal Filho et al., 2022). Local knowledge retains biological and cultural information and is built relationally between lived space and resources exploited. It follows rainfall, as rain relates to people, grass and the future, and it also builds forms

of protection in the shape of rituals, prayers and amulets, when confronted by rains' unpredictability. Finally, such knowledge is not static as it is built through movement and experience. Hence, it provides valuable insights into changes, including climate changes. It is transmitted through the generations and modified as changes are observed. It is linked and encoded in the environment and recognizes the co-implication of several factors in the modification of lived spaces. Enhancing and mainstreaming nature-based solutions within national governance, climate action and climate policy-related instruments, including Nationally Determined Contributions, Adaptation Communications, long-term low greenhouse gas emission development strategies, spatial planning, national development plans, business plans are an essential ingredient in the ensuring sustained application of nature-based solutions. The foundational framework for sustainable nature-based solutions for Indigenous peoples is collective land ownership regulated within customary law and traditional institutions of decision-making. Governments and other actors should support land tenure transitions towards securing customary land tenure - lands, waters, territories, and biodiversity - for Indigenous peoples. Indigenous peoples to strategize and sustain their lobbying and advocacy efforts on land rights claims. Indigenous knowledge systems and practices founded on Indigenous value systems, cultural heritage, and norms, reflected in positive people-nature relations and traditional occupation is the heartbeat of nature-based



solutions among Indigenous peoples. The practice, generation, application, and dissemination of these knowledge systems within Indigenous Peoples' territories is threatened.

**Conservational Challenges of the World  
Heritages of Konso**  
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The major elements of Konso cultural landscape are walled traditional villages, agricultural terraces, water ponds, traditional or 'sacred' forests, traditional meeting and ritual places. The objective of the study is to understand the conservation challenges of the World Heritage Site of Konso and proposing the ways tackling the challenges and preserve the site. The research method of data collection and analysis is qualitative and quantitative approach. Interview and observation were made on eight traditional villages and surrounding terraced agriculture, two water ponds and three sacred forest areas. Primary data was collected through interviews and observation. Secondary data collected from publications, books, articles, and governmental reports. Data collection field work took place in two terms in December 2021 and in April 2022. Climate changes, culture change, urbanization, 'modernization', population growth, abandonment and deteriorations of terraces, walls and water ponds, improper administrative issues and discouragement of traditional knowledge and skills are the conservational challenges of the world heritage site of Konso. Revising the management plan of the site; community awareness creation and mobilizing the local people for the conservation of the site; preparing special rules and regulations which restrict activities in the core zone of the site; creating

events which revive and promote the traditional practices, reserving area for plantation and production of conservation materials are recommended for the sustainable conservation of the site

**Botanical gardens as habitat and refugia for  
biodiversity conservation**

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The conversion of natural landscapes into human-dominated areas has been identified as one major threat to the existence of biodiversity. However, properly managed anthropogenic biomes can act as areas of biodiversity conservation with the potential of providing ecosystem services, similar to those obtained in natural habitats. Classic examples are botanical gardens where plants are grown for scientific studies and for public display. They that have become popular in urban centers as examples of nature-based solutions to landscape loss and degradation. To assess the importance of botanic gardens as biodiversity habitats a study was carried out in Nairobi Museum Botanic Garden (NMBG). Bees were sampled using pan traps and sweep nets in four habitats classified as gardens including the Herbal Garden (HG), Memorial Garden (MG), Succulent Garden (SG), and Quarry Garden (QG). A total of 286 individual bees were collected with MG having 83 individuals, QG (75), SG (66), and HG(62). Though HG recorded the lowest abundance of bees, it recorded the highest number of bee species (14), MG (13), SG (12), and QG (5). The diversity of bees was highest in the HG ( $H'=1.89$ ), SG (1.88), MG (1.67), and QG (1.15). Meanwhile, high bee abundances and richness were strongly correlated with diverse flowering plants per habitat with HG having the highest number of flowering plants (23), MG (16), and SG (13) and QG (7). The most abundant bee species was *Ceratina* sp.1



with (107) individuals then *Lasioglossum* sp. 1 (52). This study found different flowering plants provided unique habitats in NMBG that supported unique assemblages of bee communities, a scenario attributed to enhanced habitat heterogeneity. The findings of this study demonstrated that botanic gardens can act as important habitats and refugia for bees in human-dominated landscapes. Therefore, establishment and conservation of botanic gardens in urban areas is one way to contribute to Sustainable Development Goal 11 of ensuring sustainable cities and human settlements.

### Tree Conservation Challenges among the Indigenous Pastoral Rendille Community in Marsabit, Kenya

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Every environment is surrounded by traditional people who have lived in the geographic location for a long time and use their particular knowledge to cohabit with the natural ecosystem. This study assessed challenges encountered towards tree conservation by the Rendille pastoral community in Kenya. Selected tree species; *Olea europaea*, *Terminalia* sp. and *Hyphaene compressa*, that are commonly used by the community were identified and the probable threats towards their conservation. Some of these tree conservation challenges by the indigenous Rendille were: charcoal burning and fuel wood consumption, demand of traditional tree medicinal value, climate variability extremes and demand for land for settlement by the community. The results indicate that, charcoal burning (84.4%) and demand for traditional tree medicine (77.3%) were leading causes frustrating tree conservation among the Rendille. To mitigate these challenges, the respondents indicated that, creation of awareness (89.1%) and promotion of other sources of fuel (78.9%) could be vital

factors. The study recommends Integration of Indigenous Knowledge (IK) with formal education to enhance conservation of the mentioned tree species.

**Keywords:** Tree conservation, challenges, ecosystem, environment, *olea europaea*, *terminalia* sp., *hyphaene compressa*

### The state of Cultural Heritage of Tigray during the war from November 2020 to November 2022

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Tigray, the northernmost region of modern Ethiopia, is center of Ethiopian civilization marked by the presence of ancient administrative centers with relics of palaces, underground tombs; standing and fallen monolithic obelisks, pre-Christian temples, coins (of gold, silver and bronze), pottery, metal work, and the like. This civilization had its centers first in Yeha and then in Aksum with its port Adulis on the Red Sea coast. Christianity was introduced to the region of Tigray in Aksum in the 4th c. AD; ever since then, large number of churches and monasteries were built in Tigray. The churches and monasteries were centers of education and production of religious manuscripts. Aksum, the ancient capital of Aksumite Empire, is home to the world's largest monolithic obelisks that once stood to the height of 33 meters, weighing 520 tons of granite stone. This ancient capital also houses the Ark of Covenant. The region of Tigray was hub of international researchs in archaeology and history since the beginning of 20th c AD. French, Germans, Americans, Canadians, Italians, Polish and British researchers conducted archaeological research till the eve of the 2020 war on Tigray. A war was declared on Tigray on 03 November 2020; Ethiopian National Defense



Forces (ENDF) in alliance with Eritrean Defense Forces (ENF) fought against Tigray regional forces. During this war, cultural heritage was deliberately targeted by the Ethiopian and Eritrean forces; the offensive war both from air and ground also caused an indirect damage on cultural heritage. It caused unprecedented damage to the cultural heritage of Tigray. The largest percentage of the destruction was caused due to deliberate shelling on cultural heritage sites and religious buildings (churches and mosques). During the war, archaeological sites, museums, churches, mosques and temples were damaged by bullets and heavy shelling, while the troops burnt church treasures, looted movable heritages from church and archaeological museums, and destroyed archaeological museum collections. The consequence of such looting of treasures from Tigray was seen on the e-bay online shopping; especially religious parchment books have been sold outside the country. In response to this, international scholars and medias have expressed their concern over the cultural heritage damage, the looting and heritage trafficking. The soldiers entered every church and monastery with disrespect to the faiths to hunt for centuries-old manuscripts and crosses. This heritage cleansing was carried out under the cover of a war of law enforcement against the Tigray Regional leaders. The war was offensive in its character to smash down the glory of the Tigray. One of the means to achieve this mission was through looting and destruction under the cover of law enforcement that lasted until November 2022. Those heritage which escaped looting were deliberately damaged; museum collections were looted and the rest destroyed, burned down, messed-up, and littered. A survey of the situation of heritage in other countries in event of armed conflict tells us that cultural

heritage are targets during war either through looting, direct attack, or indirect damage.

### **Cultural Heritage, Human and Wildlife Evolution as a Contributor to Biodiversity**

#### **Conservation in the Rift**

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The historical greatness of culture in the Rift is characteristic of the region's immense cultural grandiose, a foundation used by human society to mould other societies and move towards sculpting the global environmental landscape. Tracing the origins of different cultural practices brings to life the area's history and, much more importantly, sheds light on its current connection to the environment and biodiversity areas. One of the crucial aspects of the study is to trace the history of human populations in the Rift and investigate their influence on the local ecology. The research focuses on one of the most pressing problems- conservation strategies that bear an intricate relationship with human uses, which pose both threats and opportunities for biodiversity preservation. So, from historical backdrops to the modern stage, the subtle study of human-wildlife evolution and interaction explains the necessity of an ever adaptive conservation approach.

The research poses three fundamental questions:

1. What are the ways in which cultural practices in the Rift have changed with time, and what kind of influence do they have on the environment and biodiversity now?
2. What is the legacy of evolutionary history of human populations in the Rift and how does this affect the structure and dynamics of local ecosystems?



3. What are the threats and opportunities of human-wildlife interactions as far as the biodiversity of the rift is concerned?

To address these, a comprehensive mixed methods approach is to be applied, qualitative methods like historical analysis and narrative analysis explore the transformation of cultural behavior. Quantitative surveys and ecological assessments seek answers to the evolutionary origins of human populations and determine the adaptiveness of wildlife. The integrated approach of the analysis combines qualitative and quantitative results, capturing the full nature of factors influencing biodiversity conservation, reinforcing the emphasis on interdisciplinary approaches, fusing cultural, historical, and ecological aspects.

Directed towards the working examples of collaborative conservation initiatives, positive cases carry catchy signals, indicating the cooperation between local communities, conservation bodies, and policymakers has positive impacts. These shared ventures represent lighthouses of successful biodiversity preservation, demonstrating the importance and potential of collective action. Finally, with a set of recommendations on how to promote cooperation and information sharing, such suggested approaches are consistent with the need for collective knowledge and collaboration to solve the complex issues facing the Rift, envisaging a sustainable future where collaborative conservation becomes habitual in the ultimate preservation of the cultural heritage and biodiversity by all and for all. This statement presents as an offer to a macro view of a complex, multi-cultural Rift that goes further than individual predispositions in offering a glimpse of one of the earth's marvels. It is an invitation to plunge into the complex interaction between cultural legacy, human-wildlife evolution, and

cooperative conservation, one that is open to conversations, discoveries and shared reflections on why heritage matters.

**Seasonal changes in phytoplankton species composition and abundance in arid and semi-arid water pans under different land uses in Narok, Kenya**

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Water pans are small reservoirs created either by excavating open ground or occurred naturally. Sources of water in pans in Narok include run-off from agricultural fields, roads, pastoral fields and rainwater. In the arid and semi-arid Narok ecosystem these water pans supply water to communities for livestock and wildlife consumption, domestic use and also for agricultural activities such as irrigation. However, there is a dearth of published work on ecological dynamics of these water bodies specifically studies on phytoplankton abundance, a major driver of trophic structure of aquatic ecosystems. This research aimed at analyzing seasonal changes in phytoplankton abundance in water pans in Narok under principally two majors but overlapping land uses: medium scale crop production and livestock and wildlife grazing. The study was conducted between January- July 2023 to cover both the dry and wet seasons. Water samples for phytoplankton enumeration and identification were collected by taking 20litres of water at the subsurface from 2 points within each water pan using a calibrated 20litres bucket. A sub-sample of 6ml was drawn using plastic valcon tubes in triplicates and were fixed by



adding drops of 1% Lugol's solution. Identification and enumeration of the algal cells was done using a Zeiss Axioinvert 35 inverted microscope model at 100X and 400X magnification. Six major phytoplankton taxonomic groups represented by chlorophytes, diatoms, cyanophytes, Zygnematophytes, euglenophytes and dinoflagellates were found. The result showed that, chlorophytes occurred in higher abundance in both the dry and wet season. Phytoplankton species composition was higher during the wet season in water pans located in the more humid areas where agriculture was the main land use but higher abundance was recorded in water pans located where pastoralism is dominant in dry season. Phytoplankton abundance during the dry season ranged between  $183 \times 10^5$ - $5469 \times 10^5$  individuals/L and  $213 \times 10^5$ - $1833 \times 10^5$  individuals/L during the wet season but there was no significant seasonal variation in phytoplankton abundance  $p > 0.946$ . Between different land uses there was significant difference in species abundance ( $p = 0.019$ ) with water pans located in agricultural areas recording higher species abundance. Land use appears to influence phytoplankton abundance. Fluctuations in species composition and abundance in these water bodies can be attributed to small size of the pans, seasonal desiccation and short water residence time. Water pans in this arid and semi-arid landscape are important reservoirs for phytoplankton biodiversity and can be exploited for fish farming as a climate smart food production strategy. Climate variability in this region is likely to result in proliferation of cyanobacteria algal blooms thus making the water bodies eutrophic and exposing the pans to threats of cytotoxins, two factors which may compromise the quality of the water and their suitability for domestic, livestock and wildlife use.

### Analyzing the Impact of Human-Wildlife Conflict at Maasai Mara National Reserve using a Modified Lotka-Volterra Model

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Human-wildlife conflict has emerged as a significant challenge among communities residing near game parks and reserves. These conflicts arise from the essential needs and behaviour of wildlife negatively impacting humans or from human interventions disrupting the needs of wild animals. To investigate these real-world phenomena and causal agents contributing to human-wildlife conflict (HWC) between humans and animals, a comprehensive study will be conducted at the Maasai Mara National Reserve. A refined Lotka-Volterra model will be employed to analyse and interpret the competition dynamics following the research findings. Data collection will encompass the use of structured questionnaire guides, secondary data sourced from the park office, and extensive field observations. Employing a cross-sectional approach, the study aims to identify the underlying causes of human-wildlife conflicts, encompassing factors like deforestation, livestock overgrazing, and agricultural expansion. Furthermore, the study will evaluate the varying degrees of impact experienced by both human populations and wildlife within the study area. By meticulously assessing and quantifying these impacts, the research endeavors to generate invaluable insights essential for conflict resolution and fostering coexistence between human communities and wildlife. The intricate relationship between human activities and wildlife necessities often constitutes the core of these conflicts. Hence, this study endeavours to unravel the underlying factors exacerbating





tensions, paving the way for informed decision-making and proactive solutions to mitigate these issues. Employing sophisticated modelling techniques and diverse data collection methods, this research aspires to construct a robust framework for understanding and managing human-wildlife conflicts. Ultimately, the aim is to foster sustainable practices that ensure harmonious coexistence between local communities and the diverse wildlife inhabiting these critical ecosystems. Through this comprehensive effort, the research seeks to contribute significantly to addressing human-wildlife conflicts. By identifying causal factors and providing nuanced insights, it aims to lay the groundwork for sustainable practices promoting the peaceful cohabitation of communities and wildlife, ensuring the preservation of biodiversity and ecological balance.



## HEALTH



*Inhalation of medicinal smoke from folk herbal drugs in Kenya*



## **The Role of Media During COVID-19 Global Outbreak: A Conservation Perspective**

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The COVID-19 pandemic is fast driving the ways of life and economies. In this study, we used Zimbabwe as a case study to assess how different forms of media are being utilised to access information of the COVID-19 disease (across age, educational level, and employment status). We investigated people's perceptions of the origins of COVID-19, its implication on the continued consumption of meat from wildlife species by humans, and management strategies of wildlife species that harbor the coronavirus. We gathered 139 responses using an online structured questionnaire survey. Social media platforms were used to acquire information on the COVID-19 pandemic when compared to traditional sources (television, radio, and newspapers). Most respondents thought that the COVID-19 virus was created by humans (n=55, mostly the young and middle-aged) while others believed that it originated from animals (n=54, mostly middle-aged with postgraduate qualifications). The majority (73%) of respondents who cited COVID-19 origin as animals also supported a ban on consumption of meat from the species. The middle-aged respondents (in comparison to the young and older respondents) and those who were employed (compared to the unemployed) were more likely to support the ban in wildlife trade. The likelihood of visiting wildlife centers given the consequences of COVID-19 was significantly lower in the old-aged respondents when compared to the young and the middle-aged respondents. Our results emphasize the need for science to penetrate social media circles to

provide appropriate information. The observed perceptions about visiting wildlife centers could negatively impact conservation funding.

## **A Youth is Sufferer: Navigating Youth Development Challenges and Charting Pathways to Solutions in Kenya**

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The youth population bulge in Kenya comes with so many challenges such as poverty, gender inequalities, political inequities, the absence of adequate health and medical resources, low educational attainment, homelessness, increased involvement in violence, drugs, and alcohol, poor physical and mental health, a lack of key life skills, premature sexual involvement. Using inductive or "bottom up" thematic analysis, we explored experiences of the youth aged 18-35 (n=36), youth workers (n=26) and administrators of youth programs (n=22) on the challenges and existing programs of positive youth development. Six key findings from the study sufficed as follows: (1) the mismatch between education and job skills: a degree without skills and talent is meaningless; (2) promoting youth development through creative arts and talent development programs; (3) leveraging on entrepreneurship to curb socio-economic barriers of the youth; (4) empowering youth: navigating reproductive and sexual health; (5) navigating psycho-social challenges and fostering youth empowerment; and (6) overcoming political tribalism and strengthening youth services. We provide the challenges and illustrate existing PYD programs to address the same. Implications



for PYD research and practice are discussed.

**Indigenous Medicinal Practitioners in Ethiopia: A Case Study of Herbal Medicinal Pharmacies, Clinics, and their Human Herbal Remedies in Addis Ababa**

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The study seeks to explore and examine the prevalence and utilization of herbal medicinal practices in the present-day urban environment of Addis Ababa by focusing on selected licensed herbal medicinal practitioners and evaluate the cultural policy of Ethiopia in line with indigenous knowledge and indigenous medicine development perspective. The research questions of the study include: how long have you been practicing indigenous herbal medicine in Addis Ababa? Have you used or sought treatment from indigenous medicinal practitioners in Addis Ababa? And how would you describe the current cultural policy of Ethiopia regarding indigenous knowledge and medicine development? The research design of the study follows an observational research design, specifically descriptive and exploratory case study research. It aims to explore and describe the prevalence and utilization of indigenous medicine in Addis Ababa, while also evaluating the cultural policies of Ethiopia in relation to indigenous knowledge and medicine. The primary research approach of the study is qualitative; specifically, it employs an ethnographic research approach to explore the prevalence of indigenous medicinal practices in Addis Ababa. The proposed research will employ in-depth interviews, key informant interviews, case studies, and non-participant observation methods to gather a comprehensive

understanding of indigenous medicinal knowledge and practices in the city. Addis Ababa, as an urban center, may have a different cultural landscape compared to rural areas. While it may not have specific indigenous communities in the traditional sense, it is home to the cultures of the diverse indigenous ethnic groups and peoples of Ethiopia including indigenous medicine. Indigenous medicine in Addis Ababa offers alternative treatments for various ailments, i.e. digestive, respiratory, musculoskeletal, skin, women's health, and chronic ailments like diabetes, hypertension, cardiovascular diseases and other viral diseases. Despite its existence and continued use over many countries and by more than 90% of the population in the Great African Rift countries, and its popularity and extensive use during the last decade, in urban areas indigenous medicine has not been officially recognized in most countries. Consequently, education, training and research in this area have not been accorded due attention and support. This research represents a relatively new area that has emerged from the widespread use of indigenous medicines in urban areas. It prioritizes national and regional development goals. Thematically the study will have to scopes. The first thematic scope of the study will explore and examine the prevalence and utilization of herbal medicinal practices and the indigenous medicinal knowledge of selected herbal practitioners licensed by Addis Ababa Bureau of Health and users of the herbal medicine in the city. The second thematic scope of the study will evaluate the cultural policy of Ethiopia in line with indigenous knowledge and indigenous medicine. The general format of the study consists of five chapters; and present's different cases including my personal account to search for the indigenous COVID-19 herbal medicine during the out brake of the pandemic in Addis Ababa from the



forgotten Ethiopian herbal plants in the ministry of culture and tourism of Ethiopia. The emerging health challenges in the Rift are greatly preventable by the local knowledges of the people in collaboration with allopathic medicine by developing and exploring solutions from the indigenous medicine.

### **Water Quality and Quantitative Microbial Risk Assessment in Shared Wetlands: case study of Narok West Subcounty, Kenya**

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Access to quality and enough freshwater is a global concern. Arid and Semi-Arid Land (ASAL) regions of Kenya, the horn of Africa and the global south continuously face strains on the available surface water, a trend intensified by adverse weather patterns and climate change. The regions available surface water points are mostly collectively used by humans, livestock, and wildlife. Utilizing mixed methods of aseptic water sampling, membrane filtration, differential bacterial characterization, culturing and counts, we examined wet season faecal bacteria loads across 25 waterpoints within the heterogeneous landscape in Narok West Subcounty, to establish their suitability for human consumption and status of hydroecosystem health. The study revealed that majority of the shared water points in the landscape are contaminated, with high microbial pollution loads comprising of *Escherichia coli* (*E. coli*) and total coliform colony (MPN/100ml) counts above recommended water safety standards. These pathogens of public health concern, when ingested, can manifest in form of abdominal cramps, vomiting, bloody diarrhoea, and death. The high number of these waterborne pathogen counts in the waterpoints are plausibly attributed

to surface run-offs, environment contamination (open air defecation) and soiling by livestock and wildlife. This is exacerbated by the pathogen's environmental survival ability in the waterbodies, a trait that can lead to virulent mutations and zoonotic epidemics of public health concern. The high number of bacterial pathogens counts in these waterpoints at a microscale, potentially predispose Narok West Subcounty residents and adjacent communities to increased incidents of morbidity, compromised health and death; financial strain; and increased incidents of zoonotic antimicrobial resistance bacterial infections. The findings at a microscale, highlight the need for continuous ecological and public health monitoring on water quality status and interdisciplinary community awareness in line with a myriad of county, national, regional, and global development, and health agenda. We recommend community continuous awareness and engagement in i) reducing waterpoint contamination and establishing zonation of use; ii) improving ecosystem health awareness within upstream, midstream, and downstream communities; iii) reducing community waterborne diseases through portable water provision; iv) efficacy testing of remedial *E. coli* antimicrobial therapeutics in the shared landscape; and v) genetic characterization of antimicrobial resistant strains identified.

### **The Invasive Alien Species Assessment and their Control: A Global Concern and Threat to Biodiversity**

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The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is an independent



intergovernmental body comprising over 143 member Governments and States. Established by Governments and States in 2012, IPBES provides policymakers in Governments, the private sector and civil society with scientifically credible and independent up-to-date assessments about the state of knowledge regarding nature and the contributions it provides to people, as well as options for actions to protect and sustainably use these vital natural assets as better evidence-informed policy decisions and action at the local, national, regional and global levels. The Invasive Alien Species Assessment was carried out for 4 years by a multidisciplinary team of 86 selected world experts from all regions of the world (from 49 countries), including assistance from 200 early career fellows contributing as authors. More than 13,000 scientific publications were analyzed as well as a substantive body of Indigenous and local knowledge. The assessment summary was accepted and approved for policymakers by IPBES Plenary composed of 143 member States at its tenth session held from 28th August to 2nd September 2023 in Bonn, Germany (IPBES 10, Bonn, Germany, 2023).

The Assessment provides the best-available evidence, critical analysis and options for governments, states, civil society, Indigenous Peoples and local communities, the private sector and all those seeking to address the issue of **biological invasions**. The Assessment highlighted that invasive alien species are a major and growing threat to nature, nature's contributions to people, with, in some cases, irreversible changes to biodiversity and ecosystems. Invasive alien species also dramatically impact the

economy, food security, water security and human health, sometimes adding to marginalization and inequity. The Assessment demonstrates that with sufficient resources, political will, and long-term commitment, preventing and controlling invasive alien species are attainable goals that will yield significant long-term benefits for people and nature.

### Sero-Prevalence and Risk Factor of Infectious Bovine Rhinotracheitis Virus (Type 1) in Meru County, Kenya

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Infectious Bovine Rhinotracheitis (IBR) is a multi-organ disease of significant economic importance worldwide caused by Bovine Herpes Virus-1 (BHV-1), and it affects both domestic and wild ruminants. Bovine Herpes Virus-1 is a virus of the genus *Varicellovirus*, subfamily *Alphaherpesvirinae* and *Herpesviridae*, and is a highly contagious and infectious virus. Infectious Bovine Rhinotracheitis in bovine animals is caused by BHV-1.1, the respiratory subtypes, while strain BHV1.2a and BHV-1.2B are the genital subtypes, and BHV-1.3 is the encephalitic subtype. The aim of the study was to determine the antibody sero-prevalence of Bovine Herpesvirus-1 which cause Infectious Bovine Rhinotracheitis (IBR) and to identify risk factors associated with BHV-1 antibody seropositivity among smallholder dairy farms in Meru County, Kenya. A cross-sectional study was conducted in Naari area of Meru County, Kenya between September - October 2016 and March-April 2017. The 149 farmers were randomly selected from members of the Naari Dairy Farmers



Cooperative Society who were actively delivering milk to the society at the time of the study. Serum samples were obtained from 403 female dairy cattle. Farm level management and animal factors were collected through direct interviews with the owner or someone who was knowledgeable about the animals. All serum samples were processed with an indirect enzyme-linked immunosorbents assay (gB ELISA) to determine the presence of antibodies to BHV-1. The overall farm-level and animal-level seroprevalences of BHV-1 antibodies were 30.9% (95% CI: 23.6%-39.0%) and 17.4% (95% CI: 13.8%-21.4%), respectively. In the final multivariable analysis, the factors significantly associated with BHV-1 antibodies included; age of the cattle (OR=1.200, p=0.001), age of the principal female farmers (OR=0.182, p=0.001) and rearing goats on the farm (OR=26.77, p=0.000). There was a significant interaction between rearing goats on the farm and age of the dairy cattle (p <0.010); younger cattle seemed to have been exposed to BHV or cross-reacting caprine herpesvirus when goats were on the farm. The results showed that BHV-1 was circulating among the cattle population in the Naari area of Meru County. Given that there is no BHV-1 vaccination use in the study population, training on the importance of biosecurity and vaccination for BHV-1 are recommended to reduce the transmission and impacts of BHV-1.

#### **Investigation of the suitability of the selected edible plant(s) as pathogen removing agent from drinking water**

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Access to lean water is essential for human well-being, yet global challenges like climate change,

Water resource competition, and contamination threaten its availability. With only 10% of Earth's Freshwater easily accessible on the surface, reliance on groundwater, particularly through wells, is crucial for an estimated 1.5 to 3 billion people, especially in developing countries. However, groundwater sources in countries like Kenya, Uganda, and Tanzania face increased contamination risks from microorganisms and pollutants. Traditional water sources, considered safe, are now compromised by coliforms and E. coli, affecting around 50% of the African population and hindering progress toward Sustainable Development Goal 6. In rural Tanzania, people often turn to cost-effective sources like shallow wells, hand-pumped tube-wells, and streams, which are vulnerable to pollution, leading to waterborne diseases like gastroenteritis. Waterborne diseases pose severe consequences, impacting vulnerable populations with financial burdens, reduced productivity, and strained healthcare systems. While various water treatment methods exist, many are costly and require expertise. Natural plant extracts, acting as biocoagulants, show promise in removing turbidity but need further research for eliminating waterborne microbes. The primary emphasis of this research is on exploring the capacity of the chosen edible plant roots to eliminate pathogens from drinking water sourced from shallow wells in Tanzania. The specific plant species was selected due to its accessibility, established traditional use, availability in the market, and its potential for removing pathogens. This investigation into the plant aligns with its environmentally friendly characteristics and economic viability, with the overarching goal of enhancing the quality of drinking water in rural Tanzania.



## Antimycobacterial Activity, Phytochemical Profile, and Molecular Docking of *Albizia zygia* (Dc.) J.F. Macrb, Used in Treatment of TB in Kenya

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Tuberculosis (TB) is the most prevalent infectious disease after COVID-19. Medicinal plants have reportedly been used to treat TB and multidrug-resistant TB (MDR-TB) in East Africa. However, they have not been evaluated for antimycobacterial activity. The present study examines the antimycobacterial activity, cytotoxicity, synergistic interactions, phytochemical profiles, and an *in-silico* study of the root bark of *Albizia zygia* (Dc.) J.F. Macrb. Plant material was extracted using organic solvents and water. Antimycobacterial activity was conducted using MABA, cytotoxicity performed using MTT assay, Checkerboard assay was used to determine synergistic interaction, chromatographic techniques were used for phytochemical profiling and, molecular docking and ADMET was performed using Schrodinger 2023. The  $CC_{50}$  of the tested extracts was  $>1000$   $\mu\text{g/mL}$  (non-cytotoxic), except for the dichloromethane extract with  $82.59 \pm 00$   $\mu\text{g/mL}$  (moderately cytotoxic). The  $MIC_{99}$  of methanolic and aqueous extracts was  $625 \pm 0$   $\mu\text{g/mL}$  and  $2500 \pm 0$   $\mu\text{g/mL}$ , respectively. Hexane, dichloromethane, and ethyl acetate extracts were inactive. The methanolic and aqueous extracts exhibited synergistic (FICI of 0.5) and additive (FICI of 0.75) interactions, respectively. GC-MS detected phytochemicals by docking with 3AR4, 3PTY, 3ZXR, 4OW8, 5KWA, and 3V3Y *Mycobacterium tuberculosis* target proteins. 4H-Pyran-4-one, 2,3-dihydro-3,5-dihydroxy-6-

methyl, 7-ethyl quinoline, 2,4-di-tert-butylphenol, diphenyl sulfone, 1,3-dichlorobenzene, exhibited strong to moderate interactions with appropriate ADMET prediction properties. *A. zygia* contains phytochemicals with antimycobacterial activity. These findings provide scientific evidence for the ethnomedicinal knowledge and use of *A. zygia* for the treatment of TB and its associated symptoms by Kenyan practitioners. However, further *in vitro* and *in vivo* studies are needed to be performed on individual compounds for validation.

## Improving nutrients availability of high fluoride laden manure in the rift for sustainable crop production

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Manure in some parts of the rift and nearby areas is being discarded due to the fact that it is not productive when applied in farms. Small holder farmers and vegetable growers import manures from nearby villages which is costly. The research was carried out to understand what locks the manure and or nutrients within it and how to defluoridate it. Experiments were carried out using anaerobic digestion, where the conditions within the digesters and fortificants facilitated the defluoridation. The manures were characterized using some tools and instruments to understand the mineralogical contents and forms. During the process, while manure is being defluoridated, clean energy in the form of biogas as a byproduct is being produced which lessens the pressure in the forest nearby where households would go for firewood and charcoal.





### **Determination of the purity of honey sold in Narok town and its environs**

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The objective of this study is to determine the levels of glucose and fructose in honey from narok county. Honey is obtained from three regions; the maasai bee keeping farm, local bee farming group and the maasai honeyhawkers. The sugar content profile of honey is analyzed for glucose, fructose, and sucrose contents; reducing sugars; the sum of fructose and glucose; and the ratio of fructose to glucose. All data will be statistically analyzed using one-way analysis of variance (ANOVA), and significant differences between the means were identified with Duncan's multiple range test (DMRT).

A significant effect on glucose and sucrose contents, and reducing sugars, but not on the sum of fructose and glucose ( $p > 0.05$ ). In addition, region had a highly significant effect on fructose content and the ratio of fructose to glucose. Honey from the Faculty of maasai bee keepers is expected to have the highest sugar content profile compared with the honey from local beekeepers and the hawkers.

### **Assessment of Water Quality from Water Browsers in Narok County: A Case Study of Gate D Estate**

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For a third-world country like Kenya, the health hazards linked with Bowser's water quality are unclear. One of the key concerns in developing countries is the availability of safe drinking water. The study aimed to analyze the physical, chemical and biological quality of the water provided by water browsers in Narok County to residents of Gate D estate near Maasai Mara University. Water samples were obtained using a simple random sampling procedure from six water browsers using sterilized plastic bottles

prepared before sampling, labeled, and kept in a cool box for transportation to the laboratory for analysis. Physico-chemical parameters were measured using laboratory equipment in the Maasai Mara chemistry laboratory. PH levels range from 4.387 to 4.812 with Bowser 5 recorded the highest. TDS values vary from 400mg/l to 1800mg/l, TSS ranges from 200mg/l to 600mg/l, Electrical conductivity values vary from 141.03ms to 168.9ms and dissolved oxygen ranges from 5.16mg/l to 9.84mg/l with Bowser 3 with the highest value which is within the permissible standard of 5-9.5mg/l. Microbiological parameters such as TC I (cfu/100ml) and FC were measured in the NARWASCO lab using Membrane Filtration techniques. Total coliforms vary from 0cfu to 28Cfu with Bowser one recorded as the highest value. Fecal coliform (*E. coli*) varies from 0 Cfu to 20 Cfu with the highest value from Bowser one as it's above the permissible limit by the WHO of 0cfu per 100ml of water, it should not be detected in any drinking water. Residents of Gate D estate in Narok County were requested to fill out questionnaires to obtain primary data about their awareness of water quality and its influence on their health. In the gate D estate, a pilot study comprising nine surveys was delivered using a basic random sample technique. Cronbach Alpha test was used to determine reliability at a level of 0.7. The Statistical Program of Social Sciences (SPSS) Version 25 was used to evaluate descriptive and inferential statistics. To test hypotheses, inferential statistics such as Pearson Product Moment Correlation Coefficient (PPMCC) and Multiple Linear Regression Analysis were used. Tables and pie charts were used to illustrate the data. In descriptive statistics, the mean of the values was recorded. The study recommended Education and awareness to the residents and routine inspections of the water Bowser's by the WRM of Narok.



## Assessing the Health Hazards Present in Open-Air Markets and The Effects They Pose; A Case Study of Markets in Narok Town

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The growth of open-air markets has been rising both globally and locally. However, these open-air markets are associated with various health hazards that pose threats to the public health and the entire environment. This study aimed to identify the health hazards in the two major open-air markets in Narok, ODM and Muthurwa open-air markets and the health effects they pose. The study was carried out for three months and involved thirty-four participants. The objectives for this were to determine the public health hazards and risks in these markets, how these hazards affect the health of people working in these open-air markets, to determine the levels of knowledge and awareness of public health standards and requirements among the market and to suggest possible recommendations on how to improve the working conditions in these open-air markets. A descriptive cross-sectional study design was used where a semi-structured questionnaire was administered to the target population and was duly filled. Approximately 75% of the respondents agreed that health hazards are present in the markets, which put them at a high risk for diseases. Although a few people in the markets are aware of the public health standards, there is still inadequate information, and the levels of awareness need to be improved in these markets. 80% of the respondents agreed on the need to improve the working conditions of these markets to address these challenges. This study concluded that these major open-air markets in Narok town face many challenges that affect the human health of individuals involved in these markets. It is thus essential for all the involved stakeholders to adopt relevant measures that will mitigate the

challenges in these markets. It was recommended that similar studies be conducted in other open-air markets in the country to compare the results with the findings of this study. As a town in the Rift region, Narok illustrates the unique environmental and socio-economic dynamics that require understanding and mitigating these hazards to safeguard public health and the Rift's ecological integrity. The findings from this study can inform targeted interventions and policies to promote healthier and more sustainable market environments, aligning with broader conservation, environmental, and human health objectives in the region.

## Assessment of essential mineral nutrients in selected indigenous and exotic vegetables from Murang'a and Kisii counties, Kenya

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Minerals and nutrients play a vital role in human body which includes resistance to diseases. Leafy vegetables are a key source of vitamins A, C and E, trace metal nutrients like calcium, copper, iron, sodium therefore consumption of foods and vegetables that are nutritious is essential for good health. Different vegetables have different taste, leaf shapes, color and mineral composition. There are two types of vegetables, that is indigenous and exotic vegetables with indigenous termed as local and exotic termed as foreign. Indigenous vegetables fetch a higher price in both rural and urban markets compared to the exotic vegetables. This has directly impacted indigenous vegetables which are underutilized due to lack of their mineral nutrition values. However, nutritionists and health experts have highly recommended use of these indigenous vegetables due to their high nutrition values compared to most of the exotic vegetables which are less nutritious. This study



will determine the presence and the levels of essential mineral nutrients bio-metals (trace metal nutrients Cu, K, Na, Ca, Zn, Mg, Fe, Co), primary metabolites (glycoproteins, proteins, vitamin A, carbohydrates, antioxidants (vitamin E, C and K)), secondary metabolites phytochemicals (alkaloids, flavonoids, polyphenols, steroids) and non-essential mineral nutrients (heavy metals Cd, Cr, Pb, Mn, Ar, Hg) in selected vegetables African nightshade (*Solanum villosum*), Spider plant (*Cleome gynandra*), Malabar spinach (*Basella alba*) and Spinach (*Spinacia oleracea*) using wet chemistry, Induced Coupled Plasma (ICP) spectrometer.

### **Climate Change Influence on Rift Valley Fever and its Implication for Regional Development: A Review of Literatures**

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Climate change affect the distribution and abundance of competence vectors of Rift Valley Fever (RVF). The study consider the prevalence, effect and control of RVF and the results was analysed using in-depth literature review. The climate tolerance limits of vector to colonise new ecosystems affect the distribution of vector-born disease. RVF is expanding beyond the region because of the changing climate, the increasing rainfall intensity, temperature, humidity events within the rift valley region influence pathogens' or vectors' metabolic processes, hatching episode of Aedes mosquito resulting to large vector population. Flooding of macro and micro depressions serve as good habitats for *Culex* and *Anopheles* (epizootic vectors) which were intensify by climate change. The effect of RVF were; mortality in animals (sheep, goat and cattle), reduction in the household income from livestock's sales, increase food price which affect

purchase and consumption of inadequate food items such as declined flesh-meat consumption, cheap food that have potentially low nutrition outcomes. It causes health challenges to human illnesses, livestock abortions and neonatal death. The sickness negatively impacts livestock producers, traders, casual labour's and butchers were seriously affected by imposition of slaughter bans during the period of outbreaks, even the government lost a lot of revenue in the region and COVID 19 surge delayed testing and patient care. The control RVF include; immunization/ vaccination of all susceptible of animals prevent infection, pre-treatment of mosquitoes habitat, placed restriction on the movement of animals during epizootic and mosquito proof sheds, livestock moved from low lying areas to well drain and winds wept pastures of higher altitude, reduce exposure of neonates to biting Aedes, use of pesticides by directly targeting flying or resting adults mosquitos', use of local communities in surveillance, trapping of larvae, genetic control of Aedes mosquitos and continues viral hemorrhagic fever surveillance in the region. The study builds resilience among the people through developing more effective and efficient control strategies and also how to restore market chains system within the region. The work proffer local means of creating awareness on outbreak of RVF in the region. The study recommends integration of veterinary and human medicine solutions such as development of human vaccine and medical care for RVF, broad and interdisciplinary collaborations, introduction of more natural enemies to the habitat in other to control the growth and spread of the mosquitos that cases RVF within the study areas and quarantining the infected animals and humans and also use of facemasks, hands globs and washing of hands with sanitizer by those coming in contact with the infected animals.



## Removal of Antibiotic Sulfamethoxazole from Water using Zeolite/Bi<sub>2</sub>O<sub>3</sub> Nanocomposite: A means of antimicrobial resistance control

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In recent times, there have been reports of antibiotic resistance cases from various hospitals in the Rift Valley region. The consumption of water-containing antibiotics, such as sulfamethoxazole by humans and animals, has been identified as a major cause of antibiotic resistance in the area. This has led to the development of antibiotic-resistant bacteria and the spread of antibiotic-resistance genes over time. Antibiotics have entered surface water, which serves as a source of drinking water for the Rift Valley region, through various channels, including the dumping of unused antibiotic drugs into water bodies. Conventional water treatment methods are not specifically designed to remove sulfamethoxazole from water. Therefore, there is a need to address this issue by utilizing zeolite-based materials as adsorbents for water treatment, taking advantage of the availability of natural zeolite in the Rift Valley. As a response to this need, this study developed Zeolite/Bi<sub>2</sub>O<sub>3</sub> nanocomposites to remove sulfamethoxazole from water using Response Surface Methodology (RSM). The removal process in an aqueous solution achieved a maximum efficiency of 100%. Subsequently, testing with real water samples confirmed the efficiency of the Zeolite/Bi<sub>2</sub>O<sub>3</sub> nanocomposite in removing sulfamethoxazole. This study holds significant importance for the Rift Valley region as it addresses a pressing issue of antibiotic resistance caused by the consumption of water-containing antibiotics. By developing an efficient method to remove sulfamethoxazole from water using

locally available zeolite-based materials, this study offers a practical solution tailored to the specific needs of the Rift Valley, potentially improving the quality of drinking water and contributing to the mitigation of antibiotic resistance in the region.

## A 2-Year Retrospective Assessment of Dog Bite Cases Reported at Narok County Referral Hospital, Kenya

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Rabies is a significant zoonotic disease with a global health burden estimated at 59,000 deaths annually. It is listed among the top 3 priority zoonotic diseases in Kenya. Human-animal bite injuries are a serious public health concern due to their associated risk of rabies virus exposure. Animal bite injuries, especially dog bites are useful proxies for assessing the risk of rabies transmission. The main objective of this study was to estimate the frequency of dog bite cases reported in Narok County Referral Hospital and obtain information on the demographics of dog bite patients. The review was to complement other baseline activities as precursors to the implementation of future rabies vaccination and spay-neuter campaigns. Outpatient and anti-rabies vaccine registers were assessed for the period October 2018 to September 2020. Data on age, sex, area of residence and administration of rabies virus Post Exposure Prophylaxis (PEP) was extracted and subjected to descriptive analysis. A total of 112 dog bite injuries were reported. The proportion of children bitten was relatively higher than that of adults. Male victims (58.9%) were more than female victims (41.1%). Most of the dog bite cases were from Narok North sub-county. The median age for dog bite victims



was 13 years. The monthly arithmetic means for bites falling within the years 2018-2019 and 2019-2020 were 4.8 and 4.6 respectively, the difference was not statistically significant,  $p$  value= 0.86. Quality issues were elucidated regarding the records accessed, parameters such as date of bite, site of the bite, and status of administration of PEP, were not indicated. Public health education on responsible dog ownership should primarily target children below the age of 15. Health facilities should improve the quality of records to facilitate monitoring and the development of a more robust epidemiological picture.

**A Study on Gross Pathological Lesions and Resultant Economic Losses of Slaughtered Cattle in Kiharu Abattoir, Murang'a County, Kenya**

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Cattle production is an important economic activity in Kenya, but not fully maximized due to losses from disease conditions, some causing condemnation of organs at slaughter. This study aimed at identifying the frequency of gross pathological lesions in cattle slaughtered in Kiharu slaughterhouse Murang'a County and to estimate the associated financial losses. The study was carried out in two phases involving a retrospective desk study (from 2016-2020), followed by a cross-sectional study (from 11th January 2021 – 12th March 2020). Data from slaughterhouse records were retrieved, causes for condemnation recorded and monetary values of the condemned organs estimated in the retrospective study. The cross-sectional study involved postmortem inspection of the slaughtered carcasses, eviscerated organs, and gross examination of the condemned organs.

Weights of condemned organs were measured and using their prevailing market prices, the respective financial loss was estimated. Descriptive statistics were used to summarize the data. Retrospective desk study results showed that out of 16,434 cattle slaughtered between 2016 to 2020, 1221 (7.4%) organs were condemned mainly due to parasitic conditions, inflammatory conditions 427 (2.6%) and circulatory disturbances 789 (4.8%). The total direct financial losses incurred during the 5-year period was Kenya shillings (KShs.) 3,663,947 (US\$ 36,276.7), with a mean annual loss of KShs. 732,789.4 (US\$ 7254.54). In the cross-sectional study, 146 out of 200 (76%) cattle slaughtered had one or more organs condemned. On characterization, parasitic infestations [*hepatic fasciolosis* 40 (20%), circulatory disturbances (infarcts) 9 (4.5%), (telangiectasia) 6 (3%) and lung *emphysema* 37 (18.5%) were the major causes. *Fasciola gigantica* were identified morphologically as the cause of hepatic Fasciolosis. As a result of these condemnations, a total of KShs. 158,396 (US\$ 1568.3) losses were incurred. In conclusion, organs were condemned mainly due to parasitic and inflammatory conditions and laboratory methods if used, would be helpful in ascertaining the causes. Many organs were condemned at slaughter due to controllable parasitic, bacterial and conditions associated with poor slaughtering techniques; causing wastage of edible organs and heavy economic losses for the livestock industry. The occurrence of hepatic fasciolosis and *Hydatidiosis* suggested a possible transmission of the zoonotic agents to humans. The study recommends dissemination of the findings to all stakeholders and enhanced sensitization to farmers on measures of controlling the conditions at farm level and sensitization of slaughter workers on proper slaughter techniques to reduce



losses in slaughterhouses. Further research is needed, employing more advanced methods like molecular techniques to determine a possible transmission of zoonotic diseases including *Hydatidiosis* and *fasciolosis* to humans.

### **Emerging challenges in human and other animal health in the Rift**

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Soil microbiology has been been a part of major discoveries that have aided in conserving the integrity of soil microorganisms. Microorganisms in the soil play two major roles that is decomposition and cycling of soil nutrients that increases plant growth promoting factors. Studying soil microorganisms has enabled the improved on soil care generally diverging agriculture trends from the conventional methods of dumpening soil with synthetic chemicals to increase plant productivity. The aim of the project was to study rhizospheric bacteria in the Maasai Mara University botanical garden citrus orchard. A number of microorganisms were identified during the research and hence the research can be used as a way of recommending safer option contrary to the use of synthetic chemicals used in the citrus orchard. The aim of the study was to isolate and characterize bacteria from the rhizosphere of the citrus orchard from the Botanical Garden Maasai Mara University. The aim of the study was to learn the diversity of bacteria associated with the rhizosphere soil at different regions. The study was effective in the determination of the different genus found within the rhizosphere in addition to the use synthetic fertilizers on the citrus orchard. Samples were collected from the orchard based on different levels which were the following; 0 inches from the periphery of the plant 5cm deep, 5inches away from the periphery of the plant 5cm deep and 10

inches away from the plant periphery 5cm deep. Samples were aseptically collected and put in brown bags then transferred to the laboratory for action The soil samples were serially diluted and inoculated onto nutrient agar plates from which distinct colonies were obtained and isolated to obtain pure cultures. Pure isolates were characterized on the basis of physical and biochemical tests such as; gram test, indole test, catalase test, citrate utilization test, oxidase test, and sugar fermentation test. Data collected from the laboratory tests was then analyzed and reported in tables and charts. ANNOVA test was then used to determine that the diversity of microbes in all the different regions were equal and the same regardless of the criteria of sample collection.

### **Breaking Taboos, building a Future: Analyzing Youth and Women's Knowledge and Attitudes towards Humanure for Circular Sanitation Economy in the Kenyan Rift**

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Despite the pressing need for sustainable sanitation solutions in the Kenyan Rift, there exists a significant gap in understanding the knowledge and attitudes of youth and women towards the recovery and utilisation of humanure and fecal waste within the context of a circular sanitation economy. The prevailing taboos and myths surrounding human waste management contribute to the persistence of inadequate sanitation practices, posing challenges to the region's environmental sustainability, public health, and overall well-being. This study aimed to investigate the existing knowledge and attitudes among youth and women in the Kenyan Rift (particularly in Kajiado County) concerning humanure and fecal waste recovery methods and their potential incorporation into a circular



sanitation economy. Understanding the socio-cultural factors, taboos, and community dynamics that influence these perceptions is crucial for the successful implementation of sustainable sanitation practices in the region. Key facets of the problem include of the current study included the following;

- Cultural taboos and stigmas surrounding human waste treatment and recovery: unexplored cultural taboos and stigmas surrounding humanure and fecal waste may hinder the adoption of innovative sanitation solutions. This study seeks to identify and address these cultural barriers to promote community acceptance and participation.
- Knowledge gap and awareness; the level of awareness and understanding among youth and women regarding the benefits, risks, and technical aspects of humanure and fecal waste recovery remains unclear. Bridging these knowledge gaps is essential for fostering informed decision-making and encouraging sustainable sanitation practices.
- Gender dynamics: Gender-specific roles and responsibilities may influence the perceptions and involvement of women in sanitation initiatives. Examining the gender dynamics in the context of circular sanitation economy initiatives will contribute to developing targeted strategies that consider the unique needs and contributions of women. In the context of the current study, a particular interest was attributed to the Maasai Community in Kajiado County, and how their unique gender dynamics influence perception of human waste treatment and recovery.
- Youth engagement: The youth demographic, being a key driver of societal change, plays a pivotal role in shaping the future of sanitation practices. Analyzing the attitudes of young individuals towards humanure and fecal waste recovery is essential for designing

interventions that resonate with this demographic.

- Implementation of circular economy in the Kenyan Rift: Understanding the challenges and opportunities associated with integrating humanure and fecal waste recovery into a circular sanitation economy is critical for formulating effective policies and interventions. This study aims to identify actionable insights that can inform sustainable development initiatives in the Kenyan Rift.

By addressing these aspects, the research sought to provide a comprehensive understanding of the knowledge and attitudes of youth and women towards humanure and fecal waste recovery, ultimately contributing to the development of culturally sensitive and community-driven strategies for sustainable sanitation in the Kenyan Rift.



## COSMOPOLITICS



*Women from the Mursi community in Omo Valley, Ethiopia*





## Inter-Ethnic Conflict Resolution Through Cultural Norms and Practices in Laisamis Sub-County, Marsabit County, Kenya

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Ethnic communities violently compete for property, rights, jobs, education, language, social amenities and good health care facilities. These conflicts have caused loss of life and property, human displacement, cattle rustling and slow socio-economic growth. Indigenous conflict resolution strategies emphasize empathy, sharing, and cooperation in coping with common challenges, emphasizing the essence of humanity. This study sought to investigate how cultural factors enhance inter-ethnic conflict resolution in Laisamis Sub-county, Marsabit County in Kenya. Specifically, the study used mixed research design. The target population constituted 292 leaders of Laisamis Sub-county. A sample of 123 respondents was selected using both purposive and simple random sampling methods. The study used a questionnaire, key informant interview schedule and focus group discussions guide to collect data. Response from key informant interviews and focus group discussions were organized into themes and analyzed qualitatively. The findings were presented using frequencies and percentages. The results indicated that cultural factors do indeed enhance inter-ethnic conflict resolution in the study area.

### The Politics of Magic in the Kilimanjaro Region

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The practice of nungu among the Chagga, Meru, Arusha and Maasai people in the Kilimanjaro region is a widespread tradition that relates to

different spheres of social life and politics. The nungu, a clay figurine or a round shaped stone object is used to either recover stolen property or protect land from wrongdoings. Christianity, modernization and other factors all affected the use of these objects in the past hundred years and what we see today is a net of tradition that covers a certain area and emerges as a creative and constitutive practice. The Museum of Ethnography, Budapest accommodates a collection of these objects from the end of the early XX. century, and this collection raises several questions that researchers try to answer. What role objects played in a non-formal political decision making before the advent of Christianity and how larger religions integrated and eliminated the nungu's superhuman power. How the related rituals still reproduce the social environment in these communities and what kind of new meanings, conventions and intentions emerged in the past decades related to nungu rituals. In this presentation I try to discuss some of the issues emerged in our research related to the politics of religious rituals in the Kilimanjaro region, Tanzania.

### Safeguarding Our Shared Heritage: A Comprehensive Study of Cultural, Human, and Wildlife Contributions to Biodiversity Conservation in the Rift

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This communication aims to revisit a longstanding dialogue between West Africa and East Africa centered around the concepts of age and generation. I will draw on the ethnography of the Bassari (Guinea), where I have been working for about fifteen years, hoping that a reasoned generalization of this particular case opens up comparative avenues towards East Africa. The



comparison between West and East Africa has long focused on the varying propensity of age and/or generation to establish themselves as a political institution (Bernardi 1985, Peatrik 1995). Beyond the classic opposition between age-grade systems in West Africa and generational systems in East Africa, I aim to focus the analysis on the pragmatic conditions of these modes of social organization. In the case of the Bassari, age classifications, which segment the entire male and female population into six-year cycles, do not exist independently of the male initiation ritual that marks entry into the age-grade system. Additionally, periodically, different age collectives make their existence tangible by performing collective dances that echo the already experienced initiatory trials and replay age and gender distinctions in a non-discursive manner. These ritual and aesthetic devices should not be seen merely as expressions of pre-existing social organization principles but rather as a means to showcase and generate the overall coherence they are supposed to manifest (Gabail 2011). In other words, what I suggest here is an attempt to think together age institutions, ritual practices, and aesthetic devices, a perspective that has already proven fruitful in East Africa (Eczet 2019, Marmone 2017). Taking the sensory forms of age organizations seriously raises crucial heritage issues for societies themselves and prompts renewed anthropological inquiries into classical themes, especially regarding the ritual and political effectiveness of these aesthetic devices and the gender distinctions that traverse them. Some rituals and aesthetic performances take such imposing collective forms that their importance cannot be ignored: this is the case with male initiation among the Bassari or certain collective dances of young adults. Others, on the contrary, appear in a minor mode, involving only a few people, away

from the gaze of the majority. Should we conclude that they are less important because they are more peripheral, less heritage-worthy because they are more clandestine? Drawing on a few examples of Bassari female rituals (Gabail & Di Muro 2021), I will try to show that, despite being less ostentatious, these ritual performances are no less important for those who conceive and enact them, as well as for anthropologists attempting to understand them.

**Language as a tool for Environmental Awareness, Cultural Sensitivity, and Responsible Tourism Practices: Case of French for Tourism and Hospitality in Kenyan Universities**

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Through language, education can act as a transformative force, shaping individuals into informed and responsible members of society. This principle holds immense potential when applied to the ongoing research in teaching French as a foreign language, particularly within the context of tourism and hospitality programs in Kenyan universities. French is a compulsory subject for students enrolled in tourism and hospitality programs in most Kenyan universities, serving as a potential powerful conduit for instilling values beyond linguistic competence. Traditionally, the focus in the teaching of French for tourism and hospitality has been on equipping students with communication tools to meet the needs of francophone clients. Our ongoing research explores the dynamic leveraging of the French language to promote environmental awareness and responsible Tourism Practices among students. We integrate applicable content into linguistic, sociolinguistic, and pragmatic



skills, demonstrating the pivotal role educators play in using French to articulate the significance of preserving natural resources, protecting biodiversity, and mitigating the environmental impact of tourism. By intertwining linguistic expression with environmental advocacy, students enhance language proficiency while developing a heightened sense of responsibility towards the environment. The presentation argues for pedagogical strategies, interactive learning methods, and preliminary real-world applications in teaching French to students in tourism and hospitality programs. By demonstrating that environmental consciousness and responsible Tourism Practices can be integrated into the development of linguistic, sociolinguistic, and pragmatic skills, we aim to inspire educators to embrace a holistic approach in shaping the next generation of tourism and hospitality professionals. The ultimate goal is to empower students not only to read, write, speak, and listen in French but also to engage as responsible global citizens contributing to a sustainable and ethically conscious tourism industry.

**University community attitudes, knowledge, and perceptions towards vervet monkey *Chlorocebus pygerythrus* (F. Cuvier 1821): A case of Chinhoyi University of Technology campus, Zimbabwe.**

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Human and primate interaction forms one of the major forms of human-animal interactions in urban landscapes, providing recreational experiences and also a potential source of human wildlife conflict. We assessed the attitudes, knowledge, and perceptions of the community at Chinhoyi University of Technology, Zimbabwe towards *Chlorocebus pygerythrus*. A descriptive

questionnaire survey was employed using a semi-structured questionnaire. A total of 118 questionnaires were administered to university staff and students between March and June 2023. We analyzed the data in Statistical Package for Social Sciences (SPSS) version 23 using descriptive statistics. The Chi-square test was computed to interrogate the level of associations between community attitudes and perceptions and various socio-demographic parameters. Our results showed that 58% of the respondents had positive attitudes towards coexisting with the vervet monkeys on the university campus. The university community had mixed perceptions about the species, negatively perceiving them as threats (57%) while positively perceived them as beneficial (84%). We found a significant association between gender groups and the university community's attitudes and perceptions towards vervet monkeys,  $\chi^2(1, N = 118) = 6.00, p = 0.014$ . There was no significant association between community attitudes and perceptions towards vervet monkeys and other demographic attributes (program, occupation, age and period of stay). In order to promote human-monkey co-existence at the university campus, the community identified strategies for coexisting with *C. pygerythrus* at the campus, which include education and awareness (41%), establishment of a designated nature reserve (28%), translocation (49%) and legislation (25%). The study recommended education and awareness on coexistence with primates in urban landscapes. Further recommendation was made for infrastructure design to take into consideration the need to prevent easy access into rooms by the monkeys. Efficient waste management strategies should be crafted in order to reduce access of the species to food waste and littering of the university grounds. A legislative mechanism to discourage the provision of food to the species is also recommended.



## Securing Community Land Rights and Access for Climate Action: A Case of the Marginalized Indigenous Ilchamus Community in Baringo County.

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Unclear community land rights in Baringo County undermine access to land resources, promote land resource conflicts, and limit the marginalized Indigenous Ilchamus community ability to engage in livelihood activities and access to climate change adaptation and mitigation efforts. Land provides a means of living and a variety of uses including agricultural, social, economic, and human settlement among others. Over the years, land has remained the source of livelihood and life to Ilchamus community. It has become scarcer and subject of competition from the various uses within and without. Therefore, unclear land rights have persistently jeopardized community livelihood and nurtured competition for survival and promoted malpractices, which have occasioned displacement, perpetual conflicts, and dispossession of Ilchamus community from their own land. The scenario bred unpredictable circumstances that limits investments in sustainable land use practices as well as adoption of climate change mitigation and adaptation strategies. This is happening against the government land reform agenda including; the National Land Policy, the Constitution of Kenya 2010, the Land Act, 2012, the Land Registration Act, 2012, the Community Land Act, 2016 and National Land Use Policy. A survey

covering 323 households randomly sampled from four constituencies; Baringo South, Baringo North, Tiaty and Eldama Ravine in Baringo County, using Multinomial logit model to quantify the effects. Found out that unclear community land rights have promoted inter-community land resource conflicts, limited community from adopting sustainable land use practices, denied access to climate finance and reduced efforts to invest in climate change adaptation and mitigation. This propagated social disorder hindering Ilchamus community from engaging in basic livelihood activities and accessing basic economic, social, political and infrastructural developmental needs among others. In the midst of escalating impacts of climate change including severe droughts, floods, land degradation and unpredictable future, Ilchamus community has remain marginalized despite the fruits of devolution. Government land governance institutions decisions seems to reinforce unclear community land rights particularly in the unregistered Ilchamus community land. There is need to recognize, protect and register Ilchamus community land rights under Community Land Act 2016.

### The role of corruption in impeding Mau Forest Conservation Efforts

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The Mau Forest Complex, one of Kenya's largest and ecologically significant forest ecosystems, has faced numerous conservation challenges over the years. This research study sought to examine



the extent to which political corruption and malfeasance have hindered conservation activities in the Mau Forest region. Political corruption, as a pervasive issue in many countries, often intersects with environmental conservation efforts, impacting the allocation of resources, decision-making processes, and the overall success of conservation initiatives. Through a combination of qualitative and quantitative research methods, this study investigates instances of corruption and political interference related to the Mau Forest, with a focus on local and national political actors, government agencies, and their influence on conservation policies and practices. Key objectives of the research included identifying specific instances of corruption, bribery, and embezzlement in the context of Mau Forest conservation and analysing the role of political figures and influential stakeholders in influencing or obstructing conservation efforts. The research findings provided valuable insights into the complex relationship between political corruption and environmental conservation in the Mau Forest region. The research found out that state interventions in the Mau Forest over the last 100 years have been designed to serve specific political-economic interests, rather than to conserve the ecosystem. In conclusion, the legacy of colonial forest management practices, post-colonial politics of clientelistic land redistribution and the politicisation of forest conservation have made the Mau Forest one of the most controversial areas of Kenya

**Exploration of the Strategies Used by Non-Institutional Actors to Foster Inclusion in the Implementation of County Roads Policy in**

**Narok County, Kenya**

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The dynamics of involving non-institutional actors in the implementation of local roads policies is a fundamental concern of modern governments since it enhances a nation's economic competitiveness and prosperity. The creation of county governments by the constitution of Kenya (2010) created an extra layer of policy implementation to facilitate the attainment of national development goals through effective involvement of non-institutional actors. However, the implementation of County Roads Policy at the county level has largely been dominated by the county institutions in concert with national government institutional support. This has diminished the local value contribution especially that of non-institutional actors to policy development for county-level roads. This has compelled the non-institutional actors to devise strategies that will grant them visibility in the implementation of County Roads Policy. Owing to this phenomenon, the research study sought to investigate the strategies used by the non-institutional actors to influence inclusion in the implementation of County Roads Policy. The study targeted officials in the County Department of Public Works, Roads and Transport, the non-institutional actors such as interest groups, political parties, CBOs and households. The study used clustered simple random sampling as well as purposive sampling during data collection which culminated into a sample size of 384 respondents. Descriptive and correlational research designs were used. Questionnaires and interviews were used as the research instruments to collect data. Inferential data was processed and analyzed using the Statistical Package for Social Sciences (SPSS) version 21. The study established that the exclusion of key stakeholders such as the non-institutional has been a serious challenge in the implementation of county Roads Policy. It was further established that the non-institutional actors push for inclusion mostly



through collaborations with policy-makers and pressurizing the government as evidenced by the mean responses of 85.8% and 81.6% respectively. The study recommends the adoption of policies on increasing the inclusion of all stakeholders in the implementation of public policies as well as a research study to be undertaken on how non-institutional actor networks can be formed, sustained and their visibility increased for better implementation of public policies for sustainable development in the nation.

**Exploring the Nexus: Women's Leadership in Biodiversity Conservation Within the Cultural Context of Narok County, Rift Valley, Kenya**

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This research delves into the intricate intersection of women's leadership and biodiversity conservation within the unique cultural landscape of Narok County, Rift Valley, Kenya. Employing feminist ecological theory as the theoretical framework and life histories methodology as the research approach, the study aims to achieve three main objectives.

First and foremost, it seeks to examine the multifaceted roles played by women in biodiversity conservation efforts. Through in-depth interviews and narratives, the research aims to uncover the diverse ways in which women contribute to and shape conservation practices, acknowledging their often overlooked but crucial

contributions. Secondly, the study seeks to comprehend the cultural context that underlies conservation practices in Narok County. By exploring the intricate interplay between cultural norms, traditions, and environmental stewardship, the research aims to uncover the nuanced relationships that influence and are influenced by conservation initiatives. Lastly, the research aspires to propose policy recommendations grounded in the insights gained from the examination of women's roles and the cultural context. Informed by feminist ecological theory, these recommendations aim to foster more inclusive and effective conservation policies that account for the diverse perspectives and contributions of women within the cultural fabric of Narok County. Through this comprehensive exploration, the study endeavors to contribute to the broader discourse on sustainable biodiversity conservation by highlighting the pivotal role of women and the cultural nuances that shape conservation practices in Narok County.



## MODELING



*Field mission in Ethiopia*



## Mathematical Modeling and Performance Analysis of a Novel Solar-Biogas Hybrid Dryer for Drying Agricultural Products

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Post-harvest losses of agricultural products pose a threat to food security and environmental sustainability in many developing countries. Drying is the most effective mitigation method but is energy-intensive, consuming over 12% of all energy used in agriculture. Existing hybrid solar dryers are complex and rely on unsustainable energy sources such as the national electricity grid, coal, biomass, or fossil fuels. However, a novel solar-biogas hybrid dryer, which uses solar and biogas energy, has been proposed, making it sustainable and cost-effective. A mathematical model will be developed to optimize its performance under all tropical weather conditions. This technology can potentially reduce post-harvest losses, greenhouse gas emissions, and energy consumption in agriculture while preserving the nutritional content and safety of agricultural products. It is particularly suitable for use in developing countries where post-harvest losses are between 35-50% annually.

## Geological Investigation of Hanang Volcano: A Comprehensive Analysis of the 3<sup>rd</sup> December 2023 Debris Flow Catastrophe and Structural Dynamics

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Debris flows are natural hazards that occur in many parts of the world and have been linked to fatalities and substantial destruction of

infrastructures and residences, particularly in steep mountainous regions. These events deposit significant sediments on alluvial fans, posing risks to communities. The initiation of debris flows is a complex process influenced by various factors, including antecedent moisture, precipitation, vegetation cover, topography, geology and soil type. These elements collectively contribute to shaping the characteristics of the resulting debris flow. These flows are characterized by rapid movement and the transport of substantial debris such as large boulders, trees, and even vehicles that pose significant hazards. The Hanang volcano is located within a shear zone where temporal deformation and slope stability behavior is influenced primarily by the properties of the brittle shear zones in the inherited basement rocks rather than the overall mass properties. These shear zones are the product of the rockslide evolution within tectonic fault zones observed in the Hanang area. SRTM-DEM revealed a NN-SW fault zone (shear fracture) which is oblique to Balangida fault to the north, extending southwards and dissecting Hanang volcano and Katesh town to the south. On 3<sup>rd</sup> December, 2023 the Hanang area experienced a catastrophic event involving a rockfall followed by a debris flow disaster. Numerous boulders from the rockfall, combined with large debris flows and flash flooding, led to widespread destruction claiming lives of more than 80 persons and loss of properties in two locations on the downside valleys of the Hanang volcano i.e. Katesh town (S) and Gendabi village (W) of the volcano. The primary contributing factor to this catastrophic event was long-term regional tectonic stresses leading to local strain accommodation over Hanang volcano. The rockfall occurred in distinct patches, creating a pathway for flooding that later initiated debris flows down the hill. The overall





debris flow path direction followed a fault zone towards Katesh town, while the flow path toward Gendabi village was initiated under the sudden forces of steep slope failure (gravity), involving high speed and rock failures with particle sizes ranging from very fine sandy particles to large boulders up to approximately 10 meters in diameter. Understanding the complex interactions of geological, hydrological and topographical factors leading to this catastrophic event is crucial for formulating effective monitoring and mitigation strategies and enhancing the resilience of communities in similar hazardous environments.

**Reconstructing Quaternary paleoclimates from the faunal composition of African paleoanthropological sites with machine learning.**

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East Africa has provided an extensive fossil record documenting the evolution of fauna, including hominins, and environments over the last million years. With the advent of new numerical methods for processing large datasets, paleontologists can now potentially trace the history and evolution of climate by tracking changes in faunal community composition. In general, different taxonomic groups provide distinct yet complementary paleoenvironmental information, with interpretational nuances in relation to distinctive characteristics in their abundances, ecologies, and modes of accumulation and preservation of their remains; however, incorporating these different taxa into a single global paleosynecological approach can be challenging due to methodological limitations,

researcher expertise, taphonomic factors, etc. In response to this challenge, we have developed a novel machine learning-based taxonomic method for reconstructing the climate of African Quaternary terrestrial ecosystems, enabling accurate numerical predictions based on the composition of the rodent and bovid palaeocommunity. Our standardized protocol for compiling and processing mammal distribution data as input source for environmental predictions addresses common obstacles associated with the use of machine learning paleontology, particularly those related to the nature and extent of available datasets used for training robust models. In the initial phase, we established a framework and methodology for building machine learning regression models using neo-ecological data. Modern species distribution data, combined with climatic raster layers, were aggregated and used to predict climate parameters through random forest regression algorithms. Supra-specific taxonomic ranks, including genus, subfamily, and family, were also recorded as explanatory variables, enabling the use of faunal lists with varying levels of taxonomic determination for predictions. To account for spatial dependence in our data, we introduced a geographical block validation strategy for model validation and selection. In the subsequent phase, we investigated the impact of sampling/preservation bias and taxonomic indeterminacy on palaeoenvironmental reconstructions by introducing false absences in the training data and measuring the loss of accuracy with increasing numbers of undetermined or unseen taxa. The resulting models, more robust to the loss of taxa, can ultimately be used to infer climate conditions at various early hominin-bearing fossil sites in East Africa. This approach presents intriguing prospects for paleoenvironmental studies and



highlights the potential of a multidisciplinary approach involving archaeologists, paleontologists, and mathematicians. However, it underscores the paramount importance of chronologically and stratigraphically well-contextualized data for establishing robust and reliable climatic scenarios.

**A trophic shift of ancient hominids within their ecosystems: qualitative modeling of ecological dynamics in Plio-Pleistocene faunas from the Turkana Depression, eastern Africa**

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The Plio-Pleistocene fossil record from eastern African documents important biological and technological changes in hominids. Most notably, they experienced an ecological transition from opportunistic omnivory in the Pliocene to apex predation in the Pleistocene. But the timing and processes of such a transition, and notably its relationship with the use of stone tools, remain poorly known. With this in mind, our study aims at investigating the potential interspecific interactions (competition, predation) occurring in the fossil-rich Turkana Depression during the Plio-Pleistocene among hominids and other mammals by using a new qualitative method.

**Phytolith assemblages from Modern Herbivores' Teeth-Ecometrical proxy for reconstructing mammalian paleodiets.**

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Phytolith are microscopic silica stones found in plant tissues. There is considerable variation on the rate in which different plants accumulate such silica formation in and around their cells. Monocotyledons plants accumulate silica more

than the dicotyledons plants and they produce silica cells that are unique and identifiable hence can be traced to the parent plants. Grasses, sedges and palms accumulate silica at a higher rate than woody and herbaceous dicotyledonous taxa. Grazers therefore will accumulate more phytoliths than mixed feeders and browsers. We analyzed, identified and classified phytolith assemblages derived from ~55 modern herbivore teeth cavities (infundibula) of known feeding behavior to test if the phytolith assemblage reflects their feeding behavior and their habitats. Phytolith data from specialized grazers such as buffalo and zebra show a strong correlation with feeding behavior. Buffalo specimens collected from high altitude areas such as Mt. Kenya consist of both C3 and C4 grass derived morphotypes. Phytolith data derived from browsers do not show a strong correlation with their dietary behavior as it consists substantial amount of grass morphotypes in their assemblage but have a strong correlation with their habitats-wooded grasslands. Our research suggests that phytolith assemblage derived from herbivore teeth strongly reflect their habitats and that their diet is largely dependent to the plant resources availed by their habitats. This information is critical for identification and classification of habitats of the fossil taxa.



## Unveiling Hominin Brain Evolution through Digital Endocast Analysis

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Reconstructing early hominin brain evolutionary history is key to understanding how our ancestors evolved and interacted with their environment. Unfortunately, the brain is rarely preserved in the fossil record; therefore, we are reliant on cranial endocasts: replicas of the inner table of the cranial vault. Considerable advances in palaeontology, utilising state-of-the-art digital imaging and computational analysis, have enabled us to reconstruct endocasts from the most fragmented fossil crania. In this study, we used a combination of high-resolution imaging techniques, specifically micro-CT and 3D surface scanners, to digitally reconstruct physical endocasts previously created by others and create new endocasts from crania of extant hominids for comparison. This technique involves automatically extracting the endocast using automated segmentation tools and detecting sulcal imprints using open-source software. After the imprints were detected, they were labelled using MATLAB software. We then applied modern computational techniques commonly used in neuroscience to create density maps of sulcal imprint variation in our entire sample. We reanalysed the inter-individual sulcal imprint variation and clarified debated aspects of endocranial anatomy. In particular, the study addresses the less explored cortical anatomy of the *Paranthropus* genus, uncovering significant details about their brain morphology. This contributes to a deeper understanding of the cortical expansion and variation within this hominin group, offering new perspectives on

their adaptation and survival strategies. Sulcal imprint variability was additionally analysed from *Australopithecus* and members of *Homo* from East Africa, revealing evolutionary patterns of sulcal imprints across different hominin species. Our approach integrates advanced paleontological methods with neuroscience, bridging the gap between these disciplines and offering a unique perspective on hominin brain evolution. By combining advanced technology with in-depth analysis, we not only enhance our understanding of hominin brain evolution but also demonstrate the immense potential of digital techniques in paleontological research. This study provides a novel perspective on the cognitive evolution and environmental adaptations of early hominins, contributing significantly to our understanding of human evolution. The findings from this research not only add to the existing body of knowledge but also open new avenues for future research. Our work illustrates the importance of interdisciplinary approaches in paleoneurology, encouraging further exploration into the complex evolutionary history of the hominin brain. This comprehensive analysis serves as a foundation for future studies aiming to unravel the mysteries of human origins and cognitive development.

## Dynamics of Impala population: Case study of Maasai Mara National Reserve

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This study delves into the intricate dynamics of the Impala population within the iconic Maasai Mara National Reserve, aiming to unravel the nuances of their ecological interactions and population trends. Against the backdrop of this



globally renowned ecosystem, I employ a multidimensional approach to understand the factors influencing the rise and fall of the Impala population. Methodologically, my research integrates advanced tracking technologies, ecological surveys, and statistical modeling to paint a holistic picture of Impala movements, breeding behaviors, and responses to environmental variables. By doing so, I seek to contribute valuable insights not only to wildlife conservation in Maasai Mara but also to broader discussions on ecosystem resilience and biodiversity management. Furthermore, the study addresses the practical implications of Impala population dynamics on the broader Maasai Mara ecosystem, including potential cascading effects on vegetation, predator-prey relationships, and overall biodiversity. Through a thorough examination of these aspects, my research aims to inform evidence-based wildlife management strategies, ensuring the long-term sustainability of the Impala population and the ecosystem at large. This research is positioned at the intersection of wildlife ecology, conservation biology, and environmental management. By presenting a nuanced understanding of Impala dynamics, I anticipate that my findings will not only enrich the scientific community but also provide actionable insights for wildlife managers, policymakers, and conservation practitioners. The Maasai Mara National Reserve serves as an emblematic backdrop for this study, emphasizing the broader implications for conservation efforts in similar ecosystems worldwide.

## AfriGIS Software Development.

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*Save The Elephants Organisation*

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AfriGIS is a project aimed at providing real time natural resource management by utilizing spatial data harnessed from Esri Google Earth, LIDAR and Sentinel satellite data. Other important supportive GIS solutions include Brookman consult, skywatch, sensar, infraconsult, GISWATER, ms.gis and regioDATA. Rift Valley region in Kenya is endowed with natural resources which to mention a few include Cherangany natural forest, Mount Elgon national Park and Forest, the region is source of river Nzoia and Turkwel which drains its water to Lake Victoria and Lake Turkana respectively. River Turkwel has a Turkwel power generating plant, serving most parts of Kenya with Hydro-Electric power. Minerals are in plenty both reserve and operational within the region, this include oil reserves in Ngamia 1 and 2 in Northern region, Fluorspar Mines in Kimwarer, Rimoi national reserve, a home of Elephants, Rift Valley Lakes which include Lake Baringo, Lake Naivasha and Lake Elementaita. AfriGis main focus is to provide monitoring, analysis and mapping of these resources and other supportive essentials like roads. Elevation analysis utilizing the DEM tools provides important ways and routes to reach a given area/region incase of an emergency outbreak which include natural calamities which include landslides, fire outbreak, earth drifting movement and volcanic eruptions. This facilitates rescue services to people and wildlife. This project utilizes primarily satellite data as mentioned earlier and it is integrated by using python programs to ease the automation process, these python modules and libraries are provided by ArcGIS and QGIS as ArcPy and PyQGIS



respectively. The onset of this project I have used PyQGIS, this is an opensource project and PyQGIS provides available modules which makes automation mapping efficient. Other supportive modules include Pandas to put coordinates into CSV and NuMpy to create the data array. Future of AfriGis will be aiming for a natural resource monitoring, evaluation and mapping API, which will be user friendly and shall be made available for resource managers within the region. This will take one year to make the first release which it shall make continuous improvement and information addition to meet the changing demands within Rift Valley and Kenya at large. AfriGIS has proved to be handy in resource monitoring, planning and utilization thus just like any other software projects, it requires a high speed computer with minimum RAM of 8GB and a stable internet connection which is not less than 20mbs/sec. Thus, working with stakeholders like Rift Valley colloquium team and Maasai Mara University fraternity, will make it a successful project.





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#AfricanRiftValley

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