

**The International Conference
on Renewable Energy, Climate
Change and Ecosystem
Restoration (ICRECC-2025)**

Report of Contributions

Contribution ID: 75

Type: **Oral presentation**

Environmental and Land Use Effects from Mining and Quarrying: A Case Study of Kwale and Kajiado Counties

Kenya's significant mineral wealth presents a substantial economic growth opportunity, yet the mining sector's contribution to GDP remains low. This study examines the environmental and land use impacts of mining and quarrying activities in Kwale and Kajiado Counties, Kenya, employing mixed-methods research. Findings reveal diverse mining methods and their associated impacts on water, air, wildlife, soil, social values, and climate. While mining offers economic benefits and potential biodiversity enhancement, it also results in social displacement, human-wildlife conflict, and environmental degradation. Key challenges include land access, benefit sharing, and regulatory oversight, particularly regarding environmental rehabilitation. The study recommends enhanced inter-agency collaboration, national environmental management guidelines, expedited benefit-sharing implementation, and improved land reclamation monitoring to ensure sustainable development in Kenya's mineral-rich regions.

Authors: KISANGAU, Clementine (National Land Commission); Dr MACHARIA, Mary (National Land Commission); Ms KOSGEY, Nancy (National Land Commission)

Presenters: KISANGAU, Clementine (National Land Commission); Ms KOSGEY, Nancy (National Land Commission)

Track Classification: Biodiversity and Natural Resource management: Policy frameworks that support biodiversity and natural resource management. This includes cases of carbon markets

Contribution ID: 76

Type: **Abstracts**

Exploring alternative energy sources as a Climate Change Adaptation Mechanism among Rural Women Baringo County, Kenya

Climate change stands as one of the most pressing and intricate challenges confronting the global community today, highly contributed by the energy systems. As the world's population continues to grow, the global demand for energy is increasing rapidly and is linked to environmental pollution and greenhouse gas (GHG) emissions thus the urgent need to seek for alternative energy sources that are renewable and with less emissions to the environment. (Akella et al., 2009). In Kenya rural households for instance, there is wide reliance on traditional fuels, such as firewood and charcoal. These traditional fuels have been proven to be unhealth and a major drive for deforestation and greenhouse gas emissions. The high demand for firewood has led to firewood commercialization, the depletion of preferred firewood tree species and increase in the impact of climate change. Rural women being primary users of household energy, the burdens of poor energy access fall on them. This research delves into strategies of greenhouse gas (GHG) emissions reduction by proposing alternative energy sources that will reduce the impacts on both the environment and the health of the rural women in Kenya. The study will employ systematic literature review, case studies and participatory observation. The objectives of the study is to establish the energy consumption patterns by the rural households, identify potential alternative energy sources suitable for rural women, considering factors such as affordability, sustainability, scalability, and cultural acceptability and establish the socioeconomic implications of adopting alternative energy sources for rural women, including potential benefits such as improved livelihoods, income generation opportunities, and reduced health risks associated with traditional energy use. The findings will shed light on the unique roles of women in climate adaptation and contribute to the development of policy recommendations and interventions aimed at fostering sustainable adaptation strategies in rural areas in Baringo.

Authors: Dr MAARA, John; KOSGEY, Nancy

Presenter: KOSGEY, Nancy

Track Classification: Renewable Energy: Energy access

Contribution ID: 77

Type: **Oral presentation**

Treatment of reactive blue dye textile wastewater using copper based metal organic framework

Dyes in wastewater pose significant environmental risks due to their persistence and resistance to conventional biochemical treatment methods. Photocatalytic degradation is an advanced oxidation process that is a sustainable and cost-effective method for dye degradation. In this study, a copper-based metal-organic framework (Cu-MOF), $[\text{Cu}(4,4'\text{-bipy})\text{Cl}]_n$, was synthesized via a hydrothermal method using 4,4'-bipyridine as a ligand and used to photodegrade reactive blue dye under natural sunlight. The MOF material was characterized through Fourier Transform Infrared Spectroscopy (FTIR) for chemical composition, Scanning Electron Microscopy (SEM) for morphology, X-ray Diffraction (XRD) for crystallinity, and UV-Vis Diffuse Reflectance Spectroscopy (DRS) for light absorption properties. The effects of key parameters, including dye concentration, photocatalyst dosage, and solution pH, were systematically investigated to determine the optimal degradation conditions. The Cu-MOF achieved remarkable 93.7% dye degradation efficiency under optimal conditions (0.4 mg/L dye concentration, 0.45 g catalyst, pH 10). Control experiments revealed that adsorption in the dark contributed to only 30% removal, while photolysis alone had no significant effect. The reusability of the Cu-MOF was assessed over five consecutive cycles, demonstrating stable activity with minimal performance loss. These results highlight the potential of Cu-MOF as an efficient and durable photocatalyst for water and wastewater treatment applications.

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Track Classification: Pollution and waste management: Heavy metals pollution: bioremediation of heavy metals in water bodies and aquatic systems

Contribution ID: 78

Type: **Abstracts**

Energy Access

Thursday, April 24, 2025 9:25 AM (20 minutes)

Challenges and Opportunities in Kenya's Energy Sector: Addressing Rural Electrification, Consumer Prices, and Power Losses on Distribution

Kenya's energy sector faces significant challenges in rural electrification, high consumer prices, and substantial power losses during distribution. As of 2018, only 56% of Kenyan households had access to electricity, with rural areas lagging at 31%. The high cost of grid extension to remote areas and inefficiencies in distribution systems, including technical losses (up to 18%) and non-technical losses (up to 15%), exacerbate the issue. These losses, totaling over 33% of generated power, inflate consumer costs and hinder economic growth.

Opportunities for improvement include investing in renewable energy sources like solar and wind, modernizing the distribution network, and implementing smart metering systems to reduce losses. Deregulation and liberalization of the sector could also foster competition and innovation, potentially lowering prices. However, these measures require careful regulatory frameworks to protect consumers and manage transitions effectively. Addressing these challenges through comprehensive policy adjustments can enhance the reliability, efficiency, and affordability of Kenya's electricity supply, contributing to sustainable economic development

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Track Classification: Renewable Energy: Energy access

Contribution ID: 80

Type: Oral presentation

Integrated Multi-Trophic Aquaculture (IMTA) of Seaweed and Rabbitfish: A Low-Carbon Bio-mitigation Strategy for Climate Resilience and Multidimensional Poverty Reduction

Tuesday, April 22, 2025 4:05 PM (20 minutes)

Coastal Kenyan communities rely heavily on marine resources for food, income, and ecosystem services. However, marginalized groups, particularly women, face systemic barriers to accessing these resources, exacerbating vulnerabilities to climate change and food insecurity. This study investigates the potential of IMTA systems—integrating seaweed (*Eucheuma denticulatum*) and rabbitfish (*Siganus sutor*)—as a low-carbon, gender-inclusive solution to address multidimensional poverty and climate resilience.

The IMTA model leverages symbiotic interactions: fish excreta and feed residues fertilize seaweed, while seaweed absorbs excess nutrients (reducing eutrophication risks by 16.58 t PO₄³⁻ eq. and 32.29 t N eq.) and sequesters CO₂, mitigating coastal acidification. Trials demonstrate 60% nutrient recovery efficiency, tripling biomass output compared to monoculture systems. Seaweed's carbon sequestration capacity further supports global climate goals, while rabbitfish provide protein-rich food, enhancing dietary diversity and income streams.

Economically, IMTA reduces reliance on costly external inputs, lowering production costs by 40% and diversifying revenue through sale of fish, seaweed. This targets poverty indicators like unemployment and food insecurity, while alleviating pressure on overfished wild stocks. Socially, IMTA empowers women through inclusive aquaculture training and ownership opportunities, challenging entrenched gender norms in Kenya's coastal regions.

Preliminary data from the Blue Empowerment Project (Kwale County, Kenya) highlights IMTA's dual role in fostering climate resilience and equitable livelihoods. However, scaling requires addressing socio-technical barriers, challenges and opportunities for leveraging IMTA of seaweed and fish as a low-carbon, gender-transformative, environmentally and economically sustainable innovation for equitable empowerment.

This study proposes a holistic analysis of IMTA's viability, integrating social, technological, and institutional dimensions. By collaborating with local stakeholders—including Bahari CBO and Sea Moss Corporation—the project aims to co-design replicable, gender-responsive IMTA models. Policy recommendations emphasize the need for climate-smart aquaculture incentives and equitable resource access to position IMTA as a pillar of Kenya's blue economy transition.

Keywords: IMTA, seaweed, rabbitfish, climate change, poverty

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Track Classification: Cross-cutting areas: Climate change, food security and impact on livelihoods

Contribution ID: 81

Type: Abstracts

Financing clean Energy Transition for rural households in Western Kenya; Insights from the Bidhaa Sasa Social Enterprise Model

Thursday, April 24, 2025 9:45 AM (20 minutes)

Polluting fuel use in households poses health, environmental and socio-economic problems. The use of clean cooking fuel is largely limited due to cost. To effectively reach the rural population, financing models supportive of the low-income earners need to be put in place. Bidhaa Sasa Social Enterprise Model (BS) is a social marketing approach that distributes clean cooking equipment to the rural poor and has been in operation in Western Kenya since 2017. This study evaluated how Bidhaa Sasa initiative supported rural households in Western Kenya to adopt clean, improved cooking fuel and technologies.

This study adopted a mixed method approach. 1006 households, who bought cooking products from Bidhaa Sasa either in Kapsabet or Moi's Bridge hub, were surveyed. The participants were identified from the Company customers through their coordinators and Group Leaders. Quantitative data was analyzed using descriptive and Inferential statistics. Thirteen participants from the survey were purposively sampled for in-depth interviews. Qualitative data was analyzed thematically.

Significant number (93%) of those who bought clean stoves are still in possession of them, and up to 97% are using them. The study found household income as the main predictor of the main cook stove used before Bidhaa Sasa ($P=0.029$), however, the association could not hold after the initiative ($P=0.409$) instead there was a significant improvement in the use of cleaner fuel ($P=0.000$). Qualitative findings indicates that the initiative was popular due to flexible repayment period, good customer relations, quality products and product demonstrations. Enablers of transition to clean fuels included; health issues, convenience, challenges in procuring the previous fuel and cost.

There was a significant improvement in transition to use of cleaner fuels after Bidhaa Sasa Initiative. However, fuel stacking is still common among rural households. Similar models involving peer support could be explored as we move towards attaining SDG 7.

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Track Classification: Renewable Energy: Energy access

Contribution ID: 82

Type: **Oral presentation**

Ancestral Voices, Future Earth: African Oral Traditions as Knowledge Hubs for Climate Solutions in a Globalized World

African rituals and oral traditions highlight dialogic connections between humans, animals and the natural environment. From the Agikuyu sacred mugumo tree to the Igbo mystic silk-cotton tree narratives; to songs, proverbs and riddles and puns on the natural environment and man's place in the ecosystems, African indigenous epistemologies reveal significant knowledge hubs. This paper attempts to show that these can bridge traditional and contemporary knowledges in understanding the natural environment and its sustenance of life. It adopts Cheryll Glotfelty and Harold Fromm's definitions of ecocriticism as the study of the relationship between literature and the physical environment. Analysis of the texts is done within the tenets of Ethnophilosophy, borrowing from Alaxis Kagame's view of African oral traditions as sources of indigenous knowledge and philosophy and myths, proverbs, and folktales as key to understanding African thought. Further, the Oral Narrative Performance theory by Pius Nkashama helps explain how folklore uses language creatively to bring out deep philosophical insights. Through close reading and content analysis within ecological contexts, the paper shows how interconnected and symbiotic human, animal and plant worlds are, and that destroying one segment leads to the destruction of all three. It places oral cultures at the center of communicating the needed mind shifts in environmental conservation given that orality is central to mind transformation as it promotes ethically driven actions with immediacy. The study exploits underlying African traditional wisdom that man is an integral part of the ecosystem and that its conservation demands his brains and humility rather than force and arrogance, pitting traditional African approaches against modern supremacist exploitation and degradation of the same environment. The study shows how African folklore carry practical sustainable ecological practices that are at the risk of dying with the mental archives of orality.

Key Words: Ecocriticism, Conservation, Nature, Folklore, Indigenous epistemologies

Authors: Dr OPONDO, ROSE (Moi University); Mr OTIENO, Tobias

Presenter: Dr OPONDO, ROSE (Moi University)

Track Classification: Cross-cutting areas: The effect of culture and religion in climate change adaptation and mitigation

Contribution ID: 83

Type: **Poster presentation**

Socio-Economic Impacts of Marine-Protected Areas (MPAs) on Communities in Kenya

The conservation of Kenya's marine environment is a vital aspect of broader environmental efforts. Marine Protected Areas (MPAs) have been established to promote tourism and conserve marine biodiversity, addressing threats such as overfishing, pollution, and climate change. However, their establishment has also led to conflicts over resource use, particularly between national conservation agencies like the Kenya Wildlife Service and local fishing communities. Additionally, large-scale coastal developments pose further risks to biodiversity and ecosystem services.

This study uses systematic literature review and case studies to examine the socio-economic impacts of MPAs on communities in Kenya. By addressing these, the study contributes to the achievement of Sustainable Development Goals (SDGs) and contributes significantly to global sustainability efforts. It directly supports SDG 13 (Climate Action) by conserving mangroves and coral reefs along shorelines, which serve as natural climate buffers, SDG 14 (Life Below Water) by conserving marine biodiversity and sustaining fisheries, which are crucial for food security, and SDG 8 (Decent Work and Economic Growth) through alternative livelihood activities.

Findings suggest that a balance between conservation and livelihood sustainability is essential. Well-managed MPAs with integrated socio-economic strategies can lead to improved fisheries, increased tourism revenue, and better resilience against climate change. It also found that local fishermen hold highly negative attitudes toward MPAs due to exclusion from decision-making and a lack of alternative income sources among others. In addition, lack of coordination and consultation among institutions managing coastal areas intensifies marine resource-use conflict between conservation efforts and community needs.

The study recommends a balanced approach to MPA establishment in Kenya, ensuring both marine conservation and community well-being. A multidisciplinary approach incorporating community participation to minimize conflicts and maximize MPAs' contributions to multiple SDGs while safeguarding the livelihoods of coastal communities.

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Track Classification: Biodiversity and Natural Resource management: Livestock keeping, marine and aquatic systems and the blue economy

Contribution ID: 84

Type: **Oral presentation**

The Role of Mangrove Restoration in Enhancing the Resilience of Coastal Communities in Kenya

Kenya's coastal communities are increasingly vulnerable to climate change, facing threats such as rising sea levels, coastal erosion, and declining fish stocks. Mangrove forests play a crucial role in enhancing resilience by acting as natural coastal barriers, stabilizing shorelines, absorbing carbon dioxide, and supporting marine biodiversity. However, these ecosystems are under severe pressure due to deforestation, pollution, land conversion, and unsustainable resource extraction. The degradation of mangrove forests not only exacerbates environmental risks but also undermines the socio-economic stability of coastal populations.

Despite efforts by government and conservation organizations, Kenya has lost a significant portion of its mangrove forests due to human activities and climate change. While restoration initiatives exist, there is limited research on how community-led mangrove restoration impacts socio-economic resilience and environmental sustainability.

Mangrove restoration contributes significantly to global sustainability efforts by aligning with several United Nations Sustainable Development Goals (SDGs). It directly supports SDG 13 (Climate Action) by mitigating climate change impacts through carbon sequestration and storm protection, SDG 14 (Life Below Water) by conserving marine biodiversity and sustaining fisheries, which are crucial for food security and SDG 15 (Life on Land) by preventing land degradation and fostering biodiversity conservation. From an economic perspective, mangrove-based activities such as eco-tourism, sustainable forestry, and fisheries create employment and support SDG 8 (Decent Work and Economic Growth) by providing livelihood opportunities for local communities.

This research evaluates ongoing restoration initiatives, the role of local communities in conservation, and the effectiveness of legal frameworks, including Kenya's Blue Economy Strategy and Climate Change Act.

Findings suggest that integrating traditional knowledge, strengthening governance, and increasing financial investment are essential for successful mangrove restoration. This study provides policy recommendations for enhancing community-led conservation, promoting nature-based solutions, and ensuring the long-term sustainability of Kenya's coastal ecosystems, thereby advancing national and global climate resilience goals.

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Track Classification: Restoration of Ecosystems: Restoration of natural landscapes, to include mining areas, water catchment areas

Contribution ID: 85

Type: **Oral presentation**

ASSESSMENT OF NUTRIENT RETENTION IN YALA WETLAND ECOSYSTEM, KENYA

Tuesday, April 22, 2025 4:05 PM (20 minutes)

The Yala Wetland, a key ecosystem in Kenya, plays a vital role in provision of ecosystem services and by extension, a source of livelihoods for local communities, and a natural shield against environmental pressures. This study investigates nutrients retention capacity at the Yala wetland, focusing on the selected parameters at the inlet and outlet within a selected temporal span. Key parameters, including dissolved oxygen (DO), electrical conductivity (EC), water temperature, pH, total suspended solids (TSS), nitrogen (N), and phosphorus (P) concentrations, were monitored to assess temporal changes and nutrient retention. The mean DO concentration at the inlet exhibited significant temporal variation ($F=7.315$, $p=0.051$), while the outlet showed no significant changes ($F=5.657$, $p=0.063$). EC values at both sites varied significantly ($F=28.387$, $p=0.004$), with the inlet reaching a maximum of 341.1 $\mu\text{S}/\text{cm}$ in March. Nutrient analyses revealed that ammonium concentrations significantly differed across months at both the inlet ($F=8.257$, $p=0.035$) and outlet ($F=7.463$, $p=0.028$). Nitrate and total nitrogen concentrations showed no significant variation during the study period. Notably, the wetland acted as a nutrient sink, retaining 40% of ammonium, 30.52% of nitrate, and 28.57% of total phosphorus. Understanding these relationships is vital for safeguarding water quality and supporting biodiversity. In conclusion, ongoing research and proactive management approaches are key to preserving the integrity of Yala Wetland and strengthening its resilience against future environmental challenges.

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Track Classification: Restoration of Ecosystems: Restoration of natural landscapes, to include mining areas, water catchment areas

Contribution ID: 86

Type: **Poster presentation**

Enhancing Urban Resilience and Livelihood Security Through Adoption of Pomology in the Face of a Changing Climate in Eldoret City, Kenya

Abstract

African cities are more vulnerable to climate change because they lack the capacity to cope with its impacts. With an expected increase in severity of climate change impacts coupled with rapid urbanization in African cities, livability of these cities will worsen. Eldoret city is not an exception. It faces increasing vulnerabilities due to climate change-related stormy rains, urban heat island effect and increased frequency of including; prolonged droughts and floods thus threatening the rapidly-expanding city as well the city dwellers' livelihoods. Harnessing the potential of urban pomology (fruit crop production) potential would go a long way in fostering resilience and survival of urban households. This study seeks to explore the crucial role of pomology in addressing the impact of climate change by strengthening urban resilience and livelihood security of households residing in the city. It will specifically assess the current state of fruit cultivation practices, assess vulnerability of Eldoret city dwellers to climate change impacts and map the spatial distribution of potential pomology sites in the city and its periphery. A mixed-method approach will be employed to collect data using household surveys, remotely sensed data and key informant interviews, focusing on the spatial distribution of pomology activities and their associated impacts on climate regulation and food production. Stratified random sampling will be used to select households engaged in pomology activities for quantitative surveys while purposive sampling will be used to target key informants and specific estates engaged in this practice. The study will apply both resilience theory and sustainable livelihoods theory to understand the complex interactions between pomology practice, climate change, and urban socio-economic dynamics. The findings will lead to the identification of effective pomology strategies for enhancing climate-resilient livelihoods as well as urban resilience. Evidence-based recommendations for integrating the practice into urban planning will also be provided.

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Track Classification: Sustainable city technologies: Storm water collection, sewer management and urban agriculture practices

Contribution ID: 87

Type: **Oral presentation**

Assessing the Diversity of Parasites and Microbes in Fish from Selected Fish Farms in Uasin Gishu County

Thursday, April 24, 2025 9:05 AM (20 minutes)

Abstract

Fish farming plays a crucial role in food security and economic development, yet bacterial and parasitic infections threaten productivity and fish health. This study investigates the distribution and prevalence of bacterial and parasitic species in fish organs across different farms, ponds, and pond types in Uasin Gishu County, Kenya. A total of 468 fish samples were analyzed, yielding 154 bacterial isolates and various parasitic infestations identified through cultural, biochemical, and microscopic characterization. The Kruskal-Wallis test revealed significant differences ($p \leq 0.05$) in bacterial prevalence across fish organs, farms, and measurement dates. Dunn's post hoc test further highlighted significant pairwise differences. The results revealed significant differences ($p \leq 0.05$) in bacterial and parasitic prevalence across fish organs, farms, and measurement dates. *Escherichia coli* was the most prevalent bacterial species, followed by *Pseudomonas aeruginosa*, *Vibrio harveyi*, and *Vibrio alginolyticus*. The gills exhibited the highest bacterial diversity, while the kidneys had the lowest. Parasitic infestations, including nematodes, cestodes, and protozoa, were predominantly found in the intestines and gills, with variations influenced by farm location, pond type, and seasonal factors. To mitigate these infections, regular water quality assessments, improved biosecurity measures, routine fish health monitoring, and antiparasitic treatments should be implemented. Further research on antibiotic resistance and parasitic control strategies is recommended to enhance sustainable aquaculture management and minimize disease risks.

Keywords: Bacterial diversity, parasitic infections, fish farming, aquaculture management

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Track Classification: Biodiversity and Natural Resource management: Livestock keeping, marine and aquatic systems and the blue economy

Contribution ID: 88

Type: **Poster presentation**

Effect of Selected Dopants (Bi, Sb, and Sn) on the Optoelectronic Properties of Formamidinium based Lead Halide Perovskite materials: An Ab Initio Density Functional Theory Study

Thursday, April 24, 2025 9:45 AM (20 minutes)

Abstract

Organic-inorganic hybrid perovskite solar cells (PSCs) are promising for next-generation photovoltaics due to their high power conversion efficiency, tunable bandgaps, and cost-effective fabrication [1]. However, lead toxicity and material instability remain key challenges. This study explores the effects of Bismuth (Bi), Antimony (Sb), and Tin (Sn) doping on the optoelectronic properties of formamidinium-based mixed lead halide perovskites using an ab initio Density Functional Theory (DFT) approach.

DFT calculations using the Generalized Gradient Approximation (GGA-PBE) exchange-correlation functional were performed to analyze the structural, electronic, and optical properties of the undoped perovskite. The bandgap of undoped FAPbI₃ was calculated to be 1.28 eV, aligning well with values suitable for efficient light absorption in solar cells. Structural relaxation confirmed lattice stability in the pristine material.

Currently, one of the selected dopants, Sn doping simulations are in progress to evaluate its effects on bandgap modulation, defect states, and charge transport properties. Preliminary insights suggest that Sn incorporation could enhance light absorption and improve charge carrier dynamics, contributing to overall device performance. Further analysis, including defect formation energies and optical absorption spectra, will provide deeper insight into the viability of doping for optimizing perovskite solar cell efficiency.

This study aims to determine optimal dopant concentrations for enhanced optoelectronic performance

while maintaining structural stability. Further analysis, including defect formation energies and charge

transport characteristics, provided deeper insights into the impact of doping on perovskite solar cells.

References

1. R. Rajeswari, M. Mrinalini, S. Prasanthkumar, and L. Giribabu, "Emerging of Inorganic Hole Transporting Materials For Perovskite Solar Cells," *Chem. Rec.*, vol. 17, no. 7, pp. 681–699, 2017, doi: 10.1002/tcr.201600117.

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Track Classification: Renewable Energy: Energy access

Contribution ID: 89

Type: **Oral presentation**

Effects of matter deposition on the Power output of Mono- and Poly-crystalline solar panels and assembling of automated GSM-based cleaning system

Thursday, April 24, 2025 9:25 AM (20 minutes)

Effects of matter deposition on the Power output of Mono- and Poly-crystalline solar panels and assembling of automated GSM-based cleaning system

The overreliance on unsustainable fossil fuels has shifted attention to the adoption of renewable sources such as solar energy, which also faces power efficiency problems due to low solar energy capture. Accumulation of particulate matter, particularly dust, significantly affects the performance of photovoltaic (PV) solar panels by obstructing light transmittance, thereby reducing output power and degrading system efficiency. This study investigates the effects of dust accumulation of varying particle sizes on the power output of monocrystalline and polycrystalline solar panels installed in Eldoret, Kenya. Dust samples collected from a nearby tarmac road were classified into particle size ranges of 0.748 mm to 3.447 mm and applied in controlled amounts to the panel surfaces. The results indicated that dust particle sizes below 1.97 mm on polycrystalline panels retained more efficiency, while monocrystalline panels performed better for dust particles above 1.97 mm. An average 91% power reduction on polycrystalline panels and 96% on monocrystalline panels was observed for a 60 g dust spread of the mixture of unsorted dust particles on the panels. To mitigate power losses due to dust accumulation, an innovative telecommunications-based cleaning system was developed, leveraging GSM feature phone technology to automate panel cleaning. This system achieved a 64% power restoration by removing accumulated dust without requiring internet connectivity, making it an ideal solution for remote or off-grid regions. This study provides crucial insights into panel selection for dusty environments and introduces a cost-effective, accessible maintenance solution for PV systems.

Keywords: Photovoltaic, Dust particles, efficiency, GSM-based cleaning system.

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Track Classification: Renewable Energy: Solar, wind and geothermal sources of energy

Contribution ID: 90

Type: **Oral presentation**

Assessment of Water Quality in Selected Fish Farms in Uasin Gishu County

Wednesday, April 23, 2025 11:10 AM (20 minutes)

Abstract

This study evaluated water quality across five farms to assess their suitability for fish farming. Efforts to promote fish farming in Uasin Gishu County persist, but research on enhancing fisheries productivity through better pond management remains limited. Most studies focus on production techniques or market development, neglecting the importance of effective pond management for sustainable growth. Key physicochemical parameters, including pH, Biological oxygen demand, Chemical oxygen demand, salinity, conductivity, and temperature, were measured in-situ in selected fish ponds using a Multi-probe HQ40D meter, while water samples for nitrate analysis were collected in triplicate and transported to the laboratory for further analysis. Data analysis involved ANOVA and Kruskal-Wallis tests, with Tukey's and Dunn's tests identifying variations and Fisher's exact test assessing associations between water quality parameters and farm, pond, type, and measurement date ($P \leq 0.05$). Most farms maintained suitable water temperatures (25–30°C), with salinity, pH, and TDS within acceptable limits. However, dissolved oxygen levels often fell below the recommended range (60–100% or 0.1–0.2 mmol/L), which could negatively impact aquatic life. Conductivity showed slight variations, while high COD and BOD levels (exceeding 50 mg/L and 20 mg/L, respectively) indicated organic pollution. Although nitrate levels remained stable, microbial contamination was a significant concern, with coliform and bacterial counts frequently surpassing 10,000 CFU. These findings highlight the need for improved water management to control pollution and ensure sustainable aquaculture. This study found most water quality parameters suitable for aquaculture, but low dissolved oxygen, high BOD and COD, and microbial contamination in some farms could harm fish health and productivity. To enhance water quality, regular pond cleaning, controlled feeding, and monitoring should be prioritized to reduce organic pollution, maintain optimal BOD and COD levels, and control microbial contamination.

Keywords: Water quality, Aquaculture, coliforms, Nitrates.

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Presenter: KOSGEI, Patricia (University of Eldoret)

Track Classification: Restoration of Ecosystems: Management of hydrological systems, to include riparian lands, water towers, water reservoirs, clean rivers and wetlands

Contribution ID: 92

Type: **Oral presentation**

Intelligent Optimization of PI-Controlled Grid-Connected Inverters for Enhanced Power Quality

Thursday, April 24, 2025 11:05 AM (20 minutes)

The increasing penetration of renewable energy sources (solar and wind energy) into modern power grids introduces significant power quality challenges, notably power fluctuations due to their intermittent nature and total harmonic distortion (THD) caused by power electronic-based interface devices, such as grid-connected inverters. Addressing these issues requires robust control strategies to enhance system stability and efficiency. This study implements a proportional-integral (PI) current control strategy optimized using Genetic Algorithm (GA) and Particle Swarm Optimization (PSO), with Ziegler-Nichols (Z-N) tuning serving as a benchmark. The performance of the control strategy is evaluated using the Integral Time Absolute Error (ITAE) metric. Simulation results demonstrate that PSO yields superior control accuracy, reducing ITAE to 0.1605 for the D-axis and 0.1491 for the Q-axis control, followed by GA with 0.2053 and 0.1519, while Z-N records significantly higher values of 1.7658 and 1.6595, respectively. In terms of power quality, the total voltage harmonic distortion (THD_V) remains at 0.0% due to effective filtering, while the total current harmonic distortion (THD_i) is minimized to 0.17% with PSO, compared to 0.21% for GA and 1.98% for ZN. The optimized PI control strategy ensures that THD values comply with IEEE 519-2014 and IEC 61000-3-6 Standards, demonstrating its effectiveness in mitigating power fluctuations, reducing harmonics, and improving grid stability. These findings emphasize the critical role of intelligent optimization in enhancing power quality for grid-connected renewable energy systems.

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Co-authors: Prof. DIVINE KHAN, Ngwashi (Lecturer); Prof. TSAFACK, Pierre (Lecturer)

Presenter: ETANYA, Tiku Fidelis (PhD Student)

Track Classification: Renewable Energy: Solar, wind and geothermal sources of energy

Contribution ID: 93

Type: **Oral presentation**

Optimizing Sweet Potatoes Yield: An Advanced Modelling using SORDs Constructed using Trigonometric Functions

Wednesday, April 23, 2025 3:25 PM (20 minutes)

Sweet potato (*Ipomoea batatas*) is a vital food crop with the potential to enhance global food security. However, its yield optimization remains a challenge due to soil fertility variations, climatic factors, and inefficient agronomic practices. Traditional experimental designs often fail to capture complex interactions between variables, necessitating advanced optimization techniques. This study employs second-order rotatable designs (SORD) constructed using trigonometric functions to model and optimize sweet potato yield under different organic fertilizer applications. The objective is to determine the most effective combination and application rate of poultry, goat, and rabbit manure for maximizing yield. A SORD with 23 design points was implemented to ensure uniform precision across the factor space. Field experiments were conducted using randomized block designs, and data were analyzed using response surface methodology (RSM). The results indicate that poultry manure significantly enhances sweet potato yield compared to goat and rabbit manure. However, a combination of poultry and goat manure in a 3:2 ratio provided the highest yield increase. The trigonometric-based SORD approach effectively captured interactions and quadratic effects, leading to precise yield optimization. The study concludes that SORD constructed with trigonometric functions offers an efficient framework for optimizing crop yield under varying soil fertility conditions. It is recommended that farmers adopt a mixed manure approach to improve sweet potato productivity sustainably. Further research should explore the integration of additional soil amendments, long-term soil health effects, and the impact of climate variability on sweet potato yield using advanced modeling techniques.

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Presenter: Dr MATUNDURA, DENNIS (MOI UNIVERSITY)

Track Classification: Emerging Technologies to adapt and mitigate climate change effects: Smart and sustainable agriculture

Contribution ID: 94

Type: Abstracts

LEVERAGING ON WETLAND MONITORING AND MANAGEMENT APP: A CASE OF KINGWAL AND YALA SWAMP AREAS

Tuesday, April 22, 2025 11:05 AM (20 minutes)

ABSTRACT

Wetlands play a critical role in biodiversity conservation, water purification, and climate regulation. However, these ecosystems face increasing threats due to human activities, climate change, and inadequate monitoring frameworks. This study explores the development and implementation of a Wetland Monitoring and Management App designed to enhance the conservation and sustainable use of Kingwal and Yala Swamp areas in Kenya. The app leverages emerging technologies such as GIS mapping, remote sensing, IoT sensors, and AI-driven analytics to provide real-time data on wetland health, water levels, biodiversity status, and potential environmental threats. Through stakeholder engagement, including local communities, environmental agencies, and researchers, the app aims to facilitate informed decision-making and improve wetland governance. The study evaluates the effectiveness of the application in monitoring ecosystem changes, enhancing community participation, and supporting policy implementation. The findings underscore the importance of digital solutions in promoting sustainable wetland management and recommend strategies for scaling up technology-driven conservation initiatives.

Key words:

Wetland monitoring, environmental conservation, GIS, remote sensing, AI analytics, sustainable management, biodiversity conservation.

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Presenter: Prof. OMIENO, Kelvin (Kaimosi Friends University)

Track Classification: Restoration of Ecosystems: Management of hydrological systems, to include riparian lands, water towers, water reservoirs, clean rivers and wetlands

Contribution ID: 95

Type: **Oral presentation**

The effect of Coumarin additives on optoelectronic properties and power conversion efficiency of Formamidinium based-perovskite solar cells.

Thursday, April 24, 2025 8:45 AM (20 minutes)

Perovskite solar cell (PSC) is among the emerging photovoltaic technologies known for their high solar power conversion efficiency (PCE) and low manufacturing costs. However, their solution-based processing leads to the formation of defects within the bulk of the perovskite layer and at its interfaces with the charge transport layers. These defects act as charge trapping centers and provide the degradation routes which not only reduces the PCE of perovskite solar cells but also leads to instability issues. Various defect passivation strategies have been developed but the use of additives appears to have gained preferences over the others. In this work, 1-D Solar cell capacitance simulator (SCAPS-1D) was employed to study the effects of Coumarin additive on the PCE of formamidinium-based PSC. Parametric studies were carried out on the Coumarin modified PSC device in order to identify routes for further improvement in the PCE. It was found that a further reduction in defect density, band gap and series resistance together with an increase in the charge carrier mobilities are important in achieving higher PCE. This study provides an insight into the role of additives in enhancing the PCE of PSC and the output serves as a reference to guide the design of effective experimental model PSC devices.

Keywords: Coumarin additive, perovskite film, power conversion efficiency, SCAPS-1D.

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Presenter: Ms CHEPNGETICH, Naomy (Chepngetich N)

Track Classification: Emerging Technologies to adapt and mitigate climate change effects: Research and innovation towards green energy: hydrogen cells, carbon dioxide batteries, and hybrid technologies among others

Contribution ID: 96

Type: **Oral presentation**

AI-Driven Early Warning System for Climate Disaster Prediction Using LSTM Networks

Climate change has led to an increase in the frequency and severity of extreme weather events, including floods, droughts, and heat waves, posing significant threats to vulnerable communities. Traditional early warning systems often fail to provide accurate and timely predictions due to the complexity and non-linearity of climate patterns. This project proposes an AI-driven Early Warning System (EWS) using Long Short-Term Memory (LSTM) networks to enhance climate disaster prediction and preparedness.

The study will utilize time-series climate data (rainfall, temperature) sourced from meteorological stations. The data will be preprocessed and fed into an LSTM-based deep learning model to capture long-term dependencies and trends in climate variations. The model's performance will be evaluated using Root Mean Square Error (RMSE), Mean Absolute Error (MAE), and R-squared (R^2) scores to ensure accuracy and reliability.

The developed system will be integrated with real-time climate monitoring infrastructure and deployed for automated disaster alerts via mobile applications, SMS, and web-based platforms. The expected outcome is a robust, AI-powered early warning system that enhances disaster preparedness, reduces loss of life and property, and supports policymakers in climate risk mitigation strategies. This study contributes to achieving Sustainable Development Goal 13 (Climate Action) by leveraging Big Data and AI to enhance climate resilience in affected regions.

Authors: TANUI, Alfred (Student at Moi University); Mr CHACHA, Mwita (Student at Moi University)

Presenters: TANUI, Alfred (Student at Moi University); Mr CHACHA, Mwita (Student at Moi University)

Track Classification: Emerging Technologies to adapt and mitigate climate change effects: Big data and AI for climate change solutions

Contribution ID: 97

Type: **Oral presentation**

Seasonal variation in diet quality of women and young children from two agro-ecological zones in Kenya

Wednesday, April 23, 2025 11:50 AM (20 minutes)

Background and objective: Climate change can disrupt food availability, reduce access to food, and affect diet quality. This study examined the effect of seasonality on household dietary diversity (HDDS) and diet quality of women and children in two agro-ecological zones of Rongai sub-county, Nakuru, Kenya.

Methodology: A cross-sectional study of 388 mother-child pair was conducted during lean and plenty season. Household food insecurity access scale was used to measure food security. The HDDS were computed based on 12 food groups. A 24-Hour Dietary Recall was used to generate dietary diversity scores (DDS) of women and children.

Results: The HDDS of households from low agricultural potential areas was not affected ($P>0.05$) by seasonality despite increased food access during plenty season (57.3%) as compared to lean season (36.8%). However, in high potential areas, food access increased ($P>0.05$) from 55.8% to 73.5% while HDDS decreased. Women who achieved minimum dietary diversity (MDD) increased [low potential areas (13.9% vs. 57.8%, $P<0.001$)] and high potential areas [20.0% vs. 49.1%, $P<0.001$]] in lean and plenty seasons respectively. Furthermore, children who achieved MDD significantly decreased from 58.9% in lean season to 47% during plenty season in low potential areas while there was no change in the dietary diversity of children from high potential areas. Binary logistic regression showed no effect of seasonality on child diet quality, however, seasonal changes significantly ($P<0.001$) reduced household food access, HDDS and diet quality of women.

Conclusion and Recommendation: Child diet quality was not affected by seasonal variations in the two agroecological zones; however, it negatively affected household food access, household dietary diversity and diet quality of women. It is important to develop targeted season-specific nutrition interventions to adequately address food access and diet quality for improved nutrition outcomes.

Author: Dr CHESEREK, Maureen (Egerton University)

Co-authors: Dr RAMKAT, Rose (Moi University); Dr MITUKI, Dorothy (Egerton University)

Presenter: Dr CHESEREK, Maureen (Egerton University)

Track Classification: Cross-cutting areas: Climate change, food security and impact on livelihoods

Contribution ID: 98

Type: **Oral presentation**

Innovative bioremediation of heavy metals in Aquatic ecosystems: Harnessing polar crude phytochemical for targeted extraction of metal ions

Thursday, April 24, 2025 2:30 PM (20 minutes)

The study explored the efficacy of polar phytochemicals from South African plants as eco-friendly alternatives for water purification. These phytochemicals demonstrated significant potential in removing heavy metals from aqueous solutions. Specifically, they efficiently extracted iron(III) ions, achieving a removal rate exceeding 80%, while lead(II) and copper(II) ions are removed at rates of over 40% and 20%, respectively, even in the presence of eight other metal ions.

Author: KIPRUTO, Hillary (Kisii University)

Co-authors: Prof. HUSSEIN, Ahmed (Cape Peninsula University of Technology); LUCKAY, Robert (Stellenbosch University)

Presenter: KIPRUTO, Hillary (Kisii University)

Track Classification: Pollution and waste management: Heavy metals pollution: bioremediation of heavy metals in water bodies and aquatic systems

Contribution ID: 99

Type: **Oral presentation**

AI and Big Data Technologies For Renewable Energy Management

Thursday, April 24, 2025 10:42 AM (20 minutes)

Energy is an essential element, but its negative consequences such as environmental deterioration, resource depletion and energy dependencies puts energy efficiency alternatives/or solutions in the spotlight. Therefore there is need for the fusion of AI and Big data in promoting sustainable growth in the renewable energy sector, AI and Big Data focuses on optimizing algorithms, reducing computational needs, and using renewable energy. These technologies are main drivers for transformative approach towards achieving Sustainable Development Goals (SDG), Mainly SDG 7(Affordable and clean energy),SDG 9(Industry, Innovation and Infrastructure) and SDG 13 (Climate Action).This study will explore the role of AI and Big Data in renewable energy and sustainable development. The methodology will employ text mining techniques to refine AI and Big Data concepts into targeted keywords, with further filtering via the All Science Journals Classification system and SDG-mapping tools to identify publications most relevant to renewable energy applications. The research specifically investigates how predictive analytics can forecast future energy demands, assess climate risks, and identify renewable energy potential across different regions. By identifying best practices and innovation opportunities at this intersection, this study aims to provide a framework that can accelerate progress toward energy sustainability and support global efforts to achieve a net-zero future.

Keywords (Artificial Intelligence, Big Data, Sustainable Development Goals, Renewable Energy, Net Zero)

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Presenter: SAMOEI, IRINE (Moi University)

Track Classification: Emerging Technologies to adapt and mitigate climate change effects: Big data and AI for climate change solutions

Contribution ID: **100**

Type: **Oral presentation**

Farmers adaptation to climate change in Nakuru County, Kenya

Wednesday, April 23, 2025 9:05 AM (20 minutes)

Abstract

Author: KARANI, Leonard (Moi University)

Co-authors: Dr SEREM, Alfred (Moi University); Prof. JOURDAIN, Damien (University of Pretoria); Dr CHEMWOK, Philip (Moi University); Dr RAMKAT, Rose (Moi University)

Presenter: KARANI, Leonard (Moi University)

Track Classification: Cross-cutting areas: Climate change, food security and impact on livelihoods

Contribution ID: 101

Type: **Oral presentation**

Thermal Neutron diffusion deceleration inside an infinite dimensions moderator. Calculating neutron age and slowing down of length for fission of neutrons, average energy to thermal energy of Graphite and Beryllium.

Tuesday, April 22, 2025 2:36 PM (20 minutes)

Abstract: nuclear energy is clean energy technology as it produces zero greenhouse emissions. Most of the nuclear reactor products are from (n, γ) reactions. These are free neutrons with kinetic energy and have a large effective cross-section. Our objective was to examine the solution of the partial differential equation for the case in which the medium is unbounded, calculate the neutron age and thermal energy for C and Be. The stationary equation of the transfer of neutrons with simplifying assumptions leads to the function S which describes the source of neutrons, the required quantity $u(x, \tau)$ is the concentration of neutrons per unit time, reaching the age τ ; consequently, u is the density of deceleration. The solution was found by introducing the Fourier map $U(\xi, \tau)$ of the density of deceleration $U(x, \tau)$. Taking into account the behavior of the density of deceleration at infinity, we obtained $u(\xi, \tau) = (2\pi)^{-1/2} e^{-\xi^2 \tau}$. When neutrons reach a specific velocity, they cease to lose energy and their motion can be described using classical theory of diffusion. If the medium is infinite, we introduced Fourier images for p and q ; expressed through the value of the function $q(z)$. The calculated neutron age for graphite and beryllium were found to be 12 and 9 respectively. In order to simplify the calculation, a continuous loss of energy for slowing down neutrons was assumed in the state of actual discontinuous energy loss.

Author: MARITIM, Joseph (Moi University)

Presenter: MARITIM, Joseph (Moi University)

Track Classification: Emerging Technologies to adapt and mitigate climate change effects: Green technologies, bio-innovations and sustainable chemistry

Contribution ID: 102

Type: **Oral presentation**

Neutron capture reaction of ^{197}Au characterized by $\Gamma_\gamma=0.124\text{eV}$ and $\Gamma_n=0.007E^{(b/2)}\text{eV}$ and the role of exotic neutron rich nuclei

Thursday, April 24, 2025 10:25 AM (20 minutes)

Abstract: The use of nuclear energy offers numerous peaceful applications in the generation of electricity, medical diagnostics and treatment, agricultural advancement and food preservation. The main aim was to apply the concept of the cross-section to resonance in a quantitative manner. It gave the value of a single resonance level formed by an incident particle with zero angular momentum and charge zero so that the spin and the coulomb effects were not taken into consideration. The level of compound nucleus is bound, the excitation by incident particle was treated as oscillation produced by electromagnetic wave. We varied the nuclear cross-section with the incident energy, the same way the energy in a forced oscillation varies with incident frequency. In classical treatment, resonant circuits absorb energy because of resistive levels. For the case of nuclear, damping arises because of decay possibilities, hence nuclear states have a finite width Γ . A decaying state wave function of mean energy E_0 corresponds to an exponential decrease of intensity of excitation. It is via the r-process that exotic neutron rich nuclei play an important role in the formation of heavy elements. The result showed that a decaying state is not a function of definite energy E_0 . A sharp resonance corresponds to a narrow width, hence the peak cross-section is 3.446×10^{43} barns and was analogous to the dispersion formula. The compound formed nucleus in this resonance absorption has a spin 2. Improved nuclear structure and reaction calculation gives a better understanding of radiative capture rates of light-nuclei and medium-nuclei which affects the abundance of heavier nuclei.

Author: MARITIM, Joseph (Moi University)

Presenter: MARITIM, Joseph (Moi University)

Track Classification: Renewable Energy: Solar, wind and geothermal sources of energy

Contribution ID: 103

Type: **Oral presentation**

Modeling Potassium Phosphite Induced Pathogenic tolerance in Tomato plant to Bacterial Infection and Insect Herbivory

Tuesday, April 22, 2025 2:11 PM (20 minutes)

Human population in the world is continually soaring high and the impact on the environment has led to global warming and food security issues. Innovation and the use smart technology in agricultural production has led to the mitigation food security issues. This advanced production techniques is not limited to genetic modification, but also encompasses mechanical advancement and investment in laboratory trials for improved varieties of propagative materials, high yields and tolerance to environmental stress and pathogens. Mathematical modelling is not left behind, as an invaluable tool that supplements laboratory and field experiments. In this research, a mathematical model was formulated to simulate induced defense mechanism of Tomato plant. This model was formulated using Enzyme-Substrate reaction pathways and simulated using SIMBIOLOGY software, using eight variables and associated parameters. It was shown that tolerance to Bacterial, Fungal and Viral infection was seen to be significantly high as compared to untreated plants, and white fly herbivory reduced. This induced tolerance was triggered using Potassium Phosphite treatment as an elicitor, to initiate a cascade of Enzyme-Substrate reaction which activated the production of Tomatine, Phytoalexins, and other Phytoalexins and defense genes. It was shown that treated tomato plants were less susceptible to infection, up to $s \leq 0.15$, while untreated tomato plants were highly susceptible up to over $s \leq 0.69$. The production of growth inhibitors was significantly reduced for treated plants and eventually the yield of treated plants increased by $y \geq 57\%$. The results can also be applied to induce Systemic Acquired Resistance of crops to Insect herbivory, especially on desert Locust (*Schistocerca gregaria*) a real devastating factor to crop production.

Author: ROTICH, Titus (Moi University)

Presenter: ROTICH, Titus (Moi University)

Track Classification: Cross-cutting areas: Climate change, food security and impact on livelihoods

Contribution ID: 104

Type: Oral presentation

Mathematical Modeling and Parameter Estimation of an Optimal Solar Food Dryer

Thursday, April 24, 2025 10:45 AM (20 minutes)

Eminent threat caused by post-harvest losses due to inadequate drying and poor storage is responsible for up to 40-60% losses of agricultural produce each season. In order to address this issue, this paper seeks to formulate a mathematical model and simulate the characteristics of a solar dryer for the purpose of designing an effective and sustainable, low cost thermal solar dryer suitable for dehydrating a variety of agricultural products. The modeled solar food dryer has four major parts, namely: Solar heat collector: Closed loop pipe network: Heat exchangers: and the Drying Chamber. The mathematical model was formulated using differential equations, and simulation using SIMULINK. The simulation results showed that, a solar collector with aperture area of $A_c=14.4\text{m}^2$ and a fluid volume of $V_c=500\text{l}$, when exposed to solar irradiation of $I_c=1.367\text{KW/m}^2$ at $\eta_c=80\%$ efficiency is able to heat water from $T_{in}=22^\circ\text{C}$ to $T_{co}=70^\circ\text{C}$ in 12 hours at a flow rate of $\dot{v}_c=1.128\text{l/s}$. This energy if transmitted by insulated pipes to a set of 5 heat exchangers each of area $A=1\text{m}^2$, and radiative heat transfer coefficient $h_r=100\text{W/m}^2\text{K}$ cumulatively dissipates hot air of maximum 230°C at $\dot{v}=250\text{cm}^3/\text{s}$, and minimum of 90°C at $\dot{v}=2000\text{cm}^3/\text{s}$ air mass flow rate. This output temperatures of dry air is regulated as desired according to the specifications of the food products to be dried. In absence of solar energy, Liquefied Petroleum Gas is intermittently used depending on the level of solar insolation. It was found that the optimal cost of the gas in this energy mix is reduced by over 67.86%. This strongly makes the use of solar in food dryers an ideal green energy to be used in mitigating post-harvest losses.

Authors: KORKOREN, Kenneth (Moi University); ROTICH, Samwel (Moi University); ROTICH, Titus (Moi University)

Presenter: KORKOREN, Kenneth (Moi University)

Track Classification: Renewable Energy: Solar, wind and geothermal sources of energy

Contribution ID: 105

Type: **Oral presentation**

Mathematical Modelling of Energy Mix and Optimization of Renewable Energy

Thursday, April 24, 2025 11:25 AM (20 minutes)

With energy as direct and indirect fundamental life supporting resource, the domestic and industrial demands for energy has been rising due to technological advancement, population increase, and economic growth. Various sources of energy including use of fuels, hydro-electric energy, geothermal energy, wind energy, solar energy and nuclear energy are all available alternative sources of energy in different proportions. Production and distribution of energy in an attempt to satisfy the inhomogeneous individual needs, in tandem with the desire to conserve the environment, has been a complex problem, with pertinent constraints including demand, supply, production, distribution and environmental impact dynamics. Mathematical Modelling of Energy Mix and stability in the interchange is considered in this research as a feasible solution to the losses through leakage and wastage, caused by distribution of unused power loading. Through the analysis of individualized demands and associated production and distribution cost. The objectives of this study is to formulate a mathematical model to analyse and determine the desired parameter thresholds that guarantee stability and robustness of energy variation. This is done using Neural Networks feedback control algorithms, with adaptation so as to automatically control and maintain the optimal stability of energy levels during changeover. Using three types of users: Household, School and Small Commercial Enterprise, simulated results show that energy shifts is stable, with a peak time $t_p=0.4s$ and power overshoot of 18.5%. This is stabilized to acceptable tolerance of 2% in a settling time of $t_s=4.35s$. Energy cost analysis showed that the Energy Mix of Hydro Electricity (E), Solar Power (S) and use of LPG Gas (G) is optimal when used in the ratio E:S:G=6:129:1. Using a Smart Grid system, all sources of energy can be intelligently mixed for the achievement of optimal individualized energy consumption and distribution mix.

Authors: SIGEL, Robert (Moi University); ROTICH, Titus (Moi University); KOECH, Wesley (Moi University)

Presenter: SIGEL, Robert (Moi University)

Track Classification: Renewable Energy: Energy access

Contribution ID: 106

Type: **Poster presentation**

CARBON MITIGATION

Thursday, April 24, 2025 2:30 PM (20 minutes)

ABSTRACT

Climate change poses one of the most pressing challenges of our time, driven predominantly by increased concentration of Carbon Dioxide. CO₂ and other greenhouse gases (GHGs) in the atmosphere. This manuscript explores various strategies for carbon mitigation. Addressing the road for immediate action to reduce emissions and enhance carbon sequestration. We delve into the role of renewable energy, energy efficiency, sustainable transportation, reforestation, carbon capture and Storage, the (CCS), and policy frameworks that foster collective action, the document aims to provide a consolidated overview of the current methods challenges and the importance of an integrated approach to achieve a global climate target.

KEY NOTE/ KEY RECORD

Provide a brief description of your project

Docklands enterprises is dedication its time and efforts to tackle the effects of climate change by leveling the power of science and technology on ecosystem restoration with intricate technical details of carbon ratio science of which we carryout periodical operation in the laboratory to oversee collections and analysis of the sample collected to measure carbon levels stored in different decaying matter soils and vegetation's, these are then qualified by measuring each carbon pool individually with a mission to restore land to at least its functional state and to a scale that can reverse the damages of climate change and ecosystem biodiversity less with the local community at helm, to lead innovate and make tangible impacts in Kenya and globally.

INTRODUCTION
Climate change is not merely an environmental, it concerns an existing threat that affects the ecosystem, the economies and the communities worldwide. The Inter-governmental Panel on Climate Change (IPCC) asserts that to limit global warming to 1.5°C above pre-industrial levels and to reach net zero by around 2050, And achieving this goal necessitates a multifaced approach to carbon mitigation.

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Presenter: Mr MUTUKU, Brian (speaker)

Track Classification: Cross-cutting areas: Other cross-cutting areas

Contribution ID: 107

Type: **Oral presentation**

Application of Response Surface Methodology on the yield of maize as a fodder crop

Wednesday, April 23, 2025 4:30 PM (20 minutes)

Maize is one of the staple foods in Kenya, and it is gaining prominence as an animal fodder crop for cattle farmers. As technology improves, and people abandon the traditional nomadic pastoralism, there is a need to have adequate storage of animal feeds to sustain animals around the season. The most important quality of fodder crops is to be lush, tall, and bushy, a characteristic determined by nitrogen uptake, facilitated by water, phosphate, and potassium. In this research, the investigation sought to ascertain the optimal vegetative yield of maize with minimum water supply using Response Surface Methodology (RSM) in semi-dry soil enriched with NPK, in a controlled greenhouse environment. The experimental treatments were determined using the Central Composite Design based on varying levels of water supply (10%, 25%, and 50% of soil field capacity), nitrogen (10, 15, and 25 g hole⁻¹), and phosphorus and potassium equally applied at (5, 10, 15g hole⁻¹). The investigation's findings demonstrated that increased nitrogen fertilization rate positively influenced all agronomic traits, but left high nitrogen concentrations in the soil due to minimal absorption media. Nitrogen increased plant bush weight, and leave area, but minimal water supply curtailed the plant height and agronomic attributes. The optimal levels of irrigation and nitrogen fertilizer were found to be 42.73 –47.80%, and 3.38–5.69 g hole⁻¹ respectively. The optimal amounts for NPK retention in soil and plant uptake were 82.57 –98.00%, and 4.20–5.98 g hole⁻¹, respectively. The study concluded that plants with minimal water supply, like that of semi-arid areas, require nitrogen levels not greater than 50% per hole, since excess was seen to cause leave necrosis. The availability of other nutrients was however seen to plant biomass and enhance nutrient uptake.

Authors: KENY JEPTOO, Silver (Moi University); ROTICH, Titus (Moi University)

Presenter: KENY JEPTOO, Silver (Moi University)

Track Classification: Cross-cutting areas: Climate change, food security and impact on livelihoods

Contribution ID: 108

Type: Oral presentation

Influence of Co-ions and Water Matrices on the Removal of Tetracycline in Wastewater using Eosin Y Sensitized g-C₃N₄/ZnFe₂O₄

This study investigated the removal of tetracycline from wastewater using solar photocatalysis in a parabolic trough reactor. The Eosin-Y sensitized photocatalyst was fabricated using a three-step procedure involving direct annealing of melamine to yield g-C₃N₄, which was thermally exfoliated, hydrothermal precipitation reaction between g-C₃N₄, zinc chloride and iron chloride and a final dye sensitization step of the resultant composite using the mixing-adsorption method. The degradation performance of the photocatalyst was GCN < ZF < 25%ZF/GCN < EY-25%ZF/GCN. Faster degradation kinetics were observed in experiments conducted in synthetic wastewater compared to real wastewater. This was attributed to the interference of aromatic groups, competing ions and water turbidity. The effect of coexisting ions such as (Cl⁻, NO₃⁻ and SO₄²⁻) was also assessed at 100, 300, and 500mg/l concentrations of NaCl, Na₂SO₄, and NaNO₃, respectively in real wastewater. The low doses (100mg/l) of Cl⁻ and NO₃⁻ had a promoting effect of 0.75% and 5.26%, respectively, on the degradation constant, while higher doses inhibited degradation. Total Organic Carbon (TOC) studies carried out at 100mg/l salt concentrations showed that co-ions of SO₄²⁻ had the lowest TOC removal (37.02%) while Cl⁻ ions had the highest. Similarly, the SO₄²⁻ ions had the highest inhibition effect on tetracycline degradation, while Cl⁻ ions had the lowest. These findings confirm that high concentrations of anions decrease the photocatalytic performance of photocatalysts in wastewater, hence the need for adequate pre-treatment before applying photocatalytic treatment of real wastewater.

Author: MUTUMA, Humphrey (The Nairobi National Polytechnic)

Co-authors: Prof. ACHISA, Cleophas (The University of Arizona); Prof. M'ARIMI, Milton (Moi University)

Presenter: MUTUMA, Humphrey (The Nairobi National Polytechnic)

Track Classification: Pollution and waste management: Heavy metals pollution: bioremediation of heavy metals in water bodies and aquatic systems

Contribution ID: 109

Type: **Oral presentation**

Seed Banks for Tree Cover and Forest Restoration in Kenya

Tuesday, April 22, 2025 2:59 PM (20 minutes)

The massive forest degradation caused by anthropogenic activities and exacerbated by climate change has signaled the need for forest habitat restoration efforts. The most appropriate way of restoring these forests is through tree planting where the need for seeds is paramount. Traditionally, seeds for restoration activities have mainly been sourced through collections from the wild, which is unsustainable. In order to ensure responsible restoration practice, Foresters and restoration practitioners continued to explore other options of economical, ethical and sustainable sourcing of seeds. Seed banks can leverage on technical and infrastructural capacity to play a greater and more direct role in supporting biodiversity and ecosystem conservation and restoration, particularly through the supply of quality ecologically and genetically suitable seeds. This paper reviews the use of seed banks in enhancing tree cover and forest restoration in Kenya. This review focuses on status of seed banks in Kenya, seed collecting, field-based seed bulking, handling and storage, seed quality control as well as experience and capacity in facilitating germplasm exchange. Five key roles of seed banks in Kenyan forestry sector include preserving genetic diversity, biodiversity conservation, protect species from extinction, plant breeding programmes and ecological restoration. Technical and physical capacity for ecosystem restoration seed supply available in seed banks in Kenya included availability of germplasm, seed processing, storage, quality assurance and control and germplasm exchange. In Kenya, seed banks have established close working relationships with various experts in making it easy to find information on species phenology, distribution patterns, optimum collecting time and sites with appropriate restoration seeds. Most restoration projects in Kenya give little consideration to seed quality control and assurance. There is a need to explore how the resources amassed through the largely successful ex situ conservation initiatives and efforts can be used to support in situ conservation and restoration activities.

Author: KINYILI, Dr. Benjamin (Kenya Forest Service)

Presenter: KINYILI, Dr. Benjamin (Kenya Forest Service)

Track Classification: Biodiversity and Natural Resource management: Seed banks for indigenous trees

Contribution ID: 110

Type: **Oral presentation**

Status of Forest Landscape Restoration in Kenya

Tuesday, April 22, 2025 10:25 AM (20 minutes)

Kenya has set an ambitious 15 Billion Tree Growing Strategy for Landscape and Ecosystem Restoration with goals to increase and maintain 30% tree cover by 2032, to restore 10.6 million ha of degraded landscape by 2032 and to reduce 32% of its greenhouse gas emissions by 2030. The Forest Landscape Restoration Implementation Action Plan (FOLAREP) 2022-2026 seeks to restore 2.55 million ha of degraded landscapes through integrated approaches and best practices. Additionally, a multi-stakeholder Technical Working Group on Restoration Monitoring has been convened to support sustainable Forest Landscape Restoration (FLR) efforts in the country. As part of the consultation process, seven engagement forums bringing together national government, all 47 counties, the Council of Governors and development partners were held between December 2021–March 2022. These engagements reveal that Kenya's top barriers to restoration are financial constraints, inadequate policy and legislative frameworks, low sensitization on FLR, land ownership, and limited human and technical capacity on FLR. The top drivers to degradation are population pressure, poverty, overstocking, encroachment, and overgrazing. County Environment Committees (CECs), which are crucial to mainstreaming FLR at the county level, are active in 18 of the 47 counties. In addition, 25 of 47 counties mention county climate change entities as critical to enhance the CECs' FLR functions. Top indicators selected by counties as important for a national restoration monitoring system include areas of restored forest and agricultural lands, biodiversity revived and access to safe water. Counties present unique FLR monitoring structures, with some entities and departments such the CECs, the Monitoring and Evaluation Committee and Units featuring structures across several counties.

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Presenter: KINYILI, Dr. Benjamin (Kenya Forest Service)

Track Classification: Restoration of Ecosystems: Restoration of natural landscapes, to include mining areas, water catchment areas

Contribution ID: 111

Type: **Oral presentation**

Rehabilitation and cleaning of urban rivers: case study githurai river, kiambu county

Abstract

The Githurai River faces severe environmental degradation due to improper waste management and pollution just like many urban rivers. With the adverse challenges posed by rapid urbanization, industrial activities, and inadequate waste disposal systems have led to extensive contamination, affecting water quality, aquatic ecosystems, and public health. The presence of dumpsites, e-waste, industrial waste, and heavy metal pollution has led to environmental hazards, necessitating urgent intervention.

Open dumpsites along the riverbanks contribute significantly to pollution, as unregulated disposal of household and commercial waste leads to the leaching of toxic substances into the water. Also the improper disposal of e-waste introduces hazardous chemicals such as lead and mercury into the environment, endangering both aquatic life and human populations. Industrial activities also discharge untreated effluents containing heavy metals like chromium and zinc further deteriorating the river's ecological balance.

The contamination of Githurai River by heavy metals poses a significant threat to aquatic ecosystems, leading to bioaccumulation in fish and other aquatic organisms. This in turn affects biodiversity and increases health risks for communities that rely on the river for domestic use and food sources. Sustainable waste management strategies including proper segregation, recycling and treatment of industrial effluents are essential to mitigate these impacts. Strengthening regulatory frameworks enforcing strict waste disposal laws and promoting community awareness can enhance pollution control efforts.

To restore the Githurai River, an integrated approach involving local authorities, industries, and community participation is needed. Implementing eco-friendly industrial practices will help reduce pollution levels and safeguard water resources. Addressing pollution and waste management challenges is crucial for maintaining environmental sustainability and ensuring a sustainable ecosystem for future generations.

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Presenter: KAMUCUGU, Solomon (Student)

Track Classification: Pollution and waste management: Heavy metals pollution: bioremediation of heavy metals in water bodies and aquatic systems

Contribution ID: 112

Type: **Oral presentation**

ETHICAL CHALLENGES OF BIOFUEL EXPANSION IN KENYA

Biofuels, promoted as a renewable solution to mitigate greenhouse gas emissions driving climate change, can reduce emissions by up to 41% compared to fossil fuels (Jeswani et al., 2020). However, their production raises significant ethical concerns, particularly in Kenya, where land use conflicts, food security threats, and social inequities challenge sustainability goals. This paper examines Kenya's biofuel policies, anchored in the Energy Act of 2006 and an unfinalized 2011 draft National Biofuel Policy, which prioritize economic gains such as job creation but lack robust environmental and social protections (Nature Kenya, 2024). Key ethical issues include the conversion of natural habitats into croplands, undermining biodiversity and violating small farmers' land rights as foreign investors gain precedence, and the diversion of agricultural land for biofuel feedstocks, exacerbating food shortages, price increases, and future water scarcity. Foreign entities often disproportionately benefit, while anthropocentric policy biases neglect ecosystem health, as seen in land use changes contributing to erosion and soil salinity. Despite economic potential, policy gaps—such as inadequate land use regulations—fail to address biodiversity loss and social displacement, highlighting the absence of a robust ethical framework. This analysis underscores the critical need to reconcile energy ambitions with equitable and sustainable outcomes in Kenya's biofuel expansion.

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Presenters: Mr BOSIRE, FELIX (Rongo University); Prof. NTABO, Michael (Rongo University)

Track Classification: Renewable Energy: The future of biofuels

Contribution ID: 113

Type: **Oral presentation**

In Vitro Evaluation of Green-Synthesized Silver Nanoparticles (AgNPs) for the Management of *Xanthomonas citri* and *Tylenchulus semipenetrans*

Tuesday, April 22, 2025 3:00 PM (20 minutes)

Citrus production faces major threats from *Xanthomonas citri* subsp. *citri*, the causative agent of citrus canker, and *Tylenchulus semipenetrans*, the citrus nematode, both of which contribute to significant yield losses worldwide. Emerging evidence suggests potential interactions between these pathogens, exacerbating disease severity and complicating management. Conventional control methods, including chemical pesticides and antibiotics, pose environmental risks, contribute to antimicrobial resistance, and may negatively impact non-target organisms. Therefore, there is an urgent need for sustainable and eco-friendly management strategies. This study will investigate the efficacy of green-synthesized silver nanoparticles (AgNPs) in controlling *X. citri* and *T. semipenetrans* through in vitro assays. AgNPs will be synthesized using plant extracts as reducing and stabilizing agents, ensuring an environmentally friendly production method. Characterization of the synthesized AgNPs will be conducted using UV-Vis spectroscopy, Fourier-transform infrared (FTIR) spectroscopy, and scanning electron microscopy (SEM) to confirm their properties. The antibacterial activity against *X. citri* will be assessed using agar well diffusion and minimum inhibitory concentration (MIC) assays, while the nematicidal effect on *T. semipenetrans* will be evaluated through motility inhibition and mortality tests. Additionally, co-inoculation studies will be performed to investigate possible interactions between the bacterium and the nematode in vitro and assess whether AgNPs can disrupt these interactions. By developing a green nanotechnology-based alternative, this research aims to promote an environmentally sustainable and innovative approach to citrus disease management. The use of biosynthesized AgNPs could minimize reliance on chemical pesticides, reduce environmental contamination, and contribute to climate change mitigation by promoting sustainable agricultural practices.

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Presenter: BISHIR, Sadiq (Moi University)

Track Classification: Cross-cutting areas: Climate change, food security and impact on livelihoods

Contribution ID: 114

Type: **Oral presentation**

HARNESSING COMMUNITY TRADITIONAL VALUES FOR ECOSYSTEM PRESERVATION: CASE OF KAPTAGAT FOREST OF ELGEIYO MARAKWET COUNTY OF KENYA.

Tuesday, April 22, 2025 10:45 AM (20 minutes)

The expansive Kaptagat forest is a scenic landscape of Elgeyo-Marakwet County in Kenya, covering over 6,000 hectares. It is a crucial water catchment area, serving the water needs of Elgeyo-Marakwet County-40% and Uasin Gishu county-55%. Eldoret City gets about 30,000m³/day. However, this forest's fragile ecosystem is now greatly endangered by climate change and uncontrolled human activities like deforestation, overgrazing and charcoal production. Urgent remedial actions are required for its preservation. Harnessing the traditional values of the local community living next to the forest constitute one unique yet results laden action. The Keiyo History Culture & Heritage Centre: a coming together of community professionals, has initiated a number of activities to tap into this resource. The ages-old community traditional values which include strict adherence to ecosystem preservation have been passed from generation to generation. However, laxity in enforcement of the relevant principles have led to numerous infringements. The Kenya Forest Service and Kaptagat Forest Restoration Editions in collaboration with the local leadership have implemented various mitigative initiatives. One is to set up "cow banks" to keep community livestock in selected guarded spaces. Modern renewable energy technologies are slated for installation, to tap into the forest water streams, the abundant sunlight and strong winds. The Archimedes Screw turbine, which is a cost-effective, robust and simple hydro-power machine is suitable for application at the low-head sites of the rivers. Most households bordering Kaptagat forest, use charcoal and firewood for cooking. An optimized conical solar cooker, has been highly recommended as a viable ecosystem-friendly alternative, to reduce and finally stop use of charcoal and firewood from the forest. Installation of Wind Turbines at the edge of the forest escarpment, is under consideration, to tap the wind energy.

Key words: Community, Ecosystem, Renewable Energy, Traditional Values.

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Track Classification: Cross-cutting areas: The effect of culture and religion in climate change adaptation and mitigation

Contribution ID: 115

Type: **Oral presentation**

Trends of Hypertension Prevalence in Kenya

Wednesday, April 23, 2025 2:25 PM (20 minutes)

Abstract

Aim: Hypertension prevalence in Kenya exhibits substantial variation across demographic and geographic groups, posing challenges for the development of universally effective interventions. This study aims to identify and analyse trends in hypertension prevalence disaggregated by age, sex, and county.

Method: We analysed hypertension prevalence trends among males and females aged 15–49 years using data from the 2022 Kenya Demographic and Health Survey. Counties were categorised according to the 47 administrative units defined by the Kenya National Bureau of Statistics, and age was stratified into three groups: 15–24, 25–34, and 35–49 years. To assess prevalence inequalities across these groups, we employed a log-binomial regression model.

Results: The risk of hypertension increases significantly with age. Compared to individuals aged 15–24 years, those aged 25–34 exhibit a 1.77-fold higher risk ($p = 0.000118$), while individuals aged 35–49 demonstrate a 5.67-fold increased risk ($p < 0.0001$). Females are at a significantly higher risk of hypertension compared to males, with a relative risk (RR) of 4.11 ($p = 0.000489$). High-risk counties include Nairobi, Kisumu, and Nakuru. In contrast, counties such as Wajir (RR ≈ 0.000004 , $p < 0.0001$), Nandi (RR ≈ 0.08 , $p = 0.003$), Elgeyo-Marakwet (RR ≈ 0.06 , $p = 0.015$), and Kirinyaga (RR ≈ 0.15 , $p = 0.019$) exhibit significantly lower risk levels. Conversely, females in Kirinyaga are at elevated risk (RR ≈ 3.64 , $p = 0.043$). Notably, hypertension risk among females tends to decline with age, particularly among those aged 35–49 years (risk change: -0.60 , $p = 0.018$).

Conclusion: The findings highlight the need for targeted interventions for older adults and females, and call for further investigation into protective factors in low-risk counties to guide effective prevention strategies

Keywords: hypertension prevalence, trends, logbinomial model, disaggregated.

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Presenter: KOECH, Eliud (MOI UNIVERSITY)

Track Classification: Cross-cutting areas: Climate change and health

Contribution ID: 116

Type: **Oral presentation**

Valorization of Pig Hair Waste for Sustainable Automotive Composites: Mechanical Properties and Environmental Benefits

The global automotive industry faces increasing pressure to reduce environmental impact while maintaining performance standards. Simultaneously, the meat processing industry generates substantial waste, including approximately 30% pig hair from the 28 million metric tons of pig waste produced annually in Africa alone. This research presents a sustainable solution by developing pig hair fiber (PHF) reinforced polypropylene composites for automotive applications. Pig hair fibers were extracted, characterized, and treated with 0.2M NaOH to enhance fiber-matrix compatibility. Composites were fabricated via compression molding with varying fiber lengths (7-15mm), weight fractions (0.6-6%), and processing temperatures (170-180°C). Response Surface Methodology was employed to optimize formulation parameters. The optimized composite (10.4mm fiber length, 3.6% weight fraction, 175°C processing temperature) exhibited significant improvements over pure polypropylene: 2% higher tensile strength (15.5MPa), 21.6% enhanced flexural strength (25.4MPa), 14.1% increased impact strength (62.5kJ/m²), and 48.9% improved wear resistance. Thermal conductivity increased with fiber content, reaching 0.058W/mK at 6% loading. SEM analysis confirmed good fiber dispersion and matrix adhesion. The study demonstrates that agricultural waste valorization can produce materials with comparable or superior mechanical properties to conventional polymers, simultaneously addressing waste management challenges and reducing automotive carbon footprint. This approach contributes to circular economy principles by transforming biowaste into value-added products, potentially reducing landfilling and incineration of pig hair waste while decreasing reliance on petroleum-based materials in automotive manufacturing.

Keywords: Waste valorization, Pig hair fiber, Sustainable composites, Automotive applications, Mechanical properties, Environmental sustainability

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Track Classification: Pollution and waste management: Electronic and industrial wastes disposal

Contribution ID: 117

Type: **Poster presentation**

Effect of open metal sites on carbon capture by metal-organic framework (MOF-16); a DFT approach

Thursday, April 24, 2025 2:10 PM (20 minutes)

Rising CO₂ concentrations, reported at 414 ppm in 2021, largely driven by fossil fuel combustion and deforestation, have intensified global efforts to combat climate change. Among various strategies, carbon capture and storage (CCS) has emerged as the most promising. Metal-Organic Frameworks (MOFs), known for their porosity and chemical tunability, have shown significant potential as effective adsorbents for CO₂.

MOF-16, in particular, exhibits enhanced CO₂ capture capabilities due to the role of open metal site (OMS) defects. These defects create active sites that facilitate CO₂ adsorption, but their impact on framework porosity, geometry, and CO₂ diffusion remains underexplored. Comprehensive studies are essential to understand these aspects and maximize the potential of OMS defects.

Since their discovery in the late 1990s, MOFs have been evaluated for carbon capture based on parameters like CO₂ selectivity, storage capacity, adsorption/desorption kinetics, stability through cycles, and enthalpy of CO₂ adsorption. MOFs can be customized with features like OMS, polar functional groups, tunable pore sizes, framework flexibility, and Lewis basic sites. These properties enable multiple interactions with CO₂, leading to high adsorption capacity while suppressing competing gases such as N₂, CH₄, and H₂O.

This study aims to use Density Functional Theory (DFT) simulations to examine the formation energies of OMS defects in MOF-16. Preliminary findings suggest that introducing OMS defects improves CO₂ adsorption capacity. The study will further analyze the effects of OMS on framework structure, CO₂ diffusion, and porosity, offering insights to optimize MOF-16 for carbon capture.

This exploration highlights the importance of MOFs and OMS defects in advancing carbon capture technologies to address rising atmospheric CO₂ levels and mitigate climate change.

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Track Classification: Biodiversity and Natural Resource management: Carbon markets

Contribution ID: 118

Type: **Oral presentation**

FORECASTING DROUGHT EVENTS IN KENYA ASALS REGION: A CNN-BASED FRAMEWORK USING CHIRPS PRECIPITATION DATA.

Wednesday, April 23, 2025 3:05 PM (20 minutes)

Aim: Food insecurity and economic instability have resulted from the severe effects of droughts on agricultural output in Kenya's Arid and Semi-Arid Lands (ASALs). These regions have faced increasing vulnerability due to erratic rainfall patterns, resulting in severe crop failures and livestock losses. Despite efforts to forecast droughts, existing techniques have frequently been imprecise, thereby hindering timely intervention. By developing a CNN-based framework with CHIRPS precipitation data and the Standardised Precipitation Index (SPI), this study aimed to increase the precision of drought forecasts and provide actionable insights on managing the effects of drought in ASALs by describing past drought occurrences, analysing precipitation trends, and utilising machine learning.

Method: The research involved preprocessing CHIRPS data, spanning from 1981 to 2024, to calculate SPI values and address missing data using the Inverse Distance Weighting (IDW) method. A CNN-based model that integrated precipitation's temporal and spatial characteristics was developed to forecast drought situations. The model was trained to identify spatial hotspots and forecast drought events across the 14 semi-arid counties in Kenya's ASAL region.

Results: To facilitate more informed decision-making for drought mitigation, this framework aimed to increase the accuracy and timeliness of drought predictions. When compared to conventional techniques, the CNN model performed better, improving the capacity to predict drought occurrences with more accuracy and spatial precision.

Conclusion: The results of this study offer a useful tool for enhancing resilience in Kenya's ASALs and informing proactive drought management strategies.

Keywords: CNN-Based, Chirps Precipitation Data, Forecasting Drought

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Presenter: Ms MATHENGE, Bernice (African Centre of Excellence Data Science)

Track Classification: Emerging Technologies to adapt and mitigate climate change effects: Big data and AI for climate change solutions

Contribution ID: 119

Type: Abstracts

Mathematical Modeling and Parameter Estimation of an Optimal Solar Food Dryer #104

Eminent threat caused by post-harvest losses due to inadequate drying and poor storage is responsible for up to 40-60% losses of agricultural produce each season. In order to address this issue, this paper seeks to formulate a mathematical model and simulate the characteristics of a solar dryer for the purpose of designing an effective and sustainable, low cost thermal solar dryer suitable for dehydrating a variety of agricultural products. The modeled solar food drier has four major parts, namely: Solar heat collector: Closed loop pipe network: Heat exchangers: and the Drying Chamber. The mathematical model was formulated using differential equations, and simulation using SIMULINK. The simulation results showed that, a solar collector with aperture area of $A_c=14.4\text{m}^2$ and a fluid volume of $V_c=500\text{l}$, when exposed to solar irradiation of $I_c=1.367\text{KW}/\text{m}^2$ at $\eta_c=80\%$ efficiency is able to heat water from $[T_{in}=22]^\circ\text{C}$ to $T_{co}= [70]^\circ\text{C}$ in 12 hours at a flow rate of $\dot{v}_c=1.128\text{l}/\text{s}$. This energy if transmitted by insulated pipes to a set of 5 heat exchangers each of area $A=1\text{m}^2$, and radiative heat transfer coefficient $h_r=100\text{W}/\text{m}^2\text{K}$ cumulatively dissipates hot air of maximum $[230]^\circ\text{C}$ at $\dot{v}=250\text{cm}^3/\text{s}$, and minimum of $[90]^\circ\text{C}$ at $\dot{v}=2000\text{cm}^3/\text{s}$ air mass flow rate. This output temperatures of dry air is regulated as desired according to the specifications of the food products to be dried. In absence of solar energy, Liquefied Petroleum Gas is intermittently used depending on the level of solar insolation. It was found that the optimal cost of the gas in this energy mix is reduced by over 67.86%. This strongly makes the use of solar in food dryers an ideal green energy to be used in mitigating post-harvest losses.

Presenter: ROTICH, Titus (Moi University)

Track Classification: Cross-cutting areas: Law and climate change

Contribution ID: 120

Type: **Oral presentation**

SOIL STABILIZATION USING STEIN

Wednesday, April 23, 2025 8:30 AM (20 minutes)

Soil in its natural state is usually unsuitable for engineering applications and must be treated to improve its load bearing characteristics. Emerging technologies make it possible to improve soil properties. STEIN is a commercial product that is mixed with cement and used for the stabilization of soil. It has been used in road pavements and in lining of water canals and other water retaining structures in south-east Asia and is now being introduced to Kenyan and Africa. There is little in the literature on its strength, hydraulic characteristics and environmental impacts. This paper presents the findings of laboratory experiments on soils stabilized with STEIN-cement. Six local soil types from different parts of Kenya were used: planosols, ferrosols, acrisols, andosols, nitisols, and unclassified local soil. X-ray diffraction tests were performed on the soils and the STEIN. Two types of cement were used: pozzolanic Portland cement (PPC) and ordinary Portland cement (OPC). The soils were stabilized in three categories: cement only (control); cement containing 3% STEIN; and cement containing 5% STEIN. The specimens were prepared, cured and tested for unconfined compressive strength (UCS) at 7, 14, and 28 days. The results showed that STEIN and cement consist of numerous similar minerals but in different proportions. There was significant increase in the strength of the soil when STEIN is introduced into the cement compared with stabilizing with cement only. The 5% STEIN-cement specimens gave higher UCS values than the 3% STEIN-cement specimens confirmed by the paired T-test. From the foregoing, it was inferred that STEIN-cement stabilizes soil by combined hydraulic and pozzolanic reactions leading to enhanced strength. The reactions are inorganic, cementitious and thus create a stable medium for multi-purpose engineering use. However, further research is recommended on the cost, hydraulic characteristics and environmental impacts of the STEIN-cement stabilized soil.

Key words: Soil stabilization, STEIN, Unconfined compressive strength

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Presenter: Prof. KIBIY, Joel (Moi University)

Track Classification: Cross-cutting areas: Other cross-cutting areas

Contribution ID: 121

Type: **Oral presentation**

Spatiotemporal Dynamics of Drought in Kajiado County, Kenya: Insights from SARIMA Modeling and SPI Analysis

Wednesday, April 23, 2025 3:45 PM (20 minutes)

Understanding the spatiotemporal dynamics of drought is essential for managing climate-related risks in arid and semi-arid regions. This study investigates long-term trends in drought severity in Kajiado County, Kenya, using historical climate data from 1981 to 2023. The region, predominantly inhabited by pastoralist communities, is highly vulnerable to climatic fluctuations, particularly variability in precipitation and rising temperatures. To characterise temporal trends and project future climate variability, the study employs Seasonal Autoregressive Integrated Moving Average (SARIMA) models alongside the Standardised Precipitation Index (SPI). Monthly precipitation and temperature data from three subcounties; Kajiado East, West, and Central were analysed. Following preprocessing, stationarity was assessed using the Augmented Dickey-Fuller test, and SARIMA model parameters were optimised using ACF, PACF, and information criteria metrics. The best-fitting SARIMA models were identified for each subcounty, and forecasts extending to 2028 reveal consistent seasonal patterns, particularly rainfall peaks in April and November and troughs in July–August. SPI analysis on a 3-month scale enabled classification of wet and dry periods, revealing significant interannual variability with documented extreme droughts (for example, 1982–1984, 1994, 2000) and wet events (for example, 1998, 2010). The Mann-Kendall trend test and Sen's slope estimator showed statistically significant upward trends in SPI values across all subcounties, suggesting a gradual shift towards wetter conditions. However, correlation analysis between SPI and temperature anomalies revealed weak to moderate negative relationships, indicating the compounding effect of warming on drought severity. This integrated modelling approach not only quantifies past and projected climatic trends but also enhances understanding of hydroclimatic variability crucial for informed adaptation planning. The findings underscore the importance of localised forecasting tools in supporting pastoralist resilience and policy formulation in the face of intensifying climate variability.

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Track Classification: Emerging Technologies to adapt and mitigate climate change effects: Big data and AI for climate change solutions

Contribution ID: 122

Type: **Oral presentation**

Pretreatment of Lignocellulosic Materials for Improved Biogas Production. A Review

Thursday, April 24, 2025 11:02 AM (20 minutes)

The increase in Population and industrialization has resulted to an increase in energy demand and consumptions. Currently fossil fuels are the major source of staple energy to meet this demand. Over relying on non-renewable energy forms that are expensive, depletable and emitting large amounts of greenhouse gases hence causing adverse effects to both humans and environment. Due to these effects, there is an urgent need to explore and develop alternative and sustainable energy technologies.

Use of renewable energy sources are not only sustainable but friendly both for the user and the environment and offers the best solution to address these global energy challenges. One of the sustainable energy sources is biogas that is produced by anaerobic digestion (AD) using different wastes such as agricultural residues, animal manure, and other organic wastes. Despite the availability of large amounts of agricultural waste, the use of lignocellulosic biomass for biogas production by anaerobic digestion has not been widely adopted due to the complicated structure of the plant cell wall making it resistant to microbial attack. This therefore calls for pretreatment of the lignocellulosic biomass in order to achieve the high biogas yields.

This paper reviews the various pretreatment techniques, of lignocellulosic biomass for enhanced biogas production. It also highlights the limitations of these pretreatment technologies and the need to develop environmentally friendly technologies using locally available materials.

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Presenter: BOGONKO, Nathan (Kenya Industrial Research and Development Institute (KIRDI))

Track Classification: Renewable Energy: The future of biofuels

Contribution ID: 123

Type: **Oral presentation**

Multi-level and Multi-actor governance in the management of air pollution in Kenya: case of Nairobi and Kisumu Counties

Thursday, April 24, 2025 2:10 PM (20 minutes)

Kenya continues to suffer decreased air quality levels attributed to the overreliance on biomass as a primary source of energy coupled with rapid economic development. This has resulted in environmental degradation and widespread health challenges arising from prolonged exposure to poor air quality. To address this problem, Kenya institutionalized a devolved governance system to make decisions regarding air pollution management. However, little is known about the effectiveness of the devolved air quality management and governance system. This paper therefore aimed at assessing the outcomes and challenges in management of air pollution in a devolved governance system in Kenya. The paper explored the views of multi-actors involved in management and governance of air pollution in both Nairobi and Kisumu counties. The study highlights the conflicting roles of national and county government in the management of air pollution coupled with power influence over resources and the limited opportunities for citizen involvement in decision-making processes in the management and governance of air pollution in Kenya. County Governments therefore need to be further empowered in order to play a robust role in the enforcement of air pollution standards within their jurisdiction which will ultimately influence the overall air quality levels in Kenya.

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Presenter: MENGICH, Donatos (National Environment Trust Fund (NETFUND), Nairobi, Kenya)

Track Classification: Pollution and waste management: Policy frameworks to deter pollution and irresponsible waste practices

Contribution ID: 124

Type: **Oral presentation**

Integrating Climate Smart Agriculture and Rehabilitation in Mining Affected areas;A proposed initiative in Kimwarer Fluorspar Region

Wednesday, April 23, 2025 2:45 PM (20 minutes)

Mining has long been a vital economic activity in the Kimwarer-Fluorspar region of Elgeyo Marakwet County. For years, fluorspar mining made Kimwarer a lively business town, offering jobs and attracting trade and services that sustained the local economy. However, this economic boost came with significant environmental consequences. Over time, deforestation, soil erosion, and the degradation of fertile land became widespread. These effects not only reduced the land's agricultural value but also damaged local ecosystems, leaving behind barren landscapes and vulnerable livelihoods. The closure of the mine in 2016 intensified these challenges, leading to both economic and environmental decline.

In 2024, with mining activities resuming, new opportunities for both economic revival and ecological restoration have emerged. This youth-led initiative proposes the integration of climate-smart agriculture, agroforestry, and sustainable land management in tandem with ongoing mining activities. The goal is to reclaim degraded land, restore soil fertility, and enhance environmental resilience while ensuring that mining and conservation work together for the benefit of the local community.

Methods: Field visit to Kimwarer Fluorspar mine on 20th Feb 2025, interviews with local community members and analysis of secondary data were used to gather insights for this research.

Findings: Findings show mining has degraded land and reduced agricultural value. However, community interest in land restoration and youth-led initiatives presents strong potential for integrating mining with sustainable environmental practices.

Conclusion: Mining and environmental restoration can coexist. With youth-led initiatives, Kimwarer's revival offers a chance to restore degraded land, improve livelihoods, and promote sustainable development aligned with climate action goals.

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Co-author: KIRUI, Janet (Hug a cedar foundation)

Presenter: CHEBET KAPKEA, Eda (Hug a cedar foundation)

Track Classification: Restoration of Ecosystems: Restoration of natural landscapes, to include mining areas, water catchment areas

Contribution ID: 125

Type: **Oral presentation**

Mainstreaming Gender and Youths in Climate Governance: Re-imagining Resilience through Marginalized Groups Political Ecology and Decentralized Innovations in Uasin Gishu, Kenya

Thursday, April 24, 2025 3:30 PM (20 minutes)

Gender disparities and youth exclusion in the political ecology are significant barriers to both social and environmental resilience development in Kenya. This study utilizes a mixed-methods approach that includes quasi-experimental analysis, participatory GIS mapping, and institutional ethnography to assess how structural exclusions such as patriarchal land tenure (where just 18% of women own formal land titles) and youth and women's exclusion from policy design limit their agency in climate action. Despite such constraints, women's groups have established wetland rehabilitation programs and agro ecology, and youth groups have organized clean-up initiatives, civic education platforms, and biogas installations for reducing firewood reliance by 30–40%. However, many of these groups remain unregistered and informal, which precludes them from fully benefiting from institutional support and funding mechanisms. As a result, they are unable to access the financial resources and opportunities available within the county's climate budget, which is often directed toward formally recognized entities. Additionally, capacity development programs ignore local cultural constraints, e.g., gendered land inheritance patterns. This paper advocates for three key reforms: (1) the enforced implementation of 30% binding quotas for the representation of women and youth in decision-making bodies; (2) the establishment of climate finance mechanisms to support microloans for gender-responsive innovations; and (3) the integration of intersectional vulnerability analysis into both the Kenya Climate Change Act and the Uasin Gishu Climate Change Act. These reforms are essential, as inclusive governance not only advances SDGs 5, 13, and 17, but also serves as a cornerstone for achieving sustainable climate resilience and advancing gender and youth equality in the long term.

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Track Classification: Cross-cutting areas: The effect of culture and religion in climate change adaptation and mitigation

Contribution ID: 126

Type: **Oral presentation**

Creating Sustainable Solid Waste Management Practices, An Analysis of the Proposed Solid Waste Management Solutions for Eldoret City, Kenya

Wednesday, April 23, 2025 11:30 AM (20 minutes)

The 20th century saw a radical shift in population dynamics, with rural-to-urban migration transforming small towns into mega cities. This rapid urbanization, particularly in low- and middle-income countries, has accessioned an increased generation of solid waste within the municipalities and major cities, thereby piling pressure on sustainable environmental programs, public health, and local government finances. Uasin Gishu County, home to the rapidly growing Eldoret City, is a case in point. Eldoret city chunks out approximately 250 metric tons of waste daily, of which 55% are organic, 23% recyclable, and 22% inert waste. The Kipkenyo dumpsite is already more than full, as is the case with other global landfill disasters such as Minamata (Japan) and Kiteezi (Uganda). Projections indicate a 220% volume growth in waste by 2044. Policy loopholes (70%) and infrastructural deficiencies (35%) cause waste management inefficiencies. This study proposes an integrated investment scheme of \$12.3 million involving modular bioreactor landfills, composting facilities, PPP-funded recycling parks, and data-driven logistics optimization. Containerization has already reduced litter by 32%, and route optimization has reduced operational costs by 18%. The proposed system is projected to yield a 14% return on investment per annum, reduce disease incidence by 25%, and create over 1,200 green jobs. Sustainable solid waste management is positioned here as not merely an environmental necessity, but also a corner stone of urban resilience, inclusive economics, and climate-congruent governance. The model accommodates SDGs 11 and 12 and offers an export template for use in other fast-developing cities in the Global South.

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Track Classification: Pollution and waste management: Waste management including dump sites and landfills

Contribution ID: 127

Type: **Oral presentation**

A case of a 5 MW, 10 MWh off Grid Solar Powered Street Lighting Project for Eldoret City, Kenya

Thursday, April 24, 2025 3:10 PM (20 minutes)

Street lighting, a devolved function under Kenya's Constitution (2010), is managed by County Governments. However, infrastructure is often controlled by external agencies, with one operator charging Uasin Gishu County USD 2 million annually for street lighting services, projected to rise to USD 4 million in 10 years due to tariff increases. Eldoret City enjoys high solar irradiance (2,000 kWh/m²/year, SD \approx 50 kWh/m²/year) and approximately 65% sunny days annually. Uasin Gishu County hosts key solar projects, including the operational 55 MW Kesses 1 Solar Plant, the operational 40 MW Radiant Solar Plant, and the 40 MW Eldosol Solar Plant (construction completed and commissioning), totaling approximately 135 MW of installed solar capacity which is fed to the grid and about 20 MW that is captive power. This paper evaluates both technical and financial feasibility of constructing a 5 MW, 10 MWh off-grid solar plant to power 20,000 LED street lanterns (60 W, 12 h/day, 5,256 MWh/year) in Eldoret City, comparing its financial implications with the current operator-based model. If the current model is maintained, it is projected that the County will spend 92 Million USD in the next 15 years for expansion, repair and maintenance and bills payment to the independent operator (driven by the annual cost escalation of 8.2%) compared to 23 Million USD required to set up, operate and maintain the proposed off grid solar plant over the same period. Additional benefits include potential carbon credit revenues ~USD 0.552 million (USD 10/tCO₂e, 3,679 tCO₂e/year, SD \approx 200 tCO₂e) and enhanced system reliability. The opportunities for financing of the project through Public Private Partnerships (PPP) is reviewed as a probable financing model to bridge the gap of huge initial capital costs of the project at the start which may not be accommodated within the County budget.

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Track Classification: Renewable Energy: Solar, wind and geothermal sources of energy

Contribution ID: 128

Type: **Oral presentation**

Urban River Ecosystems; An Evaluation of the Proposed Restorative model for River Sosiani, Eldoret City

Tuesday, April 22, 2025 2:35 PM (20 minutes)

Urban river degradation resulting from rapid urbanization constitutes an acute sustainability challenge, exemplified by the Sosiani River in Eldoret—a once vibrant ecological corridor in early 1900s but now facing pollution, wetland encroachment (67% loss since 2005), and plummeting biodiversity. As Eldoret expands by 4.3% annually being the only city in Kenya’s North Rift, the strain on urban ecosystems is expected to increase proportionately. The research proposes an integrated restoration framework that combines ecological science, intelligent technologies, and deliberate institutional reforms. Taking a cue from success stories like Cheonggyecheon (Seoul) and Singapore River, the framework employs geospatial mapping, hydrology modeling, and institutional diagnostics to determine root causes. Institutional problems—poor enforcement of the Water Act (2016) and fragmented urban governance—account for 68% of the ecosystem loss, study says. Failure to implement it will result in the loss of 40% of the remaining wetlands by 2045. The “modern urban river” plan employs optimized wastewater infrastructure, IoT water quality sensors, and blue-green infrastructure (i.e., bioswales, constructed wetlands) to build resilience. A County investment of KES 1.5 billion, out of which KES 500 million has been dedicated to fencing and restoring of the wetlands would decrease pollutants by 55%, lower flood risk by 40%, and yield a 9.2% per annum return on investment through eco-tourism, health savings, and disaster avoidance. The dream Sosiani River Restoration Authority (SRRA) would be grounded on enforcement, coordination, and adaptive governance. Grounded on Kenya’s Climate Change Act (2016), SDGs 6, 11, and 15, and the Ramsar Convention, this dream substitutes Sosiani as a socio-ecological asset that offers a replicable model for resilient urban futures in Africa.

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Track Classification: Restoration of Ecosystems: Management of hydrological systems, to include riparian lands, water towers, water reservoirs, clean rivers and wetlands

Contribution ID: 129

Type: **Oral presentation**

Climate change'induced cost on soil security and its implication on food security in Homa-Bay County, Kenya

Wednesday, April 23, 2025 10:15 AM (15 minutes)

While there are studies on effect of climate change on food insecurity in Homa-Bay [1,3], studies relating to effect of climate change on soil quality and food security aren't evident. This paper detailed influence of climate change on soil security and its implication on food security in the study area. It examined the cost of anthropogenic-based practices (ABPs) on climate change; interrogated their ripple effect on soil and food security situation. Praxeology theory was used to explore environmental consequences of ABPs. 250 respondents were sampled from 262,036 households for quantitative data and 20 Key Informants purposively identified for qualitative data. It was a cross-sectional survey study and quantitative data were analyzed descriptively and inferentially using Statistical Package for Social Sciences (SPSS) version 25.0. Opinions from FGDs, KII, and Field Observation were qualitatively analyzed. Results showed monoculture (96.2%), tractor tillage (71.4%), livestocking (82.3%), stone mining (92.4%), deforestation (89.1%), and hill slope-based practices (87.9%) induced climate change. Binary Logistic Regression Analysis (BLRA) indicated deforestation ($B = -0.462$, $S.E = 0.381$ and $P < 0.032$), stone mining ($B = -0.756$, $S.E = 0.364$ and $P = 0.038$), conventional tillage ($B = -0.961$, $S.E = 0.489$ and $P = 0.05$), slope-based activities ($B = -0.801$, $S.E = 0.368$ and $P = 0.0290$) predicted food insecurity. Study concludes that ABPs result to climate change, soil insecurity and significantly cause food insecurity in Homa-Bay County. The study recommends suspension of slope-based activities on elevated areas particularly on Homa-Hills, review stone extraction and tractor cultivation policies, intensive and purposive reforestation programs.

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Track Classification: Cross-cutting areas: Climate change, food security and impact on livelihoods

Contribution ID: 131

Type: **Oral presentation**

Restoring our landscapes: The use of Artificial Intelligence in curbing Global warming

Wednesday, April 23, 2025 9:45 AM (20 minutes)

Global warming, fueled by fossil fuel combustion, deforestation, and industrial pollution, endangers ecosystems, notably the biodiverse Great Rift Valley. This study explores four Artificial Intelligence (AI) strategies to mitigate climate change through landscape restoration: (1) AI-optimized agroforestry, boosting yields by 20% in India while sequestering carbon; (2) Integrated landscape initiatives in Africa, using drones to restore 500,000 hectares; (3) AI-driven forest fire management, predicting wildfires 48 hours in advance; and (4) Smart Archive Models, enhancing climate data accessibility to inform restoration policies. These approaches reduce greenhouse gas emissions by 15–20%, protect biodiversity, and foster sustainable rural development. Based on a systematic review of 200+ studies, we urge policymakers to invest in AI-driven solutions to restore 10 million hectares by 2030, safeguarding regions like the Great Rift Valley.

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Track Classification: Restoration of Ecosystems: Restoration of natural landscapes, to include mining areas, water catchment areas

Contribution ID: 132

Type: **Oral presentation**

Assessment of the Current and Future Energy Generation Mix in Uasin Gishu County, Kenya

Wednesday, April 23, 2025 9:25 AM (20 minutes)

At the global level, local financing of energy generation in such regions has led to accelerated economic growth, reduced foreign reliance on energy, and improved system reliability. The Kenya Constitution of 2010 also set up a system of devolution that vested the responsibility of overseeing most sectors with the counties, including energy. Devolution to the Uasin Gishu County presents an opportunistic benefit in exploiting indigenous energy resources with a possibility of potentially exporting surplus power to neighboring counties and even abroad to contribute own-source revenues. This study evaluates the existing energy mix and future generations possible in Uasin Gishu County. To start with, the installed capacity is currently made up of solar (140 MW), hydro (2 MW), thermal (100 kW), and wind (less than 5 kW). Other investments in development by the private sector include the Kaptagat solar plant for ammonia production (195 MW) and the proposed Copper Hetero Junction Thin Films (Cu-HJT, 20 MW) at the African Economic Zone (AEZ). Understanding that the County is just 30 km away from Kerio Valley oil field, there is a reasonable basis to suggest that indeed it is a candidate for future oil exploration. The County has a significant scope in bio diesel (from big grain crops such as wheat, maize, and sugarcane) and biogas, with over 3,000 dairy farmers eligible for small-scale digester installation. A research on Hydrogen energy is being conducted by Moi University and will provide future opportunities in the sector. This paper attempts to approximate the collective potential energy production from such resources, quantify cost saving by reduced grid dependency, and conduct a cost-benefit analysis to assess whether an expansion in localized generation is economically viable.

Key Words: Energy Mix, Solar, Wind, Hydro, hydrogen, Biodiesel, Biogas, Cu-HJT

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Track Classification: Renewable Energy: Energy access