Dryland Agriculture Conference

27th - 28th June 2024
ILRI Nairobi, Kenya

REPORT

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REPORT COMPILATION & DESIGN

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Message from the Lukenya University

On behalf of the Board of Trustees of Lukenya University, University Council, the Senate and Management Board of Lukenya University, I take this opportunity to welcome you to our Inaugural International Dryland Agriciulture and Food Systems in the Face of Climate Change Conference with the theme "Building Resilient Food Systems for a Sustainable Future." The conference will host leading regional and international speakers to share new ideas, possibilities, and the latest technological advances with students, researchers, academia, policymakers, development partners, government and private sector players.

It will focus on sustainable agriculture, pastoralism and food system management, and promote technology and policy for the transformation of drylands into sustainable and productive ecosystems.

Noteworthy is that the conference provides enormous opportunities to network, build collaborative synergies and more meaningful partnerships for continual improvement. This in turn would create opportunities like gainful employment, quality products, and better ways of conserving our environment. I wish to share with all the participants that Lukenya University is a world-class university that believes in collaborations and partnerships.

In a very special way, I wish to recognize our Bronze Sponsors International Livestock Research Institute (ILRI), an International agricultural research institute within the Consultative Group for International Agricultural Research (CGIAR), Alliance for a Green Revolution in Africa (AGRA), The Food and Land Use Coalition (FOLU), Kickstart International Ltd, our event Partners Edsource Africa Ltd and the Board of Trustees of Lukenya University. Thank you for the support in making this conference happen.

I appreciate our key partners including the Ministry of Agriculture and Livestock Development, MaMa Doing Good, Agricultural and Food Authority (AFA), Czech Technical University, Alliance of Bioversity & CIAT and the Inclusive Climate Change Adaptation for a Sustainable Africa (ICCASA), a project of African Development Bank for their support and collaboration. Additionally, I thank the South Eastern Block Universities namely; Machakos University, South Eastern Kenya University (SEKU), Garissa University, and Umma University for their moral support.

I salute all guests in this conference, for it is through your input that this conference is made successful. Thank you for creating time from your busy schedules to be with us. Your research is useful in providing direction for dealing with challenges in dryland agriculture and food systems in the face of climate change.
Welcome once more. God bless you all.

Prof. Reuben Muasya, PhD
Ag. Vice-Chancellor and Professor of Agriculture
Lukenya University

EDITORIAL

Lukenya University is a Centre for advancing research, innovation, collaboration and community outreach. This is exemplified in this Inaugural International Dryland Agriciulture and Food Systems in the Face of Climate Change Conference with the theme "Building Resilient Food Systems for a Sustainable Future." The conference is hosted jointly between Lukenya University and Edsource Africa Ltd, with the bronze sponsorship from International Livestock Research Institute(ILRI), an International agricultural research institute within the Consultative Group for International Agricultural Research (CGIAR), Kickstart International Ltd, Alliance for a Green Revolution in Africa (AGRA) and The Food and Land Use Coalition (FOLU).

Thank you very much, Board of Trustees of Lukenya University, for your support in advancing our objectives.

In line with the objectives this conference will provide an opportunity to share knowledge and ideas in mitigating climate change and food insecurity challenges; provide a platform for stakeholders to share knowledge and have engagements to integrate and accelerate inclusive sustainable development; provide an opportunity for decision-makers, private, and public players to show how food systems in dry lands can contribute to safe, equitable, resilient, and culturally diverse systems in terms of production, transportation, distribution, processing, storage, consumption, farmer organization, and markets; and to build a case for the role for women and youth in the production of nutritious food by recognizing and engaging them as active partners in sustainable food systems.

Insightful and innovative research will be shared to facilitate engagement on current research areas in dryland agriculture and food systems amidst climate change. The full articles will be subjected to a double-blind review process leading to publication in the Lukenya University Multidisciplinary Journal ISSN 2663 3183. Further, policy briefs and a dryland agriculture and food systems handbook will be generated

Our heartfelt appreciations to our partners Ministry of Agriculture and Livestock Development, MaMa Doing Good, Agricultural and Food Authority (AFA), Czech Technical University, Alliance of Bioversity & Centro Internacional de Agricultura Tropical (CIAT), and the Inclusive Climate Change Adaptation for a Sustainable Africa (ICCASA), a project of African Development Bank for your support and collaboration. Further, Machakos University, South Eastern Kenya University (SEKU), Garissa University and Umma University for the moral support.

To all participants, for your presence in this conference, thank you.

Judith A. Wafula, PhD
Ag. Deputy Vice Chancellor (Research, Collaboration and Community Outreach)
For Editorial Team

EDITORIAL

Edsource Africa Ltd
It is my privilege and honor to welcome you to the 1st Dry land Agriculture & Food Systems in the Face of Climate Change Conference. The resilience and sustainability of agricultural systems are crucial in the face of increasingly unpredictable climate conditions and changes in land use from agricultural land to construction and other uses. Addressing these challenges involves implementing strategies that enhance the ability of agricultural systems to withstand and adapt to changing conditions while maintaining productivity and preserving natural resources.

It is with great pleasure therefore to host and welcome you to the Dry land Agriculture and Food Systems in the Face of Climate Change Conference which brings together leading researchers, policymakers, practitioners, and innovators to address the urgent challenges and opportunities within dry land agriculture. This is designed to foster a collaborative environment where diverse perspectives can converge to create holistic solutions

The main goal of the conference is to share and enhance the knowledge of key players in the agriculture and climate action ecosystem. It will serve as a platform for dialogue on tangible solutions to alleviate food insecurity, particularly in the arid and semi-arid regions of Kenya and the surrounding areas in the face of climate change.

Additionally, the conference provides an excellent opportunity to facilitate the sharing of novel ideas and advancements among stakeholders in research, academia, civil society, the private sector, and policy-making through keynote addresses and presentations.
Over the next two days, we will feature esteemed speakers and panelists who bring a wealth of knowledge and experience. We are confident that their insights will inspire and inform our collective efforts. Furthermore, the discussions and networking opportunities at this conference will undoubtedly foster new partnerships and initiatives that drive progress in the field.

We extend our heartfelt thanks to all participants, sponsors, and organizers for their commitment to advancing dryland agriculture and food systems. Your dedication is crucial as we navigate the complexities of climate change and strive to ensure a secure and sustainable future for all.

Edsource Africa Ltd is a communications and events management firm that leverages on linkages and collaboration, utilizing its extensive knowledge and experience to create an enabling environment for stakeholders. This facilitates engagement and the exchange of the latest innovative ideas, maximizing value for all involved.

Priscilla Kerebi
Director
Edsource Africa Ltd
Conference Co-Convenor

01

CONFERENCE SPEAKERS

SPEAKERS

Benjamin Tito
Agriculture and Food Authority (AFA)

Mr. Tito is a Director at Agriculture and Food Authority (AFA) in charge of Horticultural Crops Directorate (HCD). He is an alumnus of Jomo Kenyatta University of Agriculture and Technology and Van Hall Larenstein, University of Applied Sciences. Through his vast experience, he is a sustainable climate smart agricultural professional with competency in food safety and value chains development.

In his role at HCD, he is actively involved in training stakeholders on KS1758. KS 1758 stipulates the hygienic, and safety requirements during the production, handling, and marketing of fresh produce to ensure that consumers access high-quality food

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Dr. Jeremiah Rogito

Dr. Rogito has held roles in various organizations, including Welthungerhilfe, Equatorial Hortifresh Limited, SNV, and AGRA (Alliance for a Green Revolution in Africa). Throughout his career, Rogito has been committed to integrating young people into agribusiness, giving them opportunities to innovate and adapt to changing agricultural landscapes.

In addition to his Bachelor of Science in Agriculture at Egerton University, Master of Management in Agribusiness at Strathmore University and PhD in Strategic Business Leadership at the Adventist University of Africa, Rogito has earned various certifications, including being a Certified Project Management Professional (PMP) and an African Youth Change Maker Fellow in 2018.

SPEAKERS

Prof. Thomas Ekamais Akuja, Associate Professor, Department of Agricultural Sciences, School of Agriculture, Environment, Water and Natural Resources, South Eastern Kenya University, Kenya.

Prof Akuja holds a B.Sc (Agriculture), University of Nairobi, M.Sc (Agronomy), University of Nairobi and PhD (Life Sciences), Ben Gurion University of the Negev, Israel.

He has won grants for his doctoral studies at the Jacob Blaustein Institute of Desert Research. Other grants are from the International Centre for Research in Semi-Arid Tropics (ICRISAT), Africa Harvest Bio-Tech (AHBT) and United Nations Operations Services (UNOPS) Totaling of USD 275 000.

Prof Akuja been involved in research and extension specifically in the fields of dryland studies, dryland agriculture, crop science (Life Sciences), household food security, needs and problem assessments, emergency response, livelihood baseline studies and surveys, early warning systems, environmental assessments and participatory community training. He has also received comprehensive academic training in the fields of crop and dryland environmental sciences. Further, he has been exposed to extensive teaching, research and consultancy assignments in the fields of agro-ecology, food security and community training and mobilization.

Prof. Thomas Ekamais Akuja, is a member of the Institute of Directors (IoD) in Kenya, a life member of Athens Institute of Education and Research (ATINER), Greece, a Member of American Association of Agricultural Engineers, USA and a Member of African Crop Science Society among others.

SPEAKERS

Jason Sircely, PhD
Senior Scientist
International Livestock Research Institute

Dr. Sircely brings over 20 years of expertise in theoretical and applied ecology and conservation. His extensive experience encompasses interdisciplinary collaborations with farmers, herders, civil society, and governments.

He is currently focused on the management and restoration of communal grazing lands to enhance livelihoods and environmental health. His methodologies include local to global simulation modeling, multi-stakeholder action research, and the testing and scaling of interdisciplinary management approaches.

Arnold Kipchumba
Deputy Director, Green Economy, Environment and Climate Action Directorate
Office of the First Lady, Republic of Kenya

Mr. Kipchumba key mandate is to inspire a women-led climate action, that reduces vulnerability to climate-related events, and improve the adaptive capacity of society to climate shocks through a green economy. He will also be responsible for the Office of the First Lady's ambitious contribution to accelerate the National Tree Growing and Restoration Campaign as part of the government ambitious Programme which is aimed at managing, conserving and expanding forests sustainably towards attaining 30 percent forest cover nationally by 2032. The initiative aims to plant 15 billion trees by 2032, will work to reduce greenhouse emissions, stop and reverse deforestation, and restore 5.1 million hectares of deforested and degraded landscapes.

SPEAKERS

Prof. Josphert Ngui Kimatu
Associate Professor, School of Sciences and Computing, Department of Life Science
South Eastern Kenya University (SEKU)

Prof. Kimatu has a Ph.D. in Plant Molecular Epigenetics from Northeast Normal University (NENU), China; an MPhil in Forestry Pathology from Moi University, Kenya; a bachelor's degree in Botany and Zoology from Moi University, Kenya; and a PGDE from Maseno University, Kenya.

He trained in post-harvest management in maize, legumes, and rice in a four-module certificate course at Stellenbosch University, South Africa; Sydney University, Australia; and Kwame Nkrumah University of Science and Technology, Ghana. He has a certificate in Molecular Diagnostics from the University of Nairobi, Kenya. Dr. Kimatu received a training certificate in integrated pest management and pesticide safety (IPM) from the Soybean Innovation Lab, and a training certificate in COVID-19 from the London School of Hygiene and Tropical Medicine. He is the PhD Director, SEKU, Wote Campus; Chairman, SEKU, Staff Training and Development.

Nancy Muindi

Nancy develops and implements marketing strategies for KickStart's MoneyMaker Irrigation Pumps. She creates brand awareness, and builds organizational integrity for its leading affordable and effective irrigation strategies across the continent. She also works with partners and farmers to ensure effective correlation and development of farmer-led solutions based on customer satisfaction and feedback.

Previously, she has worked with the Agricultural Society of Kenya in planning and managing both local and international exhibitions, and with Eveready East Africa PLC in managing product marketing and new product launches. She holds a Bachelor of Commerce degree in Marketing from Egerton University, and CPA certification.

SPEAKERS

Yen Nguyen
Entrepreneurship Coach for Agriculture Projects, Social Business Creation- HEC Montreal

Ms. Nguyen undertook a 6-month internship at UNDP in Vietnam Project "Strengthening resilience of smallholder agriculture to climate change-induced water insecurity in the central highlands and south-central coast regions of Vietnam" funded by Green Climate Fund and Asian Development Bank She is a champion on Multidimensional Poverty Index enabled by Oxford Poverty Human Development Initiative, University of Oxford and a multiple times fund receivers from Canadinan International Development Research Center and JICA Innovative Asia Internship Program. Yen is a Project Manager in the "Growing Strawberry from Zero" campaign, fostering the vegetable and plant growing practice of citizens in Hanoi. She has a Master's degree in Climate Change from Vietnam-Japan University. Additionally, she was selected for Global Leadership Training Programme on Sustainable Development of Africa by United Nations University, New York University and University of Johannesburg. She was a World Food Forum Youth Participant in 2023.

Kenndy Mugo
Chief Executive Officer Innovation Kenya (IK)

The organization is a catalyt for growth of various key economic sectors in East Africa through Innovation. IK blends human-centered designs with insights from data science and behavioral science to help organizations build a comprehensive and innovative go-to-market strategy for their products and services.

Mr. Mugo is a strategy professional with consulting background and experience in Innovation Strategy, Social Entrepreneurship, Design Thinking, and Innovation Workshops. His greatest strength is in his ability to connect, inspire and influence people from different backgrounds and cultures. He partners with Lukenya University in analyzing innovation and economic aspects of the projects under the collaboration.

SPEAKERS

Dr. Vyacheslav Kungurtsev
Researcher,
Czech Technical University, Prague

Dr. Kungurstev has skills in nonlinear programming, optimization algorithms, mathematical programming, nonlinear optimization, optimization theory, convex and numerical optimization.

He holds a Ph.D. degree in mathematics with a specialization in computational science from the University of California, San Diego, La Jolla, CA, USA, acquired in 2013. He was a Postdoctoral Fellow with KU Leuven as part of the "optimization for engineering" project. He collaborates with Lukenya University in optimizing a digital twin for the tree programme and groundwater among other areas.

Eunice Omwoyo, PhD

Dr. Eunice Omwoyo is among scientists who derived analytical solutions using Jacobi elliptic functions for bound and nearly bound photon orbits in Kerr-de Sitter (KdS) and Kerr-de Sitter Revisited (RKdS) spacetimes. She uses her skills in the collaboration at Lukenya University to optimize a digital twin for the tree programme and groundwater

She joined AIMS Senegal in 2018, immediately becoming a Mastercard Foundation Scholar, where she pursued a Master's program in mathematical sciences. After graduating from AIMS Senegal in June 2019, Dr Omwoyo got a scholarship to pursue a PhD in Astrophysics, Cosmology and Gravitation at Universidade Federal do Espírito Santo, Brazil; a giant step taking her closer to her passion – the universe.

SPEAKERS

Brian Olimba
Co-Founder and Business Development Director OLICHEZA.

OLICHEZA is a start-up African consulting agency that focuses on Improving the lives of people in Africa through value addition and adoption of innovation. He collaborates with Lukenya University in optimizing the digital twin for the tree programme and groundwater. Brian is experienced in Africa business development and infrastructure project development.

Mr. Olimba enjoys strategy development and working with teams to implement it. He builds relationships with stakeholders and focuses on finding solutions. Further, he is passionate about empowering people in Africa and adding value to their lives.

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PROGRAMME & PROCEEDINDS

PROGRAMME AND PROCEEDINGS

Time	Presenter/Activity	Responsible
9:30am-10:00am	Opening remarks and theme of the dryland conference Emphasized the theme of the dryland conference Take home message: "As Africans and as countries affected by dryland, let's make solutions that can help restore these lands"	Dr. Ibrahim Haji DVC(Finance, planning and administration) Lukenya University Moderator: Dr.Judith Wafula Rapporteurs:Protus Kyalo Moses Kioko Victor Masai
10:00am-10:20am	Topic: Environmental degradation and food security challenges	Prof. Reuben Muasya, Ag. Vice Chancellor Lukenya University
10:20-10:40am	Topic: Resiliency in food systems and challenges in dryland areas	Prof. Thomas Akuja (representing VC SEKU Prof. Shitanda)
10:40-11:05am	Topic; Opportunities for dryland agriculture and rangeland management	Dr. Jason Sicerly (senior scientist, ILRI)
11:05-11:20am	**Q/A**	
11:20-11:50am	Topic: Building resilient food systems for a sustainable future	Prof. Josphert Kimatu
11:50-12:20pm	Topic: Challenges and solutions for sustainable food systems	Mr. Arnold Kipchumba from Mama Doing Good
12:20-12:45pm	Topic: building resilient food systems for a sustainable future	Mr. Benjamin Tito (Agriculture and Food Authority)
12:45pm-1:00pm	**Photo Session**	
1:00pm-2:00pm	Lunch Break	
2:00-2:30pm	Topic: Dryland agriculture for sustainable and inclusive development	Madam Nancy Muindi (Kickstart International) Moderator:Ms. Jael Birgen Rapporteurs:Protus Kyalo Moses Kioko Victor Masai
2:30-2:45pm	**Q/A**	
2:00-2:30pm	Topic: Dryland agriculture for sustainable and inclusive development	Madam Nancy Muindi (Kickstart International)
3:00-3:15pm	Topic: Control of Tsetse flies - vector of trypanosomiasis	Ms. Esther Muli Lukenya University
3:15-3:30pm	Topic: Influence of Agro-sil fertilizer on crop production and climate change mitigation	Mr. Bernard Kivyatu Lukenya University
3:30pm-3:45pm	**Q/A**	
3:45-4:00pm	Topic: Livestock, drylands and climate change	Mr. Gonzalez Ricardo
4:00-4:15pm	**Q/A**	
4:15-4:30pm	Recap of day one	Mr.Protus Kyalo
End of Day One Programme		

Time	Presenter/Activity	Responsible
8:00-8:45AM	Opening remarks	Prof. Ibrahim Haji DVC(Finance, Planning &Administration) Lukenya University Moderator: Ms. Priscilla Kerebi Rapporteurs:Protus Kyalo Moses Kioko Victor Masai
8:45am-9:00am	Recap of Day one	Mr.Protus Kyalo
9:00-9:30am	Key Note Speech: Topic: Fostering policy and institutional frameworks to create enabling environments for the development of equitable and environmentally responsible agricultural value chains	Dr. Jeremiah Rogito, Alliance for Green Revolution in Africa (AGRA)
9:30-9:40am	Q/A	
9:40am-10:00am	Topic; Influence of head teachers coordination of donor support services on inclusion of learners with special needs education in public primary schools in Mbooni east sub county, Kenya	Dr. Domitilla Mwanzia Lukenya University
10:00-10:20am	Topic: Sustainable green jobs for dry land agriculture	Ruth Moraa (Programme Manager Forestry & Agroforestry at Mama Doing Good)
10:20-10:30am	Q/A	
10:30am-11:00am	Health Break; networking &Photos	Moderator:Ms. Purity Mutheu Rapporteurs:Protus Kyalo Moses Kioko, Victor Masai
11:00-11:45am	**Topic: Discuss how the goals and values of pastoralist in Kenya are Changing**	Panel Discussion moderated by Dr. Jason Sircerly Panelist: 1) Ms. Charity Nashipai (Chairlady Youth Pastoralist) 2) Dr. Guyo Roba (Director of Jamil observatory of food security and action
12:35-12:45pm	Topic: Comparative growth performance and adaptability of Cenchrus Ciliaris, Panicum Maasai, Camelia, Eragrotis, and Grass pea in Semi-arid conditions: implications for sustainable livestock feed in Kibwezi east, Makueni county, Kenya.	
12:45-1:00pm	Q/A	
1:00-2:00PM	**Lunch Break**	

PROGRAMME AND PROCEEDINGS

Time	Presenter/Activity	Responsible
2:00-2:15pm	Topic: Dynamics of Velocity and Pressure Profiles in Enhancing Climate Resilience in Dryland Agriculture in Kenya using turbulent forced convection modelling	Ms. Clementine Mutua Registrar Lukenya University
2:15-2:30pm	Topic: Enhancing moisture retention in drylands through soil amendments using biochar, compost and mulch	Ms. Jael Birgen
2:30:-2:45pm	Topic: Digital Twins for sustainable Agriculture	Ms. Eunice Omwoyo, Dr. Vyacheslav Kungurtsev, Brian Olimba (Innovation Kenya)
2:45-3:00pm	Topic: Enhancing dryland agriculture education: A comparative analysis of graduate exit surveys	Mr. Protus Kyalo
3:00-3:15pm	Topic: Unravelling Key-adaptive and stress-responsive proteins to climate variability in Cassava varieties for Climate-Resilient Cultivation Strategies	Mr. Victor Masai
3:15-3:30pm	Topic: : Food Sovereignty in Postcolonial Literature: Building Resilient Communities in Chinua Achebe's Things Fall Apart	Mr. Allan K'Odundo - COD Languages, Lukenya University
3:30pm-3:45pm	Recap of Day 2	Protus Kyalo Lukenya University
3:45-4:00pm	Closing Ceremony and photo session Closing Speech	Hon.Sylvia Kasanga

CONFERENCE PROCEEDINGS

The inaugural Dry Land Agriculture and Food Systems Conference, held on the 27th and 28th of June 2024 at the International Livestock Research Institute (ILRI) in Nairobi, Kenya, marked a significant milestone in addressing food security and sustainable agriculture amidst climate change. Organized by Lukenya University and Edsource Africa Ltd, the conference gathered students, professionals, researchers, scientists, policymakers, and industrialists to share innovative ideas, technological advances, and policy solutions for transforming dry lands into productive and sustainable ecosystems. The theme, "Building Resilient Food Systems for a Sustainable Future," emphasized the urgent need for strategies to mitigate climate change impacts on agriculture in Africa, a region with immense agricultural potential.

The conference aimed at providing a platform for knowledge exchange on climate change mitigation, promoting inclusive sustainable development, and highlighting the role of women and youth in sustainable food systems. Key activities included presentations, panel discussions, plenary sessions, and an exhibition showcasing advanced technologies and solutions. By bringing together over 200 participants from various sectors, the event facilitated networking, collaboration, and collective action toward a sustainable agricultural future in dry lands.

PROCEEDINGS OF THE FIRST DAY OF DRYLAND AGRICULTURE CONFERENCE, 27TH JUNE 2024

9:30 am-1:00pm
Moderator: Dr.Judith Wafula
Rapporteurs: Protus Kyalo, Moses Kioko, Victor Masai

03

PRESENTATIONS

PRELIMINARIES

Moderator
Dr. Judith A. Wafula
Deputy Vice Chancellor
Research,Collaborations & Community Outreach
Lukenya University.

The conference began with a word of prayer led by the moderator, Dr, Judith Wafula, Deputy Vice Chancellor, Lukenya University.

Dr. Ibrahim Haji
Deputy Vice Chancellor
Finance,Planning & Administratin)

Delivered opening remarks for the ceremony and explained the theme of the conference.

Take Home Message:
'As Africans and as countries affected by dryland, let's make solutions that can help restore these lands'

TOPIC	Environmental degradation & food security challenges
PRESENTER	Prof. Reuben Muasya
ORGANISATION	Ag. Vice Chancellor of Lukenya University

Quoting the Bible's mandate for human responsibility to care for the Earth, it highlights that Adam was instructed to nurture it. There is clear evidence of environmental degradation through phenomena such as acid rain and climate change. These emergent catastrophes serve as harbingers of more severe challenges to come, underscoring nature's unforgiving disposition.

The current generation often remains unaware of the crises unfolding worldwide, which are direct consequences of biodiversity loss. Food insecurity looms large today, affecting a billion people globally. Therefore, developing robust systems to ensure food security is paramount.

There is optimism that the conference will yield effective food systems capable of enhancing food security not only in Kenya but also globally. Exploring opportunities in aquaculture production where feasible, and promoting traditional crops such as beans, sorghum, specific maize varieties, and drought-resistant tree species, are key strategies.

Adopting climate-smart technologies to mitigate soil erosion and enhance biodiversity is crucial in the contemporary context. Leveraging artificial technology to boost food production in arid lands is vital for improving food security. Encouraging Generation Z to engage in agriculture is seen as pivotal for sustainable food production in the future.

Recommendation

- Promote environmental stewardship and responsibility
- Implement and enforce stronger environmental protection regulations.
- Develop early warning systems and disaster preparedness plans.
- Increase public awareness and education on biodiversity conservation and environmental issues.
- Invest in and promote research and development of resilient food systems.
- Foster international collaboration and knowledge exchange to enhance food security.
- Support the expansion and sustainability of aquaculture industries in suitable regions.
- Invest in and promote climate-smart agricultural technologies and practices.
- Develop and integrate AI and advanced technologies into agricultural practices, especially in arid and semi-arid regions.
- Advocate for the adoption of new technologies and systems discussed at the conference to improve food production in drylands.
- Encourage the youth to engage in agriculture

PRESENTATIONS

TOPIC	Food Systems in The Pastoralist Areas of Kenya
PRESENTER	Prof. Thomas E. Akuja, PhD, D.Sc.
ORGANISATION	South Eastern Kenya University

What Is Resiliency in a Food System

Resiliency is a concept that's been used in a lot of different fields. It's how systems are able to adapt and move forward in the case of various and unforeseen disasters.

Food Systems

In the food system, resiliency is the capacity over time to provide sufficient, appropriate, and acceptable food to all—even in the case of unforeseen disturbances.

More simply: How do you ensure that people have food, even when disruptions continue to happen?

Food System Disruptors

There can be natural or human-made disruptions, and they can either be a shock—a sudden disturbance to the food system—or a stressor, the more gradual eroding of it. With climate change, you can think about more severe weather events as an immediate shock, or a longer-term drought that changes natural conditions as a stressor on the food system.

Human-Made

It could be political unrest or it could be inflation within the food system that raises costs and limits people's economic access to food.

Wars and global disruptions can absolutely impact the food system, even if they happen far away from where people get food, say, from a grocery store or a farmers market.

The implications of global disruptions really can trickle down to all different levels.

Food System Resilience

It helps countries to rebuild their productive capacity, improve the management of their natural resources, strengthen food value chains and access to markets, and improve policies, national and regional, to enhance the resilience of the sector.

Resilient Food System

It's how systems are able to adapt and move forward in the case of various and unforeseen disasters. In the food system, resiliency is the capacity over time to provide sufficient, appropriate, and acceptable food to all—even in the case of unforeseen disturbances.

Resilience In Agri-Food Systems

The Resilient Agrifood Systems Science Group transforms current agrifood systems so more people, especially those who survive on less than US$1 a day, can access affordable, sufficient, and healthy diets. Efforts span planting to post-harvest needs, creating solutions that impact fields, farms, and value chains.

Food Systems in Animal Production

Food systems exist at different scales: global, regional, national and local. Local food systems around the world are very diverse and location specific.

Food Systems in Crop Production

There are two major ways to break food systems down into component parts. The first is to look at the five parts of the food cycle: production, processing, distribution, retail and consumption

The Dryland Environment

The drylands are characterized by low precipitation, highly variable rainfall patterns, high evapotranspiration rates, in adequate available nutrients in native soils, poor quality of groundwater, severe land degradation processes, short growing period and low crop yields

Dryland Agriculture

Drylands, despite their relative levels of aridity, contain a great variety of biodiversity, with many animal and plant species and habitats found only in drylands and playing a vital role in the livelihoods of many dryland inhabitants (IUCN, 2012).

Dryland farming, also known as "dry farming" or "dryland agriculture," means that farmers do not use irrigation to supply crops with water. Instead, this practice relies upon soil moisture, ground water, and the occasional rainfall.

Livelihoods in the Pastoralists in the Drylands
Pastoralism

- Agro-pastoralism
- Wild-Foods

Livestock Sector In Vision 2030

Indeed, the economic pillar of vision 2030 aims to improve the prosperity of all Kenyans through an economic development programme, covering all the regions of Kenya.

Through livestock rearing and by-products providing alternative livelihoods, the arid lands can as well meet all their economic requirements.

Very little is seen on the ASALs despite heavy investment.
The stagnation of animal production and marketing as well as under exploitation of alternative livelihood components in the region is evident everywhere one goes.

A Comparative Economic Scenario in The Drylands

The following scenario can be used to illustrate the potential wealth that obtains in the ASALs of Kenya.

A good year

In a good year an average pastoralist family could be keeping 400 goats, 400 sheep, 50 cows and 50 camels.

Scenario I

In an event of bad year looming, if this family sold a half of their stock at competitive market prices,
Its total value would be Ksh. 5.5 million i.e (200 goats @ Ksh. 5000= 1 million; 200 sheep @ Ksh. 5000 = 1 million; 50 cows @ Ksh. 20 000 = 1 million; 25 camels @ Ksh. 100 000 = 2.5 million).
Would such a person require relief

Scenario II

Compare this to a middle income earner of Ksh. 200 000 per month. Per annum this person would have a gross value of 2.4 million. The net per annum would be almost half of this figure.

The former scenario is akin to a person in formal employment earning Ksh. 460 000 per month. Unfortunately, these pastoralists would be looking up to the latter for alms and demand relief food in times of drought.

Recommendations

- Policy on pastoralism
- Livestock Production
- Livestock Marketing
- Economic benefit

PRESENTATIONS

TOPIC	Opportunities for Dryland Agriculture & Rangeland Management
PRESENTER	Dr. Jason Sicerly
ORGANISATION	Senior Scientist, ILRI

Livestock demonstrate greater resilience compared to crops, making them a crucial asset in dryland agriculture. Exploring areas adjacent to settlements for security and agricultural purposes presents promising opportunities. However, the fragmentation of rangelands remains a significant challenge, potentially impacting both wellbeing and livelihoods when agricultural areas are poorly planned.

Implementing participatory rangeland management (PRM) proves effective through local institutions, emphasizing the importance of fire management and pasture maintenance within the community. Dealing with invasive species such as prosopis requires timely intervention, ideally when the plants are young; alternatively, methods like herbicides or gel application can be considered.

Concerns persist regarding the introduction of new weeds affecting livestock, particularly in regions like Kajiado and Baringo. Mango cultivation, thriving on deep moisture, requires safeguarding from livestock and establishing robust market linkages for economic viability.

The role of academic institutions in dryland regions, exemplified by Lukenya University, becomes pivotal in addressing local challenges. Academic research should prioritize real-world issues and engage affected communities, notably pastoralists in areas like Pokot and Turkana.

Recommendation

- Promote livestock farming in dryland areas due to their higher resilience compared to crops.
- Identify and utilize secure areas near settlements for agricultural activities.
- Develop and implement policies to prevent the fragmentation of rangelands.
- Implement comprehensive spatial planning at county and sub-county levels.
- Promote PRM to involve local communities in decision-making and management of rangelands.
- Develop and enforce fire management strategies and invest in pasture maintenance programs.
- Research and implement effective methods for managing invasive species, considering environmental and economic impacts.
- Implement early detection and management programs for new invasive species to prevent their spread and impact.
- Support the cultivation of mangoes and other suitable crops with proper irrigation, protection measures, and market access.
- Increase support and recognition for academic institutions in dryland areas to enhance their impact on local development.
- Ensure that academic research outcomes are shared with and implemented in affected communities to solve practical issues

TOPIC	Building Resilient Food Systems for a Sustainable Future
PRESENTER	Prof. Josphert Kimatu
ORGANISATION	South Eastern Kenya University

Building resilient food systems for a sustainable future, particularly in Africa, involves a multifaceted approach that addresses various:

1. Components
2. Key Factors
3. Stakeholders
4. Tools
5. Requirements

Main Components

1. Sustainable Agriculture Practices

This involves the adoption of agro ecology and conservation agriculture, crop diversification and rotation. Organic farming and integrated pest management.

2. Food Security and Nutrition

This is done through ensuring access to sufficient, safe, and nutritious food which enhances dietary diversity. Promoting of indigenous foods helps address various malnutrition and micronutrient deficiencies. Climate Change Adaptation and Mitigation Efforts to develop climate-resilient crop varieties. Implementing water conservation and efficient irrigation techniques. Promoting carbon sequestration practices.

3. Infrastructure Development

Improving transportation networks and storage facilities will help prevent food wastage and loss. This will help producers have easier gain to the market of the produce. Enhancing ICT infrastructure for agricultural information dissemination.

4. Policy and Governance

Having policies that will lead to improved transportation networks and storage facilities, how we disseminate agricultural information to various stakeholders. Strengthening institutional capacities and intersectoral coordination. Formulating supportive agricultural policies and regulatory frameworks.

Key Factors

1. Environmental Sustainability

Maintaining soil health and fertility, Preserving biodiversity and ecosystems and managing water resources sustainably

2. Economic Viability

Ensuring fair pricing and market access for smallholder farmers, Providing financial services and credit facilities and encouraging agribusiness and value addition.

3. Social Inclusivity

Empowering women and youth in agriculture by promoting equitable access to resources and opportunities. Fostering community participation and traditional knowledge.

Stakeholders

- **Farmers and Agricultural Workers.** Small holder farmers, cooperatives, and large-scale farmers. Agricultural laborers and farmer associations.
- **Government and Policy Makers.** This is the Ministry of Agriculture, environment, and trade. Local and regional government bodies.
- **Research and Educational Institutions** Universities and agricultural research centers. Extension services and vocational training institutes.

- Private Sector and Agribusinesses
- Agro-industries, input suppliers, and food processors. Financial institutions and market intermediaries.
- Non-Governmental Organizations (NGOs) and Civil Society
- NGOs focusing on rural development and food security and community-based organizations and advocacy groups.
- International Organizations and Development Partners
- UN agencies, World Bank, and regional development banks. The International agricultural research organizations (e.g., CGIAR).

Tools and Technologies

1.Innovative Agricultural Technologies

Precision farming and smart agriculture. Biotechnology and genetic engineering. Mobile applications and digital platforms for information dissemination.

2.Sustainable Land Management Techniques

These are agroforestry and permaculture. Soil conservation and erosion control methods.

3. Water Management Systems

Drip irrigation and rainwater harvesting. Integrated watershed management

4. Climate-Smart Practices

Early warning systems and weather forecasting. Climate-resilient crop and livestock breeds.

Requirements

1. Capacity Building and Education

Training programs for farmers on sustainable practices. Strengthening agricultural extension services.

2. Investment and Financing

Public and private investment in agricultural infrastructure. Access to microfinance and insurance schemes for farmers.

3. Research and Development

Increased funding for agricultural research. Collaboration between research institutions and farmers.

4. Market Access and Trade

Developing local and regional markets. Promoting fair trade practices and reducing trade barriers.

5. Community Engagement and Empowerment

Involving local communities in decision-making processes. Supporting farmer-led initiatives and cooperatives.

Conclusion

Building resilient food systems in Africa requires a comprehensive approach that integrates sustainable practices, policy support, stakeholder collaboration, and innovative tools.

By addressing the multifaceted challenges and leveraging local knowledge, Africa can achieve sustainable food security and resilience against future shocks.

Recommendations

- Research genetic characteristics of invasive species to harness beneficial traits for other crops and plants.
- Promote sustainable agricultural practices such as agro ecology, crop diversification, and organic farming.
- Develop climate-resilient crops and promote water conservation and efficient irrigation techniques.
- Develop and implement supportive agricultural policies and regulatory frameworks.
- Enhance economic viability by creating markets and providing financial services and credit facilities for farmers.
- Foster social inclusivity by empowering youth and women in agriculture and involving communities in decision-making.
- Invest in capacity building and education for farmers and agricultural workers.
- Secure investment and financing for agricultural research and development.
- Develop policies and programs to include persons with disabilities in all aspects of food systems, including training, production, processing, and marketing.
- NGOs should be involved in creating and funding programs that support the inclusion of persons with disabilities in agricultural activities.
- Engage all stakeholders, including research institutions, universities, and NGOs, in the development and implementation of resilient food systems

PRESENTATIONS

TOPIC	Challenges and Solutions for Sustainable Food Systems
PRESENTER	Mr. Arnold Kipchumba
ORGANISATION	Mama Doing Good

Catastrophes hinder our food systems. It is imperative that we empower farmers to embrace technologies. Access to finances and addressing challenges faced by farmers is crucial to attaining sustainable food systems. There is a need to shift consumption patterns to convert food waste into beneficial resources. Necessitate collaborations to foster an enabling environment for knowledge sharing.

Universities have a responsibility to inform and take part in policy formulations to create resilient food systems. In conclusion all stakeholders should embrace roles in building sustainable food systems by working together, collaborating, and sharing knowledge to preserve biodiversity.

Recommendations

- Develop and implement strategies to mitigate the impact of catastrophes on food systems.
- Empower farmers through education, resources, support systems, and promote the adoption of advanced technologies.
- Improve access to financial services and address the challenges faced by farmers.
- Implement programs to reduce food waste and repurpose it for other food system
- Facilitate collaborations among stakeholders to share knowledge and best practices.
- Encourage universities to actively participate in policy development for resilient food systems.
- Promote cooperation and knowledge sharing among universities, research institutions, and other stakeholders.
- Universities should inform and participate in policy formulation

TOPIC	Building Resilient Food Systems for a Sustainable Future
PRESENTER	Mr. Benjamin Tito
ORGANISATION	Agriculture and Food Authority

AFA was established under the AFA Act 2013 to consolidate laws and regulations. Resilient food systems involve recycling, reusing, and combining resources to reduce dependency on external inputs, particularly fossil fuels. Systems not resilient enough were unable to rebound during the COVID-19 era, highlighting the need for remodeling food production. Approaches to resilient food systems include market-driven and government-driven strategies.

Aligning to SDGs involves farming communities, sustainable farm businesses, and farm and value-chain workers. AFA's contributions to food systems include capacity building for county governments, promoting best practices, regulating agricultural processing, and determining research priorities. Sustainable farming practices include produce traceability, contract farming, safe pesticide use, carbon credits, minimum tillage, soil conservation, and organic farming.

Recommendations

- Implement sustainable farming practices: produce traceability, contract farming, safe pesticide use, carbon credits, minimum tillage, organic farming, precision agriculture
- Develop resilient food systems that incorporate recycling, reuse, and reduced dependency on external inputs.
- Implement both market-driven and government-driven strategies to build resilient food systems.

PRESENTATIONS

TOPIC	Dryland Agriculture for Sustainable and Inclusive Development: Economic Diversification Opportunities for Rural Livelihoods Across Drylands
PRESENTER	Madam Nancy Muindi
ORGANISATION	Kickstart International

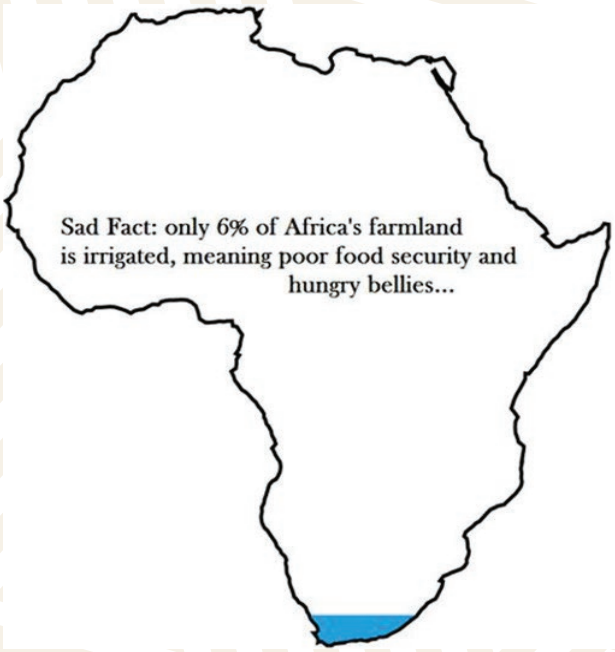
Kickstart International is a Non-Profit Social Enterprise founded in Kenya in 1991. We work in 17 Sub- Saharan Countries and have 3 Regional Hubs – Kenya, Zambia & Nigeria

Our Mission is to enable Millions of Smallholder Farmers in sub-Saharan Africa to climb out of poverty quickly, cost-effectively and sustainably through Earning a Lot More Money and Adapting to Climate Change.

Our Focus is scaling smallholder farmers' irrigation across sub–Saharan Africa

Irrigation In Statistics

- 20% of Farmland Worldwide is Irrigated
- > 40% of farmland in Asia is Irrigated
- > 52% in India
- 20% of Farmland Worldwide is Irrigated
- > 40% of farmland in Asia is Irrigated
- > 52% in India
- Kenya~3% of Farmland
- Annual 'Hungry Seasons'



Why irrigation for sustainable dryland agriculture?

Rain-fed Farming	Irrigated Farming
Low Value/Staple Crops	High-Value Crops-Fruit/Veg
1-2 Harvests/year	Multiple Harvests/yr
Flooded Markets	Sell Year-Round esp. in Off-seasons
Low Prices	
< 40% Spoils	High Prices at Farm Gate
No Crop if Rains Fail	Save Crops if Rains Fail

Proven Impacts

From case studies of farmers using our pumps

1. Sustainable Livelihoods
Increased income and profits through year-round production and sales of high-value crops Rural job creation through profitable family enterprises
2. Climate Resilience
Production independent of rains - farmers can save rainfed crops
3. Food & Nutritional Security
Households serve their immediate food needs and beyond by harvesting year-round.
4. Disaster Relief
Sustainable alternative after the initial food and aid assistance
5. Women Empowerment

Our Solution Model

1. Innovate
From our Innovations Hub, innovate high-impact irrigation solutions under the brand name "MoneyMaker, specially designed for Africa's Smallholder farmers.

2. Distribute
To enable rural smallholder farmers to access MoneyMaker irrigation technologies across SSA locally, KickStart delivers its pumps through two main channels: partner organizations (NGOs, governments, etc.) and direct sales through community-based retailers
3. Train
KickStart offers product usage and maintenance training and tailored Agropreneurship training to partners' lead farmers and staff. The training is designed to help farmers run a successful farming business and maximize the benefits of irrigation.
4. Measure
KickStart has a rigorous impact monitoring program in place, which tracks changes in the social and economic status of beneficiaries.
5. Advocate
Kickstart works to accelerate global support for farmer-led irrigation in Africa, by sharing research and advocating for the right investments, smart subsidies, and policies among key stakeholders

Irrigation + Economic Diversification

Right tools to irrigate

↓

Increased Agricultural Productivity

↓

Increased incomes

↓

Investment in livestock, non-farm activities, healthcare etc

PRESENTATIONS

Partnerships and Success Stories

Alternative livelihoods for the People of East Pokot In collaboration with WV Marigat ADP. Started vegetable gardens

In collaboration with Siongiroi FSA, drinking water for cows. Rent to try and buy for the youth

Sustainable livelihoods in Coast region

Conclusion

For dryland Agriculture to be more inclusive and support sustainable livelihoods

Scaling Up irrigation solutions, more stakeholder collaborations and more investment

Recommendations

- Advocate for increased investment in irrigation infrastructure and technology in Africa to improve agricultural productivity and food security.
- Strengthen partnerships with NGOs, governments, and private distributors to ensure widespread adoption and support for irrigation technologies.
- Invest more in knowledge and tools for dryland food systems, especially irrigation
- Expand case study initiatives and share best practices to encourage similar projects in other regions facing agricultural challenges.
- Implement water harvesting techniques and collaborate with organizations specializing in water catchment to secure water sources for irrigation in ASAL regions.

TOPIC	Comparative Effects of Organic Manure and Inorganic Fertilizers on Growth and Yield of Sorghum (Sorghum Bicolor L. Moench) In Kibwezi East, Makueni County, Kenya
PRESENTER	Esther Nthenya Muli and Joseph Munyao
ORGANISATION	

Sorghum (Sorghum bicolor) is a vital crop in semi-arid regions due to its high drought tolerance and adaptability. In areas like Makueni County, Kenya, where soil fertility is low and rainfall is unpredictable, enhancing sorghum yield is crucial for food security (Hariprasanna et.al., 2016). Traditional farming practices often rely on organic manure, while modern approaches use inorganic fertilizers.

This study aimed to evaluate the effectiveness of organic manure, inorganic fertilizers, and their combination on improving sorghum growth and yield, providing insights for sustainable agricultural practices in semi-arid environments

Objectives

To evaluate the impact of organic manure, inorganic fertilizers, and their combination on the growth and yield of sorghum in the semi-arid region of Makueni County, Kenya.

Specific Objectives

1. To determine the influence of organic manure on the growth parameters and yield of sorghum.
2. To analyze the effect of inorganic fertilizers on the growth and yield of sorghum.
3. To compare the combined application of organic manure and inorganic fertilizers with individual applications and a control, in terms of sorghum growth and yield.

Methodology

Site: Makutano, Kibwezi East, Makueni County, Kenya.

Experimental Design: Randomized Complete Block Design (RCBD) with 12 plots (3 treatments + control, each replicated 3 times).

Treatments: Organic manure, inorganic fertilizers, combination of both, and a control (no treatment).

Crop Husbandry: Clearing, primary and secondary tillage, planting sorghum seeds (variety SSR-01), thinning, weeding, and integrated pest management

Results: Growth Parameters

Parameter	Control(TO)	Organic manure(T1)	Inorganic Manure(T2)	Combined(T3)
Number of leaves	12	15	18	20
Plant height	110	130	140	150
Stem Diameter	1.2	1.4	1.6	1.8
Number of Nodes	5	6	7	8
Biomas (g/plant)	600	700	750	800

Parameter	Control(TO)	Organic Manure(T1)	Inorganic Manure(T2)	Combined(T3)
Grain size(mm)	3.5	4.0	4.3	4.5
Number of grains per head	1400	1600	1800	2000
Weight of grains per head(g)	70	80	90	100
Total Grain weight	900	1000	1100	1200

Chlorophyll Content and Canopy Temperature

Parameter	Control(TO)	Organic Manure(T1)	Inorganic Manure(T2)	Combined(T3)
Chlorophyll content(SPAD units)	35	40	42	45
Canopy Temperature	32	30	29	28

Discussion

The combined use of organic manure and inorganic fertilizers significantly enhances the growth and yield of sorghum in semi-arid conditions. This combination improves soil health, nutrient availability, and plant physiological parameters, making it a viable strategy for improving sorghum production in Makueni County.

The findings suggest that adopting integrated nutrient management practices can address the challenges of food insecurity and support sustainable agricultural development in the region.

Implications on Sustainable Agriculture

Combining organic and inorganic fertilizers can enhance crop production and maintain soil health.Food Security: Increased sorghum yield contributes to food security in semi-arid regions like Makueni County.Economic Benefits: Higher yields can lead to increased income for farmers

Recommendations

- Further Research: Investigate long-term effects of combined fertilizer use on soil health and crop yield.
- Policy Implications: Encourage policies supporting integrated fertilizer use for sustainable agriculture.
- Capacity Building
- Adoption of Integrated Nutrient Management

Conclusion

This study demonstrates that the combined use of organic manure and inorganic fertilizers significantly enhances the growth and yield of sorghum in semi-arid regions. The findings underscore the potential of integrated nutrient management to improve food security and promote sustainable agriculture.

Adopting these practices, farmers can achieve higher yields and maintain soil health, contributing to both economic stability and environmental sustainability. Further research is recommended to explore the long-term benefits and refine these practices for broader application.

TOPIC	Control of Tsetse Flies - Vector of Trypanosomiasis
PRESENTER	Dr. Benson Wachira
ORGANISATION	Pwani University

Introduction

Facing a myriad of challenges including food insecurity, disease outbreaks, unemployment, and poverty, exacerbated by resistance to commercial pesticides, the situation calls for innovative solutions. Current methods for tsetse fly control not only harm the environment but are also non-specific and costly.

Discussion

Various species of tsetse flies transmit animal trypanosomiasis, with some posing risks for human trypanosomiasis transmission. Regions such as the Lake region grapple with high human trypanosomiasis prevalence, while the coastal region faces nagana outbreaks in animals. Farmers confront significant hardships from tsetse flies and tick-borne diseases like East Coast fever.

Efforts have focused on exploring collar designs resistant to vegetation removal or alternative methods where feasible. Rigorous field trials across diverse climates are necessary to verify the effectiveness of proposed control methods against multiple trypanosome species. Additionally, implementing supplementary measures targeting alternative vectors alongside tsetse fly control is crucial.

Conclusion

Conducting region-specific studies is essential to comprehend tsetse fly distribution and disease transmission dynamics across varying geographical and ecological contexts. Engaging farmers and communities through education and awareness initiatives is vital to foster acceptance and adoption of sustainable control methods.

Recommendation

- Implement new, environmentally friendly tsetse control methods
- Further research on effectiveness of control methods in different regions and against different trypanosome species
- Collaborate with local communities and stakeholders to implement targeted control measures tailored to regional disease patterns and vector species.
- Promote integrated pest management strategies that include both tsetse control and tick management to improve overall livestock health and productivity.

PRESENTATIONS

TOPIC	The influence of Agro-Sil fertilizer formulations on crop production and climate change mitigation in Makueni County, Kenya
PRESENTER	Benard Kivyatu, Ms. Jael Birgen, Prof. Ibrahim Haji, Judith Wafula, Paul Mwania and Ms June
ORGANISATION	Lukenya University

Food is a critical issue in Africa, thanks to Climate Change .Over 1.9 billion people worldwide are food insecure (UNICEF 2023).In Africa – 1/5 (278m) PPLE are undernourished & 55 m children are stunted (OXFAM, 2023). In Kenya, 2 million children have stunted (UNICEF 2018).Makueni county- among 23 ASAL Counties (GoK, 2023).Makueni: 12.47% HH in borderline or poor Consumption score (composite: diversity, F, Qnty, Rel. Nutri. Of diff foods)

Objectives

Main objective

To assess the influence of Agro-Sil formulation in crop production and climate change mitigation

Specific objectives

1. To examine the influence of Agro-Sil on crop growth
2. To assess the influence of Agro-Sil on crop yield
3. To explore the potential of Agro-Sil on Climate change mitigation

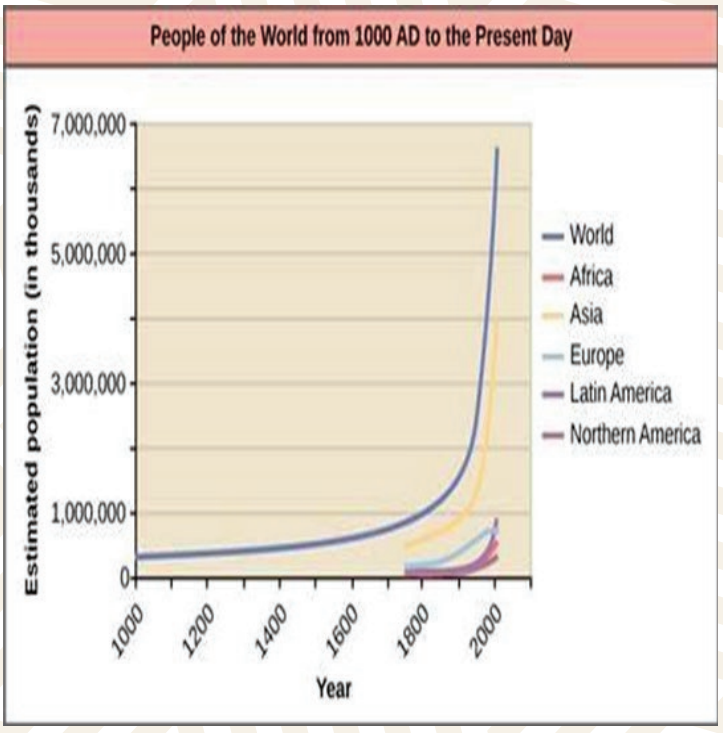
Target group

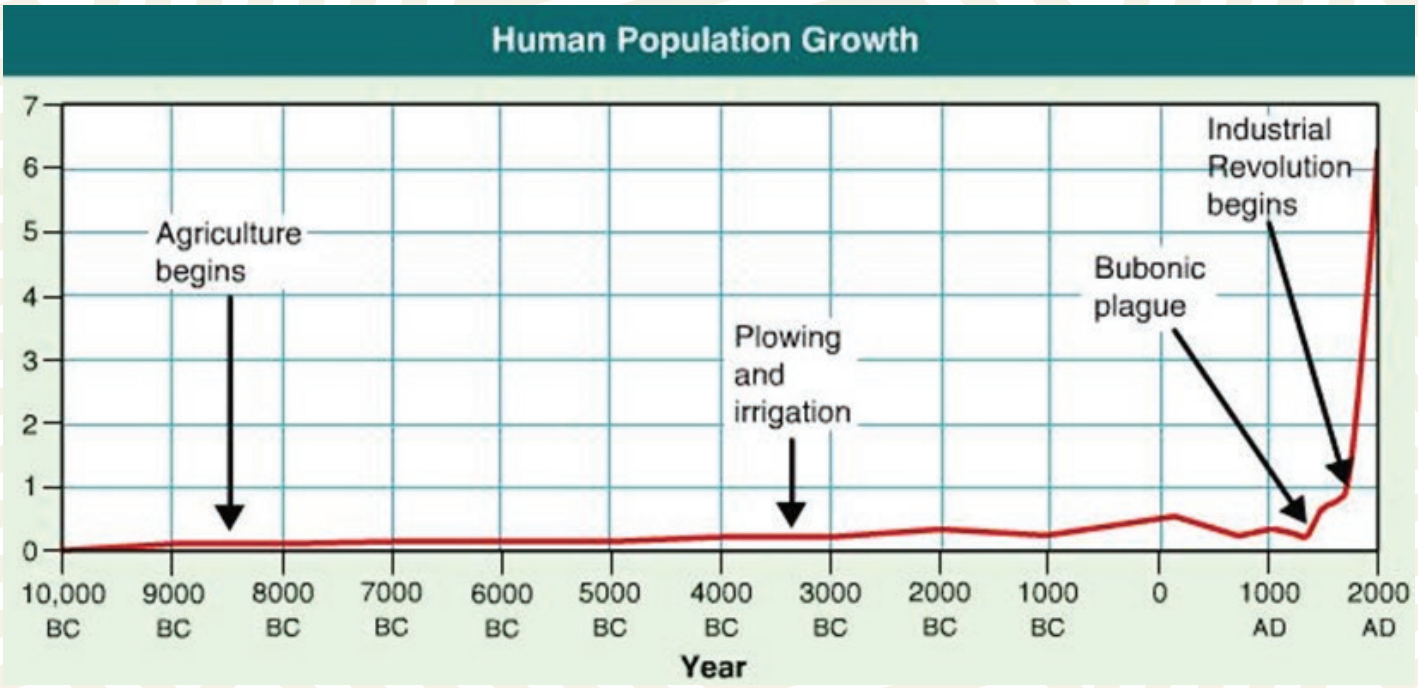
- Small scale farmers in Makueni county
- Sub-Saharan Africa: Most food is produced by small scale farmers (Giller e al., 2021)
- Target Crops: (Maize, Groundnuts, Pigeon pea, & Cow pea)

Challenges in Food Production

- Africa: Highest land per capita
- Poverty and Marginalization
- Lack of intensification, expansion and specialization (van Vlient et al., 2015) compared to DC
- Climate change – drought e.g. Malawi today.
- Conflicts (Sudan, South Sudan, Liberia, Niger, Chad, Mali, etc
- Tremendous human population – In Africa
- Compare Holocene and Anthropocene epochs
- Declining soil fertility (Climate change, inappropriate farming systems
- Many sponsored projects have little success to show
- Many HH have one meal /day
- Inadequate food supply ; Malnutrition : hunger & stunted growth among children below five years: thus future impact
- Increased poverty, increased hunger

World population: Last 12,000 years





Literature review

- World population to hit 8.8 bn in 2064 (Vollset et al., 2020)
- Global food demand to increase by 60 % by 2030
- Huge demand for food to create great challenges
- Use of fertilizers lead to pollution (Nosheen et al., 2021) e. g. Eutrophication)
- Attainment of SDG NO. 2 (Zero hunger) is a big challenge
- Food production systems should not degrade the Env. (Biotic & Abiotic)
- Look at the decline of Bumble bees and Monarch butterflies in the US

Research methods

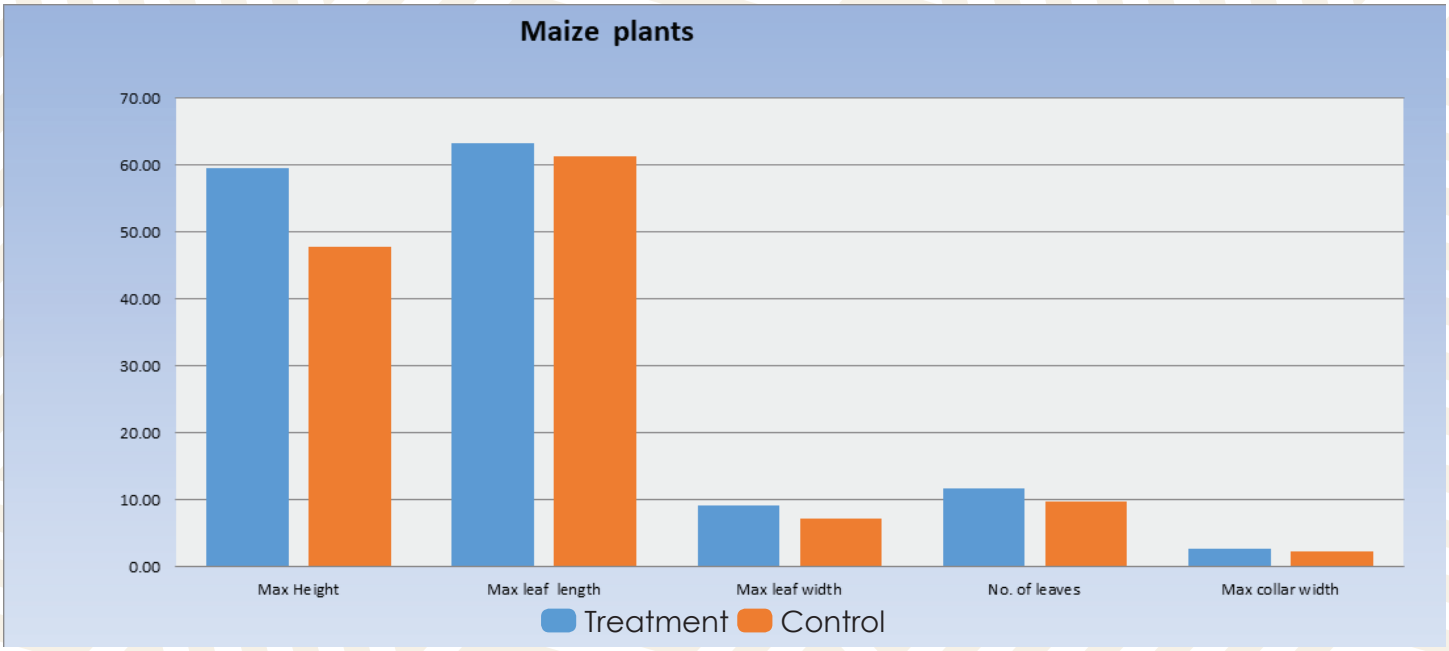
- Study area : Kibwezi east, Makueni county
- Randomized block design
- Land preparation
- Agro-Sil formulation application (48 hours before planting, 30 and 60 days after planting)
- Monitoring of germination
- Normal weed control was done

Harvesting

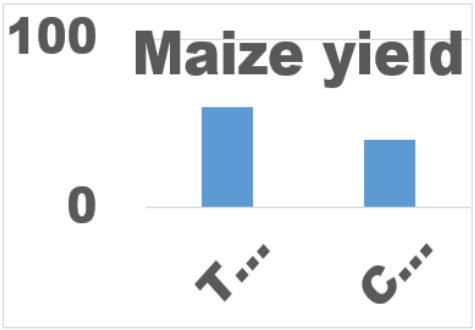
- Harvest of maize, ground nuts
- Cow pea not harvested due to influence of small ruminants
- Pigeon pea: affected by excessive rainfall

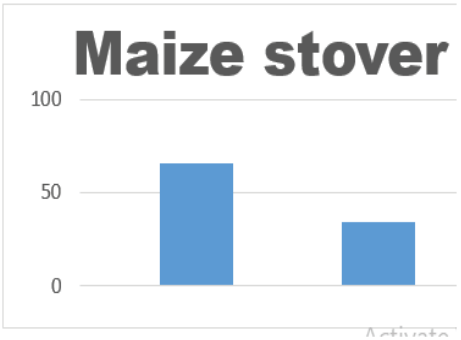
PRESENTATIONS

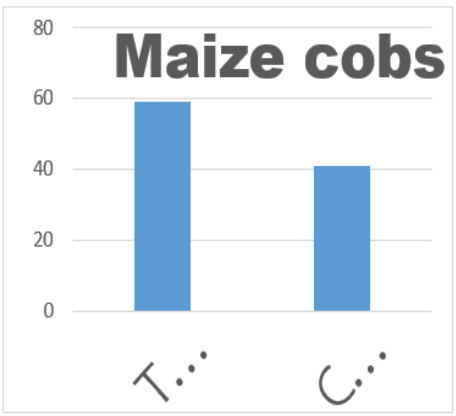
Results (Above ground biomass)



Performance of maize yield, stover and cobs







Above ground biomass

The Agro-Sil treated plants are on the right while the control is on the left. Notice the enhanced above ground development. Cow pea was affected by small ruminants and results were rejected

Below ground biomass

Plate 2a: Maize- Control

Plate 2b: Maize - Treatment

Notice the highly enhanced root system in the treatment plants. This has great potential in reduction of soil erosion and increased soil fertility upon decomposition due to added CEC capacity.

Discussion

- There is urgent need to develop strategies in food production in ASALs
- Many government efforts have had little success (Galana project)
- Population growth is a critical issue this century
- Various strategies exists (C/rotation, mulching, mixed farming, No-Till, AF, Agro-ecology, GMO's,
- Agro-Sil provides a simple method of improving soil health while enhancing crop production
- Enhanced root development (BGB) binds soil against erosion and increases soil fertility upon decay (Humus and CEC)
- 20% increase in maize can save many lives while 5.23% in G/nuts adds value

Conclusion

Agro-Sil has the potential to increase food production and enhance other strategies that mitigate soil erosion and climate change

Recommendation

▪ Further research is required to determine the potential of Agro-Sil in stem and root tuber crops such as Cassava (Manihot esculenta), Sweet potatoes (Ipomoea batatas), Irish potatoes (Solanum tuberosum L.) and Arrow roots (Maranta arundinacea)

▪ Do you think hunger can be defeated in Africa? ***Yes we can .Hunger can be eliminated in Africa***

EBM farm in Nakasongola

PRESENTATIONS

TOPIC	Livestock, Drylands and Climate Change
PRESENTER	Mr. Gonzalez Ricardo
ORGANISATION	

Climate change significantly impacts livestock through factors such as heat stress and water scarcity. Strategies aimed at mitigating heat stress involve adapting to new environmental conditions and bolstering resilience in livestock production, particularly in dairy farming.

Discussion

Silvo-pastoral systems, which involve grazing livestock among trees, not only enhance carbon stock and flow but also provide additional benefits like shade provision, carbon sequestration, biodiversity conservation, soil improvement, and economic advantages. Current research efforts are directed towards developing shade-tolerant forages, improving animal health, and enhancing biodiversity within silvo-pastoral systems.

Conclusion

Camels are increasingly recognized as a viable solution for bolstering livestock resilience amidst the challenges posed by climate change. Their unique adaptations make them well-suited to thrive in changing environmental conditions, highlighting their potential importance in sustainable livestock management strategies.

Recommendations

- Promote the adoption of heat-tolerant livestock species like camels and goats over cattle to enhance resilience against climate change impacts such as heat stress and water scarcity in dryland areas.
- Support research and development of shade-tolerant forages and integration of silvo-pastoral systems with crop systems to maximize environmental benefits (carbon sequestration, biodiversity enhancement) and economic gains (improved soil health, water management).
- Continue research on shade-tolerant forages and integration of crop systems

PROCEEDINGS OF THE SECOND DAY OF THE CONFERENCE

28TH JUNE 2024

The day began with opening remarks from DVC (Finance, Planning And Administration), Prof Ibrahim Haji of Lukenya University. He defined the characteristics of dry lands and highlighted available resources crucial for economic models in both dry lands and urban areas, emphasizing their vast potential and advocating for activities like irrigation and agroforestry. Additionally, stressed the importance of addressing climate change in dry lands by citing tree planting initiatives similar to those at Lukenya University, and requested insights from the Ethiopian team renowned for their expertise in pastoralism.

He urged various stakeholders to invest in research and innovation to continuously improve agricultural and environmental management practices tailored to the unique challenges of dry lands.

There was a recap of the previous day by Mr.Protus Kyalo

Key Note Speech

TOPIC	Fostering policy and institutional frameworks to create enabling environments for the development of equitable and environmentally responsible agricultural value chains
PRESENTER	Dr. Jeremiah Rogito
ORGANISATION	Alliance for Green Revolution Africa

Food and Land Use Coalition (FOLU Kenya) supports science-based solutions and helps build a shared understanding of the challenges and opportunities to unlock collective and ambitious action. The coalition secretariat consists of AGRA, World Resource Institute (WRI Africa) and Global Alliance for Improved Nutrition (GAIN).

FOLU and Growing Better champion sustainable land use and food systems through critical transitions and a reform agenda. They emphasize improved water and resource management to boost agricultural productivity and income generation. Strengthening partnerships with governments supports initiatives like rangeland restoration and equitable food systems development. AGRA strategies focus on resilient agricultural practices and enhancing inclusive market systems and trade. STRAK's theory of change aims to maximize agricultural production in dry lands through environmental transformation. Regenerative agriculture (RA) practices, primarily using organic manures, demonstrate higher female engagement but face market barriers and limited investment access.

Recommendation

Advocate for institutional capacity building by developing comprehensive programming frameworks that prioritize inclusive climate resilience in food and land use systems. This involves creating robust strategies to enhance the ability of institutions to respond to climate challenges, ensuring that all stakeholders, including marginalized communities, are considered. Additionally, implement practices that significantly improve water management and livelihood resources, with a particular focus on engaged agro ecological practices. These practices should aim to sustainably increase agricultural production and income while preserving the environment.

Moreover, it is crucial to foster stronger partnerships with governments at all levels to enable policy support and secure funding for various initiatives. These initiatives should be designed to empower local communities through urban agriculture projects, community-supported agriculture schemes, food cooperatives, and farmers' markets. Such collaborations will not only enhance food security and sustainability but also provide economic opportunities and strengthen community bonds. By aligning efforts with governmental policies and resources, these initiatives can achieve greater impact and long-term viability.

TOPIC	Influence of Head teachers' Coordination of Don or Support Services on Inclusion of Learners with Special Needs Education in Public Primary Schools Mbooni East Sub-County, Kenya.
PRESENTER	Dr. Domitilla Wanza Mwanzia, PhD
ORGANISATION	

The topic aligns closely with international policies promoting inclusive education, exemplified by initiatives like "No Child Left Behind," which prioritize the integration of learners with Special Needs Education (SNE) into agricultural practices in dry land areas. This approach underscores the importance of inclusivity and equity in educational settings, ensuring that all students have equal opportunities to participate in and benefit from agricultural activities.

Discussion

In this context, head teachers play a pivotal role as facilitators, engaging donors and coordinating support to enable the meaningful involvement of students with SNE in agricultural programs. Their leadership is crucial in fostering comprehensive approaches that address diverse learning needs and promote inclusivity within school communities.

Furthermore, integrating agriculture programs into the Kenyan curriculum represents a strategic move towards sustainability, empowering students to develop practical skills and knowledge that contribute to self-reliance. By embedding these initiatives into the educational framework, there is a reduced dependency on external aid, promoting long-term resilience and local empowerment.

Recognizing the diversity of disabilities, educational systems are designed to accommodate different needs and abilities, ensuring that every learner receives tailored support to effectively participate in mainstream agricultural practices. This inclusive approach not only enhances educational outcomes but also contributes to the socio-economic development of dry land areas by harnessing the potential of all students, regardless of their challenges.

Recommendations

- Adapt agricultural practices to accommodate learners with SNE based on individual disabilities, maximizing engagement and productivity, such as tree growing activities.
- Fully integrate SNE programs into the mainstream curriculum in dry land areas to address historical neglect and ensure meaningful participation.
- Enhance coordination among head teachers, government stakeholders, and donors to sustainably support SNE involvement in agricultural education.
- Implement inclusive education policies effectively to align with international standards and improve educational outcomes for learners with SNE in Kenya.

PRESENTATIONS

TOPIC	Recognizing the potential of green jobs for sustainable livelihoods among the rural youth and the need for skill development
PRESENTER	Ms.Ruth Moraa
ORGANISATION	MaMa Doing Good

The initiative focuses on environmental preservation, restoration, and reducing environmental degradation by creating green jobs. It identifies several challenges, including a lack of skills and training, as well as social and economic barriers such as limited access to finances. The Mama Doing Good Initiative has been instrumental in empowering small-scale farmers and promoting community self-reliance. Additionally, it has successfully trained 100 groups, particularly emphasizing the empowerment of women and youth through tailored training programs and providing necessary tools to support green jobs.

Community engagement plays a crucial role in these efforts, involving educational campaigns, awareness programs, and training sessions facilitated by institutions like KALRO and ICIPE, aimed at promoting green job opportunities. The benefits of green jobs in fostering sustainable development, especially among rural youth in Kenya, have been underscored.

Ms. Charity Nashipai and Dr. Guyo Roba both stress the importance of discussing the evolving goals and values of pastoralists in Kenya. They highlight initiatives focused on empowering women and youth through workshops and engagement in pastoralist activities. Both speakers agree on the necessity for pastoralists to adopt resilient agricultural practices, such as rotational grazing, water harvesting, and cultivating drought-resistant crops, all while preserving traditional values.

There is consensus on the challenges posed by increasing commercialization in pastoralist areas, particularly concerning access to markets and sustaining livelihoods. Policy-making is seen as critical, advocating for the involvement of the Maa community to ensure decisions respect and support their way of life.

Addressing environmental challenges, such as weed infestation, through scientific interventions, such as employing electricity to protect pastoral lands from livestock harm, has been identified as crucial. Recognizing the need for portfolio diversification among pastoralists to enhance resilience against climatic changes and market fluctuations has also been emphasized.

Efforts are needed to overcome cultural barriers that affect the market access of camel products and to allow time for cultural acceptance of new economic activities. Moreover, there is a recognition of challenges in market systems driven by government intervention and tax policies that hinder market flow and access to information for pastoralists. Managing arid lands is pivotal in combating degradation, with practices such as ploughing and controlled mobility being highlighted as essential strategies.

Recommendation

- Skills Development: Address technical skills (e.g., organic farming), soft skills (entrepreneurship, business management), and digital literacy (accessing grants, financial management).
- Policy and Investment: Advocate for government policies supporting green job creation and invest in infrastructure.
- Community-Based Advocacy: Encourage private entities to engage in community advocacy, particularly in rural areas, to support green job initiatives.
- Gender and Youth Empowerment: Continue promoting women and youth in agriculture through targeted training and providing necessary tools.
- Table Banking: Support both new and existing women groups in adopting table banking models, ensuring adherence to established procedures.
- Scaling Up: Expand initiatives like black soldier larvae flies for waste management and production, targeting small-scale farmers for large-scale impact.

TOPIC	Panel Discussion: How the goals and values of pastoralist in Kenya are changing
MODERATOR	Dr. Jason Sircerly
PANELISTS	1) Ms. Charity Nashipai (Chairlady Youth Pastoralist) 2) Dr. Guyo Roba (Director of Jamil observatory of food security and action)

In a collaborative discussion on the challenges and strategies concerning pastoralist communities in Kenya, Ms. Charity Nashipai and Dr. Guyo Roba highlight crucial aspects that shape their approach to sustainable development and community empowerment.

Ms. Nashipai begins by emphasizing the critical importance of ongoing dialogue regarding the evolving goals and values of pastoralists. ***"Understanding the dynamic nature of pastoralist goals is essential," she asserts, "to ensure our initiatives align with their aspirations for sustainable livelihoods."***

Dr. Roba echoes this sentiment, underlining the need for adaptive strategies that preserve traditional values while enhancing resilience. ***"Resilience is not just about adapting to climate change," he explains, "but also about safeguarding cultural integrity in the face of modern pressures."***

The discussion shifts to the empowerment of women and youth within pastoralist communities. Ms. Nashipai passionately describes the initiative's efforts in this area. ***"Empowering women and youth is not just a goal but a cornerstone," she states. "Through targeted workshops and engagement in pastoralist activities, we foster leadership and skills that are vital for community self-reliance."***

Dr. Roba nods in agreement, citing examples of successful adoption of resilient agricultural practices such as rotational grazing and water harvesting. "These practices not only mitigate environmental degradation but also ensure sustainable resource use," he remarks. ***"Preserving our natural resources is fundamental to our cultural heritage."***

The conversation turns to the challenges posed by increasing commercialization in pastoralist areas. Both speakers express concern about access to markets and sustaining livelihoods amidst these pressures. ***"Navigating commercialization requires balanced policies,"*** Ms. Nashipai suggests, ***"that respect traditional knowledge and support economic growth."***

Dr. Roba stresses the importance of inclusive policy-making involving the Maa community. ***"Policy decisions must reflect the needs and values of the community,"*** he asserts. ***"This ensures sustainable development that benefits everyone."***

Environmental challenges like weed infestation prompt discussion on innovative solutions. ***"Scientific interventions, such as using electricity to protect grazing lands, can be transformative,"*** Dr. Roba proposes. **"They help mitigate environmental threats while maintaining ecological balance."**

Portfolio diversification emerges as another critical strategy. ***"Diversifying livelihoods enhances resilience,"*** Ms. Nashipai affirms. ***"It provides buffers against climate variability and economic fluctuations."***

Cultural preservation remains central to their dialogue. ***"Cultural acceptance of new economic activities takes time,"*** Ms. Nashipai notes. ***"Efforts are needed to overcome barriers that affect market access for traditional products like camel milk."***

They conclude by addressing systemic challenges in market access and information flow. ***"Ineffective market systems hinder pastoralists' ability to thrive,"*** Dr. Roba acknowledges. ***"Reforming these systems is essential for equitable economic opportunities."***

The discussion ends on the importance of arid land management. ***"Managing arid lands through sustainable practices like ploughing and controlled mobility is crucial,"*** Ms. Nashipai asserts. ***"It ensures the long-term health of our landscapes and livelihoods."***

In summary, Ms. Charity Nashipai and Dr. Guyo Roba advocate for holistic approaches that balance environmental stewardship, cultural preservation, and economic empowerment within Kenya's pastoralist communities. Their shared vision underscores the necessity of adaptive strategies and inclusive policies to achieve sustainable development goals effectively.

Recommendations

- Policy Development: Formulate policies that respect pastoralist ways of life and support resilient agricultural practices.
- Technical Support Programs: Implement effective technical support programs tailored to pastoralist communities' needs for sustainable agriculture.
- Market Development: Improve market infrastructure and access to market information to enhance livestock trade and commercialization.
- Empowerment and Education: Continue empowering women and youth through education and skill-building programs to enhance their participation and leadership in pastoralist activities.
- Strengthen Market Access: Improve market access for pastoralists by providing better market information, reducing taxation on livestock trade, and enhancing market infrastructure in remote areas.
- Cultural Sensitivity and Integration: Develop strategies to integrate cultural values into economic activities like camel product marketing, ensuring respect and understanding of pastoralist traditions.

TOPIC	Coping with Droughts in Agriculture of Northwest of Vietnam
PRESENTER	Madam Yen Nguyen
ORGANISATION	

Northwest Vietnam is confronted with pressing challenges posed by climate change, manifesting in elevated temperatures, prolonged droughts, erratic flash floods, and altered seasonal patterns. These environmental shifts exert profound impacts on agriculture, which serves as the cornerstone of livelihoods for local communities in the region.

Discussion

The urgency for adaptation measures becomes evident as these communities heavily depend on agriculture for sustenance and income. The susceptibility of agricultural practices to extreme weather events underscores the need for proactive strategies to mitigate risks and enhance resilience.

Climate change has not only affected environmental conditions but has also disrupted economic and social dynamics within the region. Traditional livelihood patterns are increasingly vulnerable, necessitating innovative approaches to ensure sustainable development and community well-being.

In response to these challenges, a range of adaptation strategies has been identified. Implementing early warning systems for climate-related disasters emerges as a critical step to improve preparedness and minimize the impact of extreme weather events on communities and agriculture.

Promoting crop resilience through circular economy-based agriculture represents another vital strategy. This approach emphasizes sustainable resource use and waste reduction, thereby enhancing agricultural productivity and environmental sustainability.

Diversifying livelihood options beyond agriculture is crucial for reducing vulnerability to climate change impacts. Encouraging local communities to engage in non-agricultural services and industries can provide alternative sources of income and economic stability.

Advocating for sustainable land use practices such as agroforestry and forest conservation plays a pivotal role in maintaining ecosystem balance and enhancing community resilience. These practices not only contribute to climate adaptation but also promote biodiversity conservation and natural resource management.

In conclusion, addressing the climate vulnerability of Northwest Vietnam requires concerted efforts to implement adaptation measures that safeguard livelihoods, protect natural resources, and foster sustainable development. By integrating these strategies into local planning and policy frameworks, communities can better withstand the challenges posed by climate change and achieve long-term resilience.

Recommendations

- Implement Early Warning Systems: Establish and enhance early warning systems to provide timely alerts on climate-related disasters like droughts and flash floods to mitigate their impact on agriculture and communities.
- Diversify Livelihoods: Develop and support non-agricultural services and income-generating activities to reduce dependency on climate-sensitive agriculture and enhance community resilience.
- Investment in Research and Technology: Invest in qualitative statistical methods and technologies to gather necessary data for informed decision-making and adaptive strategies tailored to local climate vulnerabilities

PRESENTATIONS

TOPIC	Role of indigenous acacia in mitigating climate change in pastoralists communities of eastern Africa in arid and semi-arid area
PRESENTER	Judith Adikinyi Wafula and Sammy Muvelah
ORGANISATION	

Agriculture employs over 40% of the total population in Kenya and approximately 70% of the rural population (GOK, 2018b). Crops, livestock, and fisheries sub-sectors contribute 77.6%, 19.6%, and 2.0% of the Agricultural GDP (AgGDP) respectively, with forestry contributing about 0.8%.Initiatives in agroforestry and pastoralism have focused on high rainfall areas, neglecting the unique needs of ASALs.

The Kenya National Agroforestry Strategy 2021-2030 has recognized the potential of integrating trees into agricultural landscapes but lacks specific strategies for ASALs (Climate Technology Centre and Network, 2021).
Objectives

The objectives of this paper are:

- To identify and classify Acacia species prevalent in Eastern Africa's ASALs by use.
- To examine the practical challenges associated with Acacia species in pastoralism
- To recommend strategies for promoting Acacia propagation and creating climate-smart fodder forests.

Methodology

- Panel Discussions- Participants identified local Acacia species and shared their experiences.
- Literature review- To contextualize the findings from the panel discussions within the broader body of knowledge

Participants by Country and Frequency

Country	Frequency
Kenya	12
TZ	7
Ethiopia	7
Total	26

Findings

- Prevalence of Acacia Species- Acacia trees for fodder is widespread across Ethiopia, Kenya, and Tanzania with three prevalent and well adapted species—Acacia tortilis, Acacia nilotica, and Acacia Senegal.
- Acacia tortilis was the most prominent due to its resilience and minimal growth requirements

Findings- Classification of Uses of Some Acacia Species

Classification	Species
Fodder	Acacia tortilis, Acacia nilotica, Acacia Karoo, Faidherbia Albida
Timber	Acacia Elatior
Bird feed	All Acacia sp.
Flower (bee forage) - Melliferous Plants	Acacia tortilis, Acacia senegal, Acacia seyal, Acacia nilotica, Acacia polycanta, Acacia melifella, Faidherbia Albida
Raisins and gums	Acacia senegal, Acacia seyal,
Live fence	Acacia tortilis, Acacia senegal, Acacia abyssinica, Acacia melifella, Acacia breviata,
Soil Fertility/biomass	All Acacia sp.

Classification- Agroforestry and Complimentary Uses

Agroforestry Uses	Complimentary Uses	Crops under Agroforestry
Fodder trees	Live Fence trees	Vegetables
Timber		Cereals
Biomass		Tubers
Bird feed trees		Grasses
Flower trees		Pest inhibitors
Firewood trees		
Raisins and gums		

Challenges Associated with Acacia Species in Pastoralism

- Land Tenure: Land subdivision and privatization limit communal grazing lands.
- Awareness: There is limited awareness among pastoralists about the wide potential of Acacia species.
- Support: Inadequate support from government and non-governmental organizations for Acacia propagation.

Recommendations

- Promotion of Acacia Propagation
- Intentional propagation of Acacia tortilis, Acacia nilotica, and Acacia senegal is crucial. Efforts should focus on raising awareness among pastoralists about the benefits of these species and providing technical support for their propagation.
- Climate-Smart Fodder Forests
- Establishing climate-smart fodder forests using Acacia species through polyculture agroforestry is recommended. This approach integrates livestock rearing with tree growing, enhancing the resilience of pastoral systems.
- Development of a Dedicated Center
- A dedicated center to promote climate-smart afforestation in Eastern Africa's ASALs is essential. This center would focus on research, training, and the dissemination of best practices for Acacia propagation and agroforestry

TOPIC	Dynamics of Velocity and Pressure Profiles in Enhancing Climate Resilience in Dryland: Agriculture in Kenya using Turbulent forced Convection Modelling
PRESENTER	Clementine K. Mutua
ORGANISATION	Lukenya University

Kenya's arid and semi-arid lands (ASALs) represent approximately 89% of the country's land area and are home to nearly 36% of its population.

These regions, encompassing counties such as Kitui, Turkana, and Mandera, are characterized by harsh climatic conditions, including low and erratic rainfall, high temperatures, and frequent droughts.

Climate variability intensifies the challenges of maintaining agricultural productivity and food security, as it exacerbates temperature extremes and unpredictability in rainfall patterns (Government of Kenya, 2020; IPCC, 2019).

Traditional agricultural practices, primarily dependent on rain-fed systems, often fall short in mitigating the impacts of severe weather and maintaining stable crop yields.

Consequently, there is an urgent need for innovative strategies that can enhance the resilience of agricultural systems in these regions.

The adoption of techniques that improve microclimatic conditions within the agricultural environment, thereby reducing heat stress, improving soil moisture retention, and enhancing overall crop health are critical for sustaining agricultural livelihoods in these areas (FAO, 2021).

The primary challenge for agriculture in Kenya's ASALs is the extreme and often unpredictable weather, which significantly impacts crop yields and soil health.

High temperatures and strong winds increase evapotranspiration rates, leading to moisture loss and thermal stress on crops. These conditions necessitate the exploration of new methods to regulate microclimatic variables, such as temperature and humidity, within the agricultural environment.

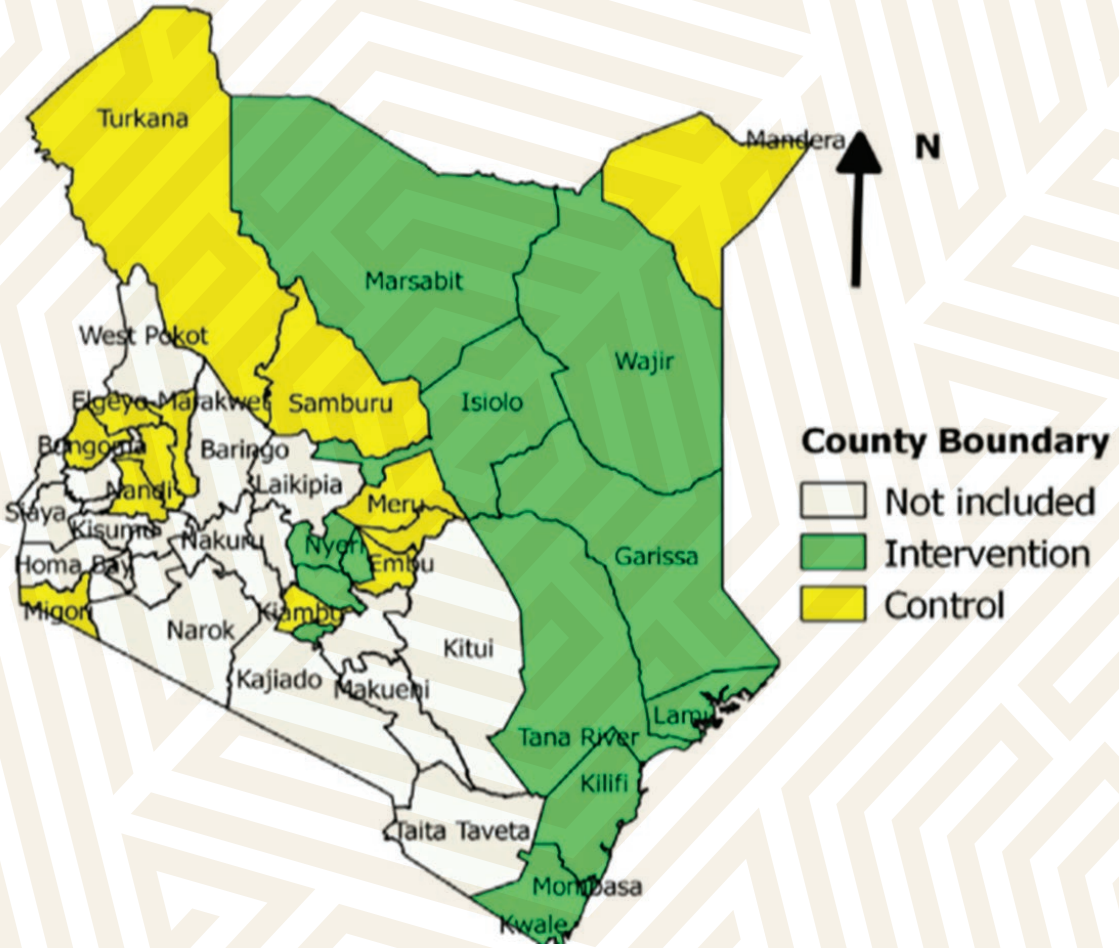
Traditional methods like crop rotation, water conservation practices, and soil management are crucial but insufficient in isolation to address the increasing intensity and frequency of climatic extremes.

There is a clear need to integrate advanced techniques that can effectively manage the microclimate to create more stable and favorable conditions for crop growth; Kim, S., & Lee, H. (2019).

Therefore, there is need to:

1. Investigates the impact of velocity and pressure profiles on microclimate regulation, focusing on airflow dynamics within agricultural systems
2. Highlight the role of optimized natural ventilation and forced convection in moderating temperature extremes, reducing heat stress, and improving soil moisture retention

To explore the dynamics of velocity and pressure profiles within agricultural systems in Kenya's dryland regions and their role in enhancing climate resilience (Kitui, Turkana and Mandera)



Methodology of the Study

Field Measurements

↓

Equipment and Setup

↓

Computational Fluid Dynamics (CFD) Simulations
CFD Model Setup

↓

Simulation Scenarios
Turbulent Forced Convection Modeling

Field Measurements

Field experiments were conducted in Kitui, Turkana, and Mandera counties. These regions were chosen due to their diverse climatic conditions and significant representation of Kenya's ASALs.

The study involved setting up test plots with and without airflow management systems (windbreaks and greenhouses) and measuring temperature, humidity, and soil moisture levels over a growing season.

Equipment and Setup

• Temperature and Humidity Sensors: Installed at multiple heights (1m, 2m, and 3m) to capture vertical profiles.
• Soil Moisture Probes: Placed at depths of 10cm, 20cm, and 30cm to monitor moisture content.
Anemometers: Used to measure wind speed and direction around and within the test plots.

Computational Fluid Dynamics (CFD) Simulations

CFD simulations were conducted to model the airflow and temperature distribution in and around the test plots. The simulations helped analyze the effects of different windbreak configurations and greenhouse designs on microclimate regulation.

CFD Model Setup

- Domain: 3D representation of the test plots, including the surrounding environment.
- Mesh: A fine mesh was used to capture detailed airflow patterns, especially around structures like windbreaks and greenhouses.
- Boundary Conditions: Set based on average climatic conditions recorded during field measurements (wind speed, direction, and ambient temperature)

Simulation Scenarios

- Baseline: Natural ventilation without any modifications.
- Windbreaks: Various placements and densities of windbreaks to evaluate their effectiveness.
- Greenhouses: Different greenhouse designs with natural ventilation and forced convection systems.

Turbulent Forced Convection Modeling

To further explore the effects of enhanced airflow management, turbulent forced convection modeling was used. This approach considers the impact of turbulence on heat transfer and airflow dynamics within the greenhouse environment.

Results and Discussion

Temperature Mitigation

- The field measurements and simulations revealed significant reductions in peak temperatures within the agricultural plots with optimized airflow management.
- In Kitui, windbreaks and forced convection systems effectively reduced peak daytime temperatures by approximately 10%.
- Turkana, experiencing extreme heat, showed the most significant benefits from airflow management. Peak temperatures decreased by up to 12% with forced convection.
- In Mandera, the temperature reduction was moderate but still significant, with forced convection lowering peak temperatures by up to 9%.

Table 1a: Temperature Reduction with Windbreaks and Forced Convection in Kitui

Time of day	Without windbreak(oc)	With wind break(oc)	With forced convection(oc)	Reduction with wind break%	Reduction with forced convection%
12:00	36	32	30	11.1	16.7
16:00	34	31	28	8.8	17.6

Table 1b: Temperature Reduction with Windbreaks and Forced Convection in Turkana

Time of day	Without windbreak(oc)	With wind break(oc)	With forced convection(oc)	Reduction with wind break%	Reduction with forced convection%
12:00	42	37	34	11.9	19.0
16:00	40	36	33	10.0	17.5

Table 1c: Temperature Reduction with Windbreaks and Forced Convection in Mandera

Time of day	Without windbreak(oc)	With wind break(oc)	With forced convection(oc)	Reduction with wind break%	Reduction with forced convection%
12:00	40	35	32	12.5	20.0
16:00	38	34	31	10.5	18.4

Soil Moisture Retention

The presence of windbreaks significantly improved soil moisture levels by reducing wind speed and evapotranspiration.

Table 2a: Soil Moisture Levels with and without Windbreaks in Kitui

Depth(cm)	Without windbreak%	With windbreak%	Increase%
10	13.0	15.5	19.2
20	12.0	14.0	16.7
30	11.0	13.5	22.7

Table 2b: Soil Moisture Levels with and without Windbreaks in Turkana

Depth(cm)	Without windbreak%	With windbreak%	Increase%
10	9.5	11.0	31.6
20	8.5	11.0	29.4
30	7.5	10.0	33.3

Table 2c: Soil Moisture Levels with and without Windbreaks in Mandera

Depth(cm)	Without windbreak%	With windbreak%	Increase%
10	10.5	13.0	23.8
20	9.5	12.0	26.4
30	8.5	11.0	29.4

Turbulent Forced Convection Analysis

The forced convection modeling highlighted the benefits of turbulence in enhancing heat transfer and cooling efficiency.

Temperature Distribution

The turbulent forced convection model showed a more uniform temperature distribution within the greenhouse, with temperature gradients significantly reduced compared to natural ventilation.

Mathematical Analysis

Using the Nusselt number Nu for convective heat transfer, the effectiveness of forced convection can be quantified:

$Nu=hL/k$

where:

h is the convective heat transfer coefficient,

L is the characteristic length,

k is the thermal conductivity of the fluid.

For forced convection, the Nusselt number was be related to the Reynolds number Re and the Prandtl number Pr:

$Nu=C \cdot Re^{m} \cdot Pr^{n}$

By comparing the Nusselt numbers under different scenarios, the enhancement in heat transfers due to forced convection were evaluated. The results showed a significant increase in the Nusselt number for forced convection scenarios, indicating improved cooling performance.

Conclusions

- Managing velocity and pressure profiles through optimized natural ventilation and forced convection can significantly enhance climate resilience in Kenya's dryland agriculture.
- The use of windbreaks and well-designed greenhouse structures not only mitigates temperature extremes but also improves soil moisture retention and reduces heat stress on crops.
- These findings provide valuable insights for developing adaptive strategies to sustain agricultural productivity in the face of climate variability.
- The integration of airflow management practices into agricultural policies and extension services can help build more resilient farming systems in Kenya's ASALs.
- Training programs and subsidies for implementing windbreaks and advanced greenhouse technologies should be prioritized to support smallholder farmers in these regions.

Recommendations

1. Based on these results this study therefore recommends further research on long-term impacts of airflow management on crop yields and quality, as well as the economic viability of different convection systems.
2. The effects of integrating renewable energy sources to power forced convection systems warrant investigation to promote sustainable and cost-effective solutions.

PRESENTATIONS

TOPIC	Enhancing Soil Structure and Moisture Retention in Drylands through Soil Amendments using Biochar, Compost and Mulch.
PRESENTER	Jael Cheptoo Birgen
ORGANISATION	

INTRODUCTION

Agricultural practices are vital for food production and improved livelihoods. Practicing Agriculture in dry areas is affected by soil health. Challenges include soil erosion, poor soil structure, and limited water holding capacity (Lal, 2015), and high evaporation rates.

The Study focused on Makueni County which is among the dryland regions in Kenya. Enhancing the quality of soil in this area is crucial for maintaining sustainable farming methods and ensuring a steady food supply.

Drylands cover approximately 46% of the Earth's surface (Chambers & Wisdom, 2009). Drylands are home to half of the world's agricultural systems (Maestre et al., 2021).

The Challenges

- Soil Degradation- Has changed the chemistry of soil affecting plant growth
- Costly fertilizers - High cost of mineral fertilizers for small-scale farmers.
- Access to enough food -challenge for arid and semi -arid regions.
- Limited studies on combined effects of biochar, compost, and mulch in drylands agriculture.

General Objective

To evaluate the effectiveness of biochar, compost, and mulch as soil amendments.

Specific Objectives:

1. To assess the impact on soil structure.
2. To evaluate the effectiveness of these soil amendments in soil moisture retention.
3. To analyze the influence on crop productivity.
4. To develop practical recommendations for dryland agriculture

Literature Review

- Soil well-being in dryland regions is essential for maintaining agricultural sustainability.
- Soil amendments are materials added to the soil to improve its physical properties, nutrient content, and biological activity (Glaser et al., 2002).

Biochar in Soil

For sustainable agricultural system, restoration and preservation of organic carbon is key and it is attributed to biomass carbon(Glaser et al., 2001). Biochar, a form of charcoal produced from biomass, can enhance soil structure, increase nutrient retention, and improve water holding capacity

Compost

Rich in organic matter, provides essential nutrients and enhances microbial activity, contributing to better soil health.

Mulch

Reduces evaporation, moderates soil temperature, and prevents erosion.

Impact on Dryland Agriculture

- Promotes sustainable farming practices.
- Increases agricultural productivity and resilience.

Despite the known benefits of these amendments, their combined effectiveness in dryland conditions remains underexplored.

METHODOLOGY

Study Area

The study will be conducted in a dryland agricultural region with typical soil and climatic conditions representative of arid and semi-arid areas-Makueni County, Kenya.

Experimental Design

A randomized complete block design (RCBD) will be used with four treatments: control (no amendment), biochar, compost, and mulch. Each treatment will be replicated three times.

Soil Analysis

Soil samples will be collected before and after the application of amendments and analyzed for

- Soil texture
- Bulk density
- Porosity
- Water-holding capacity
- Organic matter content

Crop Performance Evaluation

Crops -maize, cowpeas and kale will be grown in the experimental plots. Crop growth parameters, yield, and water use efficiency will be measured.

Data Analysis

Statistical analysis will be conducted using ANOVA to determine the significance of differences between treatments. Post-hoc (Multiple comparison) tests will be used to compare means.

Expected Outcomes

- Improved soil structure and moisture retention in amended plots.
- Enhanced crop growth and productivity in plots treated with biochar, compost, and mulch.
- Practical recommendations for the use of soil amendments in dryland agriculture.

PRESENTATIONS

TOPIC	Digital Twins for Sustainable Agriculture
PRESENTER	Lukenya University, Innovation Kenya and Czech Technical
ORGANISATION	University Consortium

Who We Are and What We Do?

A consortium of organizations and scientists who develop and implement sustainable solutions that mitigate climate change, adapt to climate change, protect and enrich the bio diversity of a location and create positive social impact by utilizing the latest and optimal technology available.

Members of the consortium

Lukenya University, Innovation Kenya, and IBM Research - Nairobi, a team of computational mathematicians and engineers in the European Union

Problem We are Solving Using Digital Twins

Traditionally, in the Physical world we had to prioritize and compromise on one or two principles (Quality, Cost or Time). In the Virtual World we can attempt to optimize for all three components while researching and before implementing a project using Digital Twins The Digital Twin virtually captures, tests and refines specimens we are researching

Digital twin assist in developing contingencies and optimization for different environmental conditions

Digital Twins for Sustainable Agriculture
- "Digital Twin" idea came from medicine:
- Make an exact copy of a person in as much detail as possible in simulation
- Experiment, operate, feed medicines, to the twin, to learn without risk

Digital Twins
Trees
- Make a twin of a tree that is of interest (e.g. a medicinal Acacia)
- Can perform "kinematic reconstruction" – the geometry of its growth
- Can study primary and secondary metabolism, and predict weather/ soil content/etc affects on health and compound production

Digital Twins for Sustainable Agriculture
- Agroforestry Plot
- Can model crops, trees, as well as geographic formations
- Full contour of a plot and region
- Use it to predict how different rotations, placements and combinations work

Digital Twins for Sustainable Water Management
River and River Network
- Model the flow of the river network as due to precipitation
- Can forecast risks of floods
- Can forecast quantity of groundwater remaining in dryseason, as based on the water flow otherwise

How to Make a Digital Twin
Grey-Box Models
- Use as much first principles scientific knowledge as possible
- Any gaps in the knowledge and uncertainty in parameters, use statistical models
- Acquire as much data as possible that is easy and cheap
- Target choice of most relevant data, using information theory, when data is scarce and expensive

What you can do with Digital Twin
- Probabilistic Forecasting – to assist economic investment and risk mitigation
- Exploratory hypotheses and conjectures profiling – can test, in simulation, bold but risky innovations

What you can do with a Digital Twin
- The Grand Vision: "Real time Control" – schemes to optimize the complex process using data in real time. For example:
- The tree is growing in a slanted way, towards an unfortunate direction, let's modify the shade to correct it
- It is expected to be unseasonably warm this year, the agroforestry plot should include more flora that preserve soil moisture
- A dam broke and there is extra flooding in a region, we can place a cheap barrier to disperse the water flow adequately until repairs

PRESENTATIONS

TOPIC	Enhancing Dryland Agriculture Education: A Comparative Analysis of Graduate Exit
PRESENTER	Mr. Protus Kyalo, Mr. David Otieno and Ms. Iris Kwamboka
ORGANISATION	

• Dryland agriculture faces unique challenges - we need a skilled workforce to ensure food security
• Universities play a crucial role in preparing these professionals, but how effective are our programs?
• Our study analyzes exit surveys from agricultural graduates over two years to find out
• We aim to provide insights that will enhance agricultural education and better prepare students for careers in dryland agriculture

Literature Review

• As stated by Usman (2010) the infrastructure facilities are becoming important, because these facilities satisfy student's perception, esteem and develop them with all the essentials and capabilities to be an efficacious learner
• Mukhtar et. al. (2015) defined Higher education as education received at a college or university level and is regarded as one of the most essential instruments for a nation's individual, social and economic development
• Weerasinghe et. al. (2017) traces the history of several models for student satisfaction derived from the business and higher education arena.
• Fatima Baptista et al (2021)Traditional face-to-face training methods are the most adequate in a MSc programme in sustainable agriculture.
• Anita and Meghana Sanjeeva (2022) Devised an innovative, generic, flexible and easy to adopt method to obtain feedback of students. The questions can be changed and altered based on the requirements of the institution. Various interpretations can be obtained using this technique.

Statement of the Problem

• Agricultural education programs often struggle to keep pace with rapidly evolving industry needs
• Limited understanding of how well current curricula prepare students for dryland agriculture challenges
• Need to assess the effectiveness of practical training and support services in agricultural programs
• Lack of comprehensive, comparative data on students' perceptions of their educational experiences and career readiness

Objectives

General Objective:

To assess and improve the effectiveness of agricultural education programs in preparing students for dryland agriculture challenges

Specific Objectives:

1. To evaluate students' perceptions of their educational experiences
2. To assess perceived career readiness for dryland agriculture
3. To compare survey results from two consecutive academic years
4. To provide recommendations for program enhancement

Methodology

• **Study Design:** Comparative analysis of graduate exit surveys
• **Data Collection:** Standardized

questionnaire, 5-point Likert scale, Two consecutive academic years

- **Key Areas Assessed:** Curriculum content, Teaching quality, Facilities and resources, Mentoring and support services, Co-curricular activities
- **Data Analysis:** Quantitative: Paired t-tests and ANOVA; Qualitative: Thematic analysis of open-ended responses

Sample

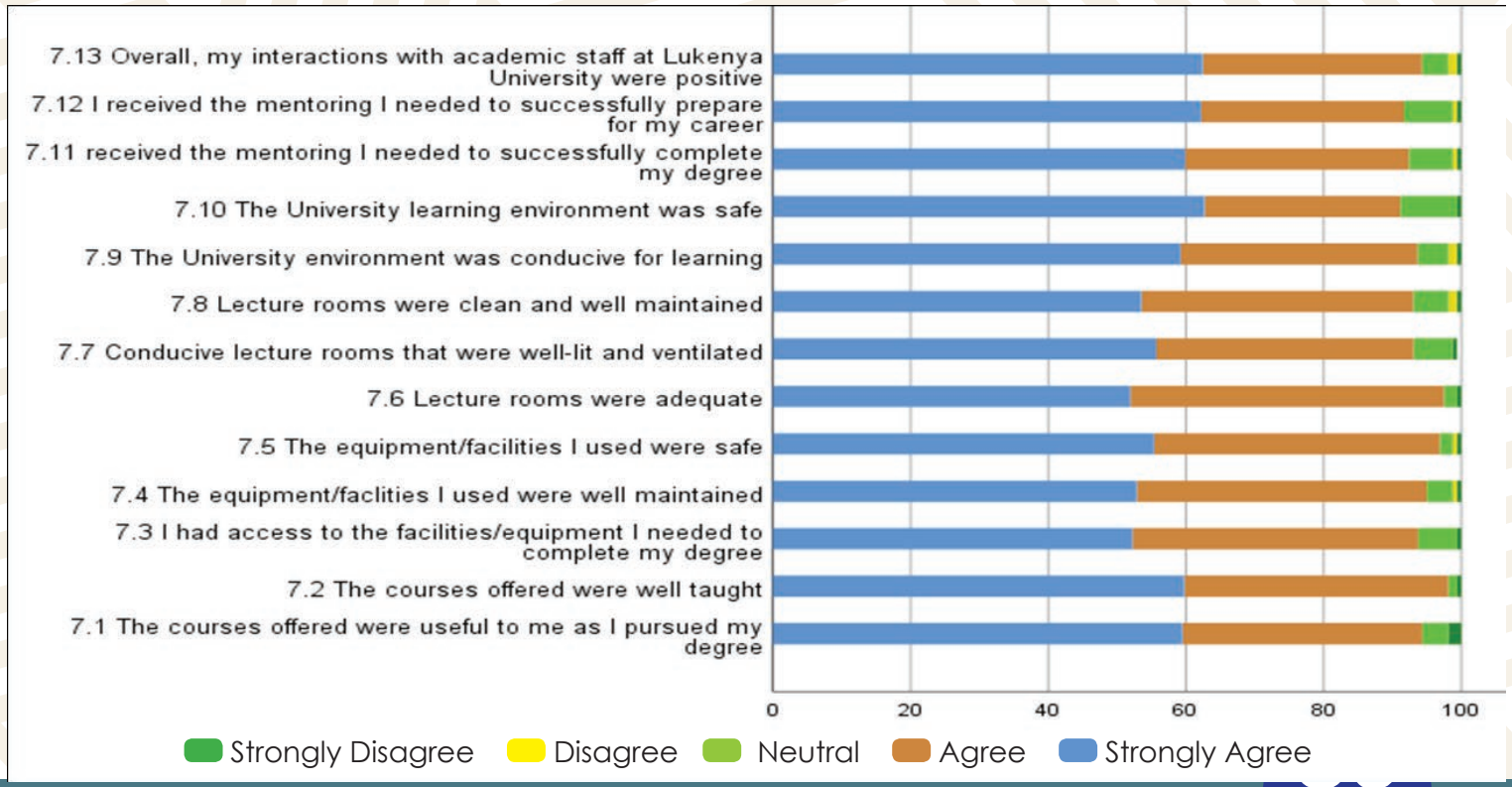
• 42 questions were framed for students to give responses on the 5 point scale
• Quality of education, library facilities, ICT infrastructure, support services and the overall student experience in the University were the five key topics that were considered.
• The sample size should be large enough to get the true picture of satisfaction level as highlighted by Solinas et. al. (2012) and Silva and Fernandes (2012).
• (Kyalo and Muiruri 2023) Out of 361 graduands, 294 participated in the survey (Sept 2022).
• Out of 379 graduands, 310 participated in the survey (Agricultural Students were 46) (Sept 2023)

Data Analysis and Findings

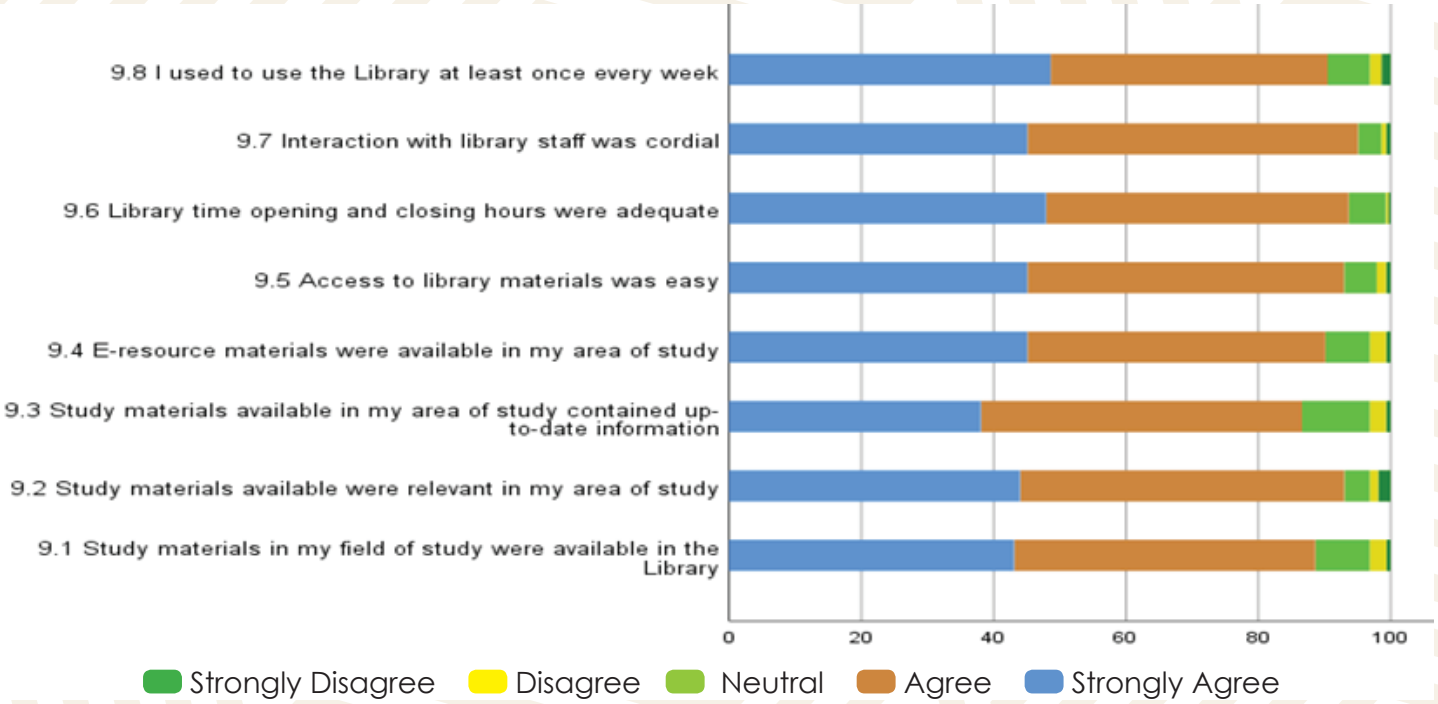
• Quantitative Analysis:
• Paired t-tests: Significant improvement in practical training satisfaction ($p < 0.05$)
• ANOVA: Variations in satisfaction across program areas ($F = 3.42$, $p < 0.01$)
• Qualitative Themes:
• Appreciation for academic rigor
• Need for enhanced practical experiences
• Desire for updated resources
• Key Findings:
• Increased satisfaction with community engagement activities
• Strong correlation between overall experience and perceived career readiness
• Identified gaps in support services

Impressions of the Quality of Education

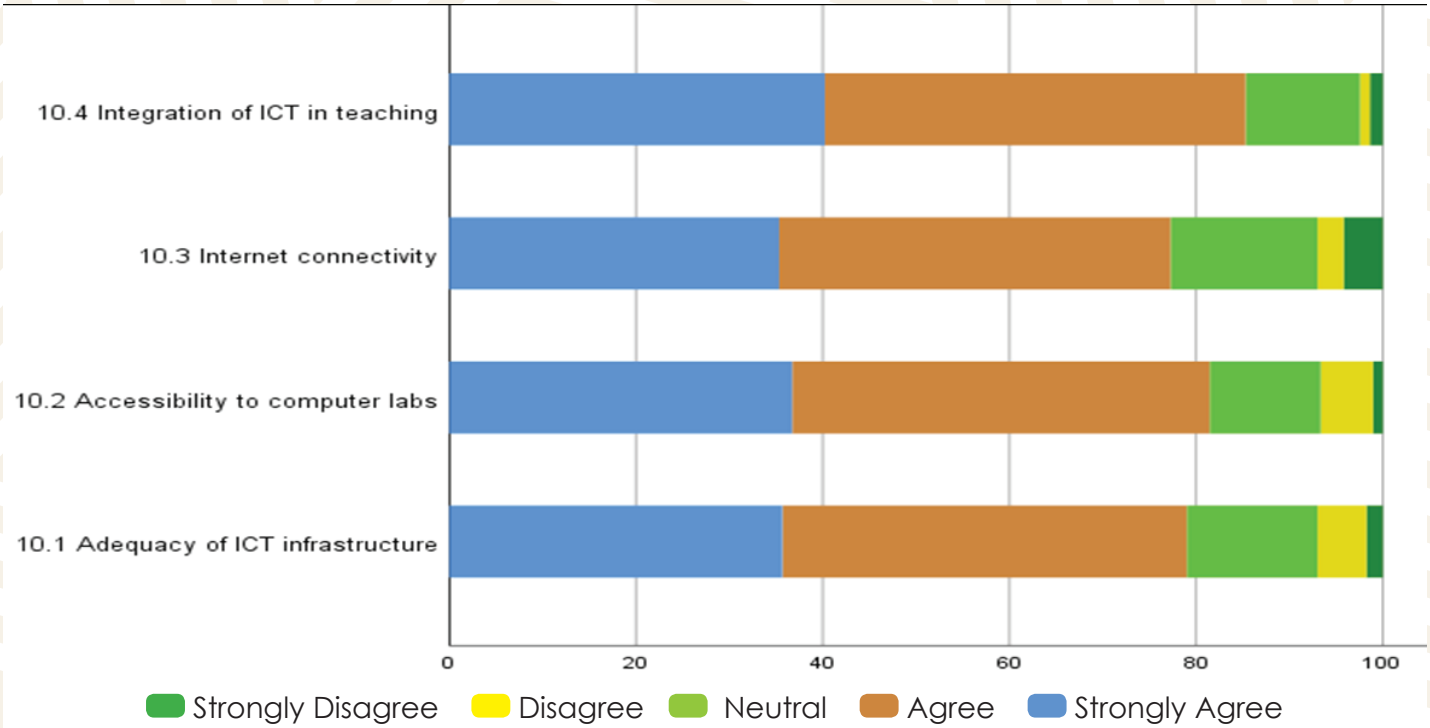
Table 1



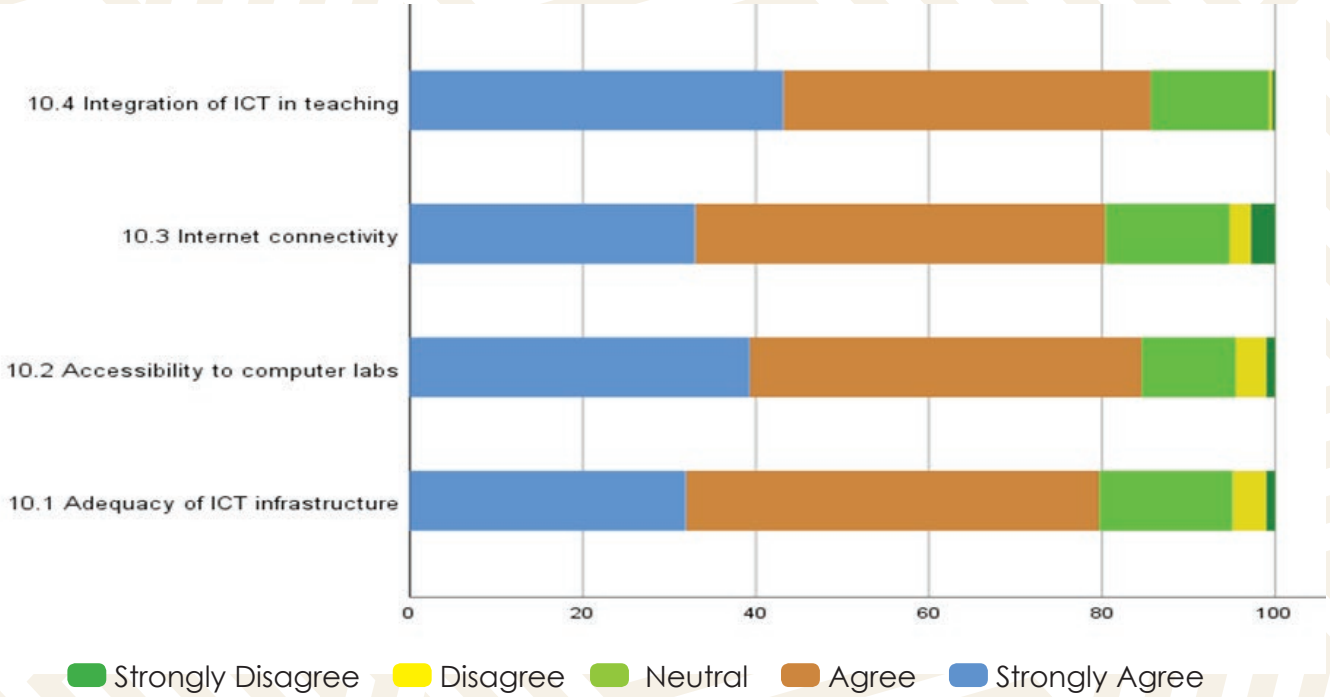
Satisfaction Level with the Library Facilities
Table 2



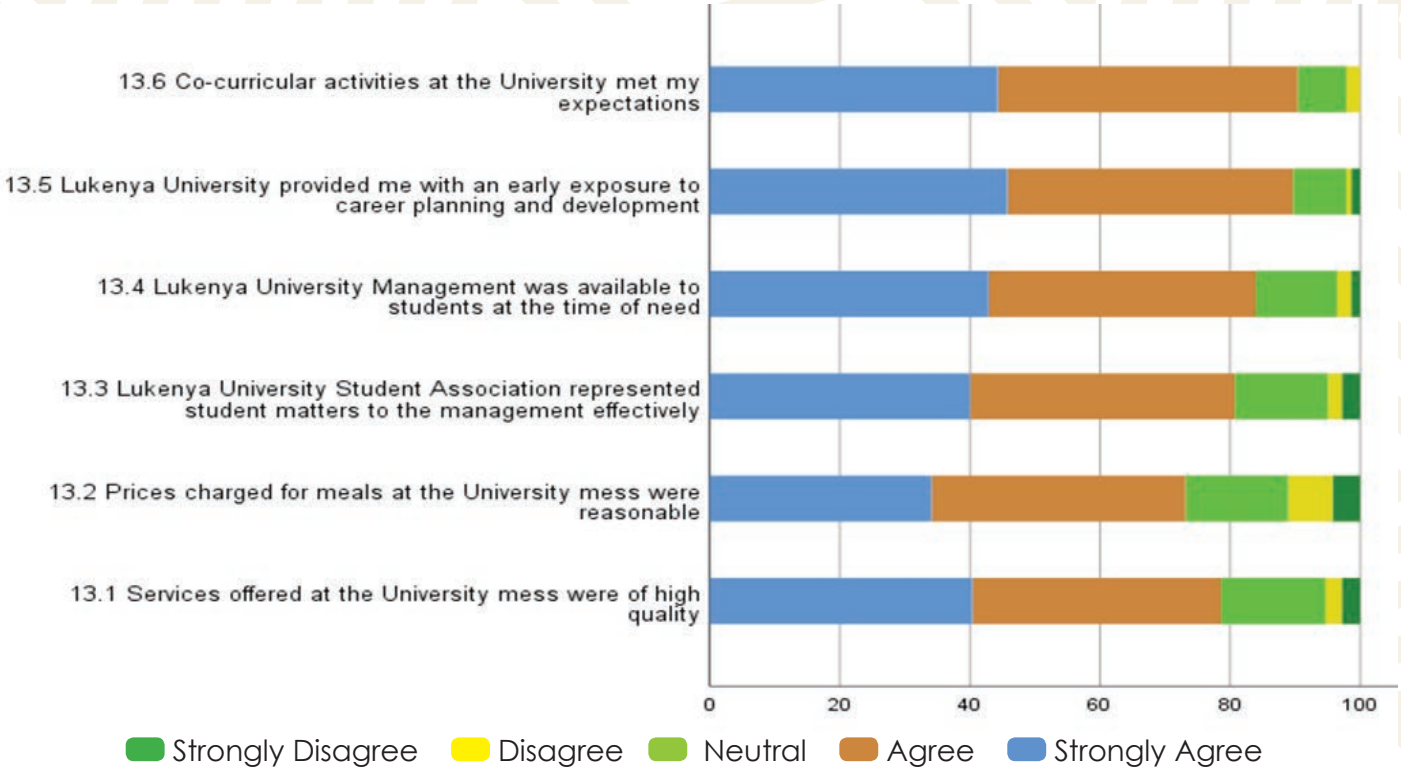
Satisfaction Level with the ICT Infrastructure
Table 3



Satisfaction Level with the Support Services
Table 4



Student Experience
Table 5



Results and Observations

Quantitative Analysis:
• Significant improvement in practical training satisfaction ($p < 0.05$)
• Variations in satisfaction across program areas ($F = 3.42$, $p < 0.01$)

Qualitative Themes:
• Strong academic foundation
• Need for more hands-on experiences
• Desire for updated resources

Key Observations:
• Increased satisfaction with community engagement (15% increase)
• Strong correlation between overall experience and career readiness ($r = 0.78$)
• Support services gaps identified in career counseling and internship placement

The odd Likert scale has a tendency to give a result in the center scale. Table 6 below shows a low standard deviation means that most of the numbers are close to the average. Coefficient of variation tells us about the variability of data. The lower the value of the coefficient of variation, the more precise is the estimate. Although here in all the cases results are pretty good and precise

Table no.	Mean	Standard deviation	Coefficient of Variation
Table 1	4.333	0.811	18.71%
Table 2	4.281	0.792	18.50%
Table 3	4.098	0.907	22.13%
Table 4	4.177	0.877	20.99%
Table 5	4.078	0.966	23.69%

Discussion

Curriculum Relevance:
• Strong academic foundation, but need for more practical applications
• Opportunity to integrate emerging technologies in dryland agriculture

Student Experience:
• Positive impact of community engagement on perceived career readiness
• Importance of mentoring and career guidance

Resource Allocation:
• Need for updated facilities and equipment
• Potential for industry partnerships to enhance resources

Program Improvements:
• Balancing theoretical knowledge with hands-on experience
• Tailoring support services to agricultural students' needs

Implications to Sustainable Agriculture

Workforce Development:
- Graduates better equipped to address dryland agriculture challenges
- Enhanced skills in sustainable farming practices

Innovation and Adaptation:
- Improved capacity for developing region-specific solutions
- Increased readiness to adopt and implement new technologies

Community Impact:
- Stronger connections between academia and local agricultural communities
- Potential for knowledge transfer and sustainable practices adoption

Food Security:
- Contribution to resilient food systems in arid regions
- Long-term impact on sustainable food production

Recommendations

Curriculum Enhancement:
- Integrate more hands-on, practical experiences
- Incorporate emerging technologies in dryland agriculture

Resource Optimization:
- Update facilities and equipment
- Leverage industry partnerships for resources and expertise

Experiential Learning:
- Expand community engagement and field study opportunities
- Implement problem-based learning focused on real-world challenges

Student Support:
- Strengthen career guidance and mentoring programs
- Develop tailored support services for agricultural students

Conclusion

Exit surveys: Valuable tool for assessing and improving agricultural education

Key insights:
- Students value academic rigor but desire more practical experiences
- Enhanced practical training and community engagement improve satisfaction
- Career readiness closely linked to overall educational experience
- Importance of continuous program evaluation and adaptation
- Potential impact: Better prepared workforce for sustainable dryland agriculture

PRESENTATIONS

TOPIC	Unraveling Key-Adaptive and Stress-Responsive Proteins to Climate Variability in Cassava Varieties for Climate-Resilient Cultivation Strategies
PRESENTER	Victor Masai1, Purity Mutheu2 & Paul Mwania3
ORGANISATION	Lukenya University

Recent climate adaptation do not only involve drought resistivity but also floods adaptation (known as extreme water logging)

Cassava's have a great importance in this research as;

1. Major staple crop in tropical and subtropical regions.
2. Has < 3g proteins hence provides calories and carbohydrates to consumers. Implying cassavas cant provide the proteins needed daily muscle growth i.e., 81-136g per day per every kg of human body. ***Note: What is the need of the proteins present in cassava apart from structural formation & disease resistance?***
3. Cassava is a drought resistant tuber crop.

Challenges Due to Climate Change involve increasing frequency of extreme weather events i.e., stressors such as drought, salinity, extreme heat, and waterlogging.

Research Objective(s)

Main Objective

To unravel the Key-Adaptive and Stress-Responsive Proteins to Climate Variability in Cassava varieties at different growth stages.

Specific Goals

i. To identify stress-responsive proteins.
ii. To elucidate the roles of these proteins in enhancing stress tolerance.

Methodology

- Proteomics Approach (Total proteins)
  Comprehensive analysis of protein changes.
- Techniques to be used are;

1) 2D Gel Electrophoresis → Separation of proteins based on isoelectric point and molecular weight.
2) Mass Spectrometry (MS)
   → MALDI-TOF: Identification of proteins.
   → LC-MS/MS: Detailed analysis of protein mixtures.

Quantification Method to be involved is;

Label-Free Quantification → Method in MS aiming to determine the relative amounts of proteins in the cassava varieties (> two sample varieties). Independent spectral information from LC-MS/MS acquisitions.

Experimental Design

- **Stress Conditions Applied**

Drought → Normal semi-arid condition in the University
Salinity → To be induced (Clay/alluvial soil)
Extreme Heat → To be induced
Waterlogging → To be induced (Clay/alluvial soil)
Control Conditions → To be structured to cater normality of crop growth plus comparisons.

- **Sample Collection**

Cassava tissues (leaves, roots(tuber), stem) subjected to different stresses.

- **Protein Extraction and Analysis**

Molecular protocols for obtaining and preparing samples for protein analysis.

Extraction (molecular techniques) à Protein purification(analytical techniques i.e.,

chromatographic analysis) à Protein confirmation test(UV Vis 260/280nm abs at < 0.6 ratio abs) [It's fast to do]à Quantitative analysis(MS techniques) à Statistical analysis (Involves bioinformatic script code for analysis(Linux)

Key Proteins of Interest

● Heat Shock Proteins (HSPs)
Role → Protect cells from heat-induced damage. They include HSP70, HSP90.
● Antioxidant Enzymes
Role → Neutralize oxidative stress. They include Superoxide Dismutase (SOD), Catalase.
● Osmoprotectant-Related Proteins
Role → Protect cells from osmotic stress. They include Proline synthesis enzymes.
● Ion Transporters
Role → Maintain ion homeostasis under stress. They include High-Affinity K+ Transporter (HKT), Na+/H+ Exchanger (NHX).
● Pathogenesis-Related (PR) Proteins
Role → Enhance disease resistance. They include PR1, PR5.

Functional Studies

The written code is expected to do virtual replication of the below techniques. It's a trial to create virtual with > 95.0% accuracy and prediction as the in-vitro expectations. This will help counter expenses and unpredictable/ unexpected errors.

● Gene Knockout
Technique → CRISPR/Cas9 to knock out target genes.
Expected Outcomes à To determine the role of specific proteins in stress tolerance.
● Over-Expression Studies
Technique → Agrobacterium-mediated transformation.
Expected Outcomes à To assess the impact of increased protein levels on stress tolerance.
● Protein-Protein Interaction Assays
Techniques → Yeast two-hybrid, Co-immunoprecipitation.
Significance: Understand interactions that are crucial for stress adaptation.
Post-translational Modifications (PTMs)
● Analysis Techniques
Mass spectrometry-based methods to identify PTMs such as phosphorylation, glycosylation.
● Regulatory Mechanisms
How PTMs modulate protein activity and function under stress.
● Impact on Stress Response
Role of PTMs in enhancing protein stability and function during stress.

Conclusion

● **Summary**
Key findings on stress-responsive proteins in cassava will validate the significance of these proteins in enhancing stress tolerance.
● Future Research
1. Further exploration of unidentified proteins and their roles. In-Vitro PPI recommended
2. Integration with other omics technologies (transcriptomics, metabolomics).
3. Long-term field studies to assess the practical implications of findings.

PRESENTATIONS

TOPIC	Food Sovereignty in Postcolonial Literature: Building Resilient Communities in Chinua Achebe's Things Fall Apart
PRESENTER	Allan Kodundo
ORGANISATION	

The Relationship Between Literature and Agriculture

Literature and agriculture, though seemingly disparate fields, share a deep connectivity that offers valuable insights into human society and cultural evolution. Literature serves as a reflective medium, capturing and preserving the intricacies of agricultural practices and the socio-economic contexts in which they occur. Through storytelling, poetry, and various forms of written expression, literature documents the human experience with the land, offering a rich blend of knowledge that extends beyond mere cultivation to encompass cultural, social, and ethical dimensions

Literature Has the Ability:

- To contextualize agricultural practices within the broader scope of human life and societal change. For instance, Wendell Berry, a renowned scholar and farmer, argues that literature helps to illuminate the deep connections between people and the land they cultivate. Berry (2000) emphasizes that literary works not only document agricultural techniques but also explore the ethical and philosophical implications of farming, thereby fostering a deeper appreciation for sustainable practices and the stewardship of the environment.

- To highlight the impacts of agricultural policies and practices on communities. As Chinua Achebe's Things Fall Apart illustrates, colonial agricultural interventions can profoundly disrupt traditional societies. Achebe (1958) portrays the introduction of cash crops in Nigeria and its detrimental effects on local food systems and cultural practices. This literary account provides a compelling narrative that complements historical and anthropological studies, offering a delicate understanding of the socio-economic transformations introduced by colonialism.

- To advocate for social change and raising awareness about agricultural issues. Rachel Carson's novel, Silent Spring (1962), for example, is a seminal work that exposed the environmental and health dangers of pesticides, sparking the modern environmental movement. Carson's literary prowess combined scientific research with evocative prose to mobilize public opinion and influence policy, demonstrating the power of literature to effect real-world change in agricultural practices.

- Literature offers a means to explore the human dimension of agricultural labor, giving voice to the often marginalized experiences of farmers and rural communities. John Steinbeck's The Grapes of Wrath (1939) provides a poignant depiction of the struggles faced by American farmers during the Dust Bowl and the Great Depression. Steinbeck's narrative sheds light on the economic hardships, social injustices, and resilience of agricultural workers, contributing to a broader understanding of the human costs associated with agricultural crises and the importance of equitable and just agricultural policies.

Area of Concern

This paper explores the theme of food sovereignty in postcolonial literature, with a focus on Chinua Achebe's Things Fall Apart. The study has two primary objectives: to analyze Achebe's portrayal of pre-colonial Igbo society's traditional agricultural practices and community resilience, and to examine the impact of colonial disruption on these practices and the subsequent struggle for food sovereignty.

Why The Two Objectives?

First, it explores how traditional agriculture underpinned Igbo society's economy, social structures, and cultural practices, contributing to their resilience and self-sufficiency. Second, it investigates the effects of colonialism on these agricultural practices, focusing on how the Igbo adapted to disruptions and fought to reclaim their food sovereignty. This dual focus enriches the understanding of Achebe's work and highlights the broader themes of resilience and adaptation in post-colonial contexts.

Introduction

In the field of postcolonial literature, food sovereignty emerges as a crucial theme, reflecting the struggles and resilience of communities in the face of colonial exploitation and cultural upheaval. Chinua Achebe's seminal novel, Things Fall Apart, offers a profound exploration of this theme through its depiction of the Igbo society's intricate relationship with land, agriculture, and sustenance. Achebe's narrative not only chronicles the impact of colonial intrusion on traditional agricultural practices but also highlights the community's efforts to maintain their food sovereignty amidst changing socio-political dynamics.

Food sovereignty, defined as the right of people to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, has become a significant topic in postcolonial literature.

In Things Fall Apart, Achebe presents a vivid portrayal of a pre-colonial Igbo society that thrives on a sustainable and self-sufficient agricultural system. The yam, a staple crop, symbolizes wealth, status, and cultural identity, underscoring the community's deep connection to the land. However, the arrival of European colonizers disrupts these traditional practices, leading to a gradual erosion of the Igbo people's control over their food production and consumption.

Achebe's novel serves as a poignant interpretation on the broader implications of colonialism on indigenous food systems and the ensuing loss of autonomy. The imposition of new agricultural practices, coupled with the introduction of foreign crops, not only undermines the traditional economy but also threatens the cultural fabric of the society. Through the experiences of characters like Okonkwo, Achebe illustrates the existential struggle to preserve food sovereignty and, by extension, the community's identity and resilience

This paper therefore looks into the various ways in which Things Fall Apart addresses the theme of food sovereignty, examining the interplay between land, culture, and colonial power. By analyzing the novel through the lens of food sovereignty, we can uncover the strategies employed by the Igbo community to resist colonial domination and build resilient food systems. Furthermore, this exploration sheds light on the broader discourse of postcolonial resistance and the enduring quest for autonomy and self-determination in the face of external pressures.

In examining Things Fall Apart, this paper aims to contribute to the understanding of food sovereignty within postcolonial literature, highlighting its significance in the fight for cultural preservation and community

resilience. Achebe's narrative not only provides a historical account of colonial impact but also offers valuable insights into contemporary discussions on sustainable agriculture and indigenous rights. Through a close reading of the text, we can appreciate the enduring relevance of food sovereignty as a cornerstone of postcolonial identity and resistance.

Discussion

Food Sovereignty: A Postcolonial Perspective

- Defined by La Via Campesina, a global movement advocating for the rights of small farmers, food sovereignty emphasizes the right of people to healthy and culturally appropriate food produced through ecologically sound and sustainable methods (Patel, 2009).

- This concept extends beyond food security, which focuses primarily on the availability of food, by addressing the power dynamics and control over food systems. It calls for a holistic approach that includes political, economic, and cultural dimensions (Wittman, 2011).

- The political aspect of food sovereignty involves advocating for policies that empower local communities and small farmers rather than multinational corporations and large agribusinesses. This entails supporting land reform, ensuring fair trade practices, and promoting democratic decision-making processes in the management of food resources. Politically, food sovereignty challenges neoliberal economic policies that prioritize profit over people, aiming to create a more equitable distribution of resources and power within the food system (Patel, 2009).

- Economically, food sovereignty emphasizes the importance of local food economies. It supports local markets and short supply chains, which can enhance the economic resilience of communities. By prioritizing local production and consumption, food sovereignty helps to reduce dependency on global markets and the volatility associated with them. This economic approach also involves fair pricing for producers, ensuring that farmers receive a living wage for their labor and produce (Wittman, 2011).

- Culturally, food sovereignty acknowledges the significance of traditional agricultural practices and indigenous knowledge systems. It respects and revitalizes cultural heritage by promoting diverse farming practices that are adapted to local environments and communities. This cultural dimension underscores the importance of food as a cultural identity marker and a means of preserving heritage and traditions. The preservation of diverse crop varieties and traditional farming methods contributes to biodiversity and environmental sustainability, which are integral to food sovereignty (Wittman et al., 2017).

- In postcolonial contexts, the struggle for food sovereignty often intersects with broader movements for social justice and decolonization. Colonialism disrupted indigenous food systems by imposing monocultures, cash crops, and Western agricultural techniques that were often unsuitable for local conditions. The legacy of these disruptions continues to affect food security and sovereignty in many postcolonial nations, where communities are still grappling with issues of land dispossession, environmental degradation, and economic exploitation (Patel, 2009).

- By advocating for food sovereignty, postcolonial societies can work towards reclaiming control over their food systems. This involves not only resisting the imposition of external agricultural models but also revitalizing indigenous practices that have sustained communities for generations. Food

sovereignty thus becomes a form of resistance against ongoing neocolonial exploitation and a means of asserting autonomy and self-determination

• Chinua Achebe's Things Fall Apart stands as a seminal work that offers a profound exploration of the impact of colonialism on Igbo society. Achebe meticulously examines the complexities of pre-colonial life while vividly depicting the drastic changes precipitated by colonial intervention. Scholars have extensively scrutinized Achebe's portrayal of cultural disintegration and the struggle for identity under colonial pressures (Irele, 2009; Gikandi, 2003). Despite this scholarly attention, the specific aspect of food sovereignty within the novel has been relatively understudied, despite its pivotal role in themes of resilience and cultural preservation.

• Achebe's narrative meticulously portrays the traditional agricultural practices and food systems of the Igbo people, emphasizing the cultural significance of staples like yams. The cultivation of yams is not merely an economic endeavor but a cultural practice deeply embedded in social structures and communal identity. However, the imposition of colonial policies disrupts these indigenous food systems, introducing cash crops and altering agricultural practices to serve colonial economic interests. This disruption not only undermines the community's food sovereignty but also erodes cultural autonomy and resilience.

Colonial Disruption and Its Impact

The onset of colonial rule in Nigeria touted profound transformations in agricultural practices and food systems. Colonial authorities, as noted by Ake (2001), imposed new crops and farming techniques without regard for the indigenous ecological and cultural knowledge that had sustained local communities for generations. This imposition not only disrupted traditional agricultural practices but also precipitated a loss of biodiversity and contributed to the degradation of the region's ecological balance

Their presence symbolizes a shift away from the Igbo people's traditional social and economic foundations. As missionaries and traders introduce cash crops like palm oil and cocoa, they encourage Igbo farmers to prioritize these commodities over staple food crops such as yams, which are central to local subsistence and cultural identity. The colonial administration's emphasis on cash crops for export purposes further destabilized local food security by diverting resources away from traditional food production. This shift not only undermined the Igbo community's ability to sustain themselves but also eroded their cultural practices tied to food sovereignty—their authority to govern and manage their own agricultural systems

Resilience in Food Systems

Resilience in food systems refers to the capacity to absorb shocks, adapt to change, and maintain functionality in the face of various stressors. In the context of Things Fall Apart, resilience is demonstrated through several key elements: crop diversification, communal labor, and cultural rituals. These practices not only ensure food security but also strengthen social cohesion and cultural identity.

Crop Diversification

Crop diversification is a vital strategy for enhancing resilience in food systems. In Things Fall Apart, the Igbo community practices diversified farming to mitigate the risks associated with crop failure. Okonkwo, the protagonist, grows yams, which are the staple crop and a symbol of wealth and masculinity. However, he also cultivates other crops such as maize, cassava, and beans.

This diversification reduces dependency on a single crop and ensures that even if one crop fails, others might still thrive, providing food security for the community.

Achebe illustrates the importance of yams in the Igbo society when he writes, "Yam, the king of crops, was a man's crop" (Achebe, 1958, p. 23). The significance of yams goes beyond nutrition; it is intertwined with social status and identity. Yams are not only a primary source of sustenance but also play a crucial role in social and economic exchanges. The successful cultivation of yams is a marker of a man's hard work, perseverance, and success, as evidenced by Okonkwo's relentless efforts to produce abundant yam harvests.

However, the cultivation of additional crops highlights the community's adaptive strategies to ensure resilience. For instance, maize, which has a shorter growing season compared to yams, provides an early harvest, reducing the period of food scarcity before the main yam harvest. Cassava, known for its drought-resistant properties, acts as a reliable food source during periods of low rainfall. Beans, on the other hand, enrich the soil with nitrogen, contributing to soil fertility and enhancing the overall productivity of the farmland.

In a particular instance, Achebe describes how Okonkwo and his family plant their crops: "The planting season was the busiest time of the year for Okonkwo. He worked daily on his farms from cock-crow until the chickens went to roost" (Achebe, 1958, p. 21). This passage underscores the labor-intensive nature of farming and the importance of crop diversification in ensuring that every member of the family contributes to agricultural productivity.

The resilience achieved through crop diversification is also evident during periods of environmental stress. For example, during a particularly harsh drought described in the novel, the diverse crops ensure that not all food sources are depleted. "The drought continued for eight market weeks and the yams were killed in their beds" (Achebe, 1958, p. 24). Despite the devastation of the yam crop, the presence of other crops like cassava and maize provides a buffer against total food scarcity, showcasing the community's ability to withstand environmental shocks.

Communal Labor

Communal labor, or cooperative farming, is another critical aspect of resilience depicted in Things Fall Apart. The Igbo people often come together to work on each other's farms, especially during the planting and harvesting seasons. This system, known as "group work" or "work parties," helps distribute labor more efficiently and ensures that all community members can cultivate their lands adequately. This collective approach not only enhances agricultural productivity but also reinforces social bonds and mutual support within the community.

Achebe provides a vivid example of this practice through the character of Okonkwo, who organizes a work party to clear his fields. This communal effort involves friends, family members, and neighbors coming together to assist Okonkwo in preparing his land for planting. The shared labor lightens the burden on individual farmers and ensures that even those with smaller families or fewer resources can keep up with the demands of farming.

Achebe writes, "Okonkwo's neighbors gathered at his farm for the work party. The men brought their machetes and hoes, and the women carried baskets and cooking pots" (Achebe, 1958, p. 40). This scene illustrates the collaborative spirit and community cohesion that underpin the Igbo approach to farming. The work party is not just a practical arrangement but also a social event, where people engage in conversation, share meals, and strengthen their communal ties.

The proverb, "If one finger brought oil it soiled the others," underscores the interconnectedness and mutual dependence within the community (Achebe, 1958, p. 125). This saying reflects the Igbo belief in collective responsibility and the idea that the actions of one individual can impact the entire community. By working together, the villagers ensure that everyone's fields are tended to and that no one is left behind, fostering a sense of unity and shared purpose.

Conclusion

By analyzing Things Fall Apart through the lens of resilience theory, this study underscores the crucial role of indigenous knowledge and practices in maintaining sustainable food systems. The depiction of Igbo food systems in Achebe's novel illustrates the community's resilience, offering valuable insights into how traditional societies can adapt to external pressures while preserving their cultural heritage. This research enriches the broader discourse on sustainable food systems by exploring the intricate interplay between culture, agriculture, and resilience within a historical context.

The findings highlight the ongoing relevance of Achebe's work in contemporary discussions on food security and sustainability, especially in the face of global environmental and socio-economic challenges. By examining the resilience inherent in traditional food systems, the study provides a nuanced understanding of their significance and potential contributions to future sustainability efforts. This exploration emphasizes the importance of integrating cultural heritage with modern agricultural practices to foster resilient and sustainable food systems for the future.

RECAP: DAY TWO
28TH JUNE 2024

With the support of prominent donors in the public primary schools, learners with SNE can sufficiently and effectively engage in Agricultural activities and tree growing to enhance Dryland Agriculture and food systems in the face of Climate Change as part of the CBE and Inclusion implementation in Mbooni East Sub-County, Kenya. This will enhance the programs of food security and climate change in the institutions. Therefore, the Head teacher is the key player in coordinating the donors to support CBE and Inclusion, financially and with material resources for effective implementation and sustainability of the programs in their institution.

04

ABSTRACTS

ABSTRACTS

TOPIC	Effect of Nitrogen fertilizer and topping height on tobacco crop growth and yield
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Tobacco growth and yield is largely regulated by crop genetics, environmental conditions, and agronomic practices. Among tobacco agronomic practices, crop nitrogen (N) nutrition and topping are crucial. While N metabolism drives crop growth and development, topping concentrates nutrients to increase leaf expansion and final yield. However, interactions between the rate of N supply and topping height on tobacco growth and leaf yield is to some extent not well understood. A study was conducted to determine the effect of different rates of N supply and plant topping height on growth and yield in two contrasting environments of Busia and Bungoma counties. The N rates were 0, 40, 80, 120 and 160 kg N/ha while crops were topped at the 14th, 18th and 22nd leaf, in addition to an untopped control. Results showed significant differences on plant height, crop growth rate, biomass, leaf area index, nitrogen levels and leaf yield. Crops topped at the 22nd leaf had the highest leaf yield of 2149 kg/ha while the control was lowest at no topping height at 1342kg/ha. Addition of 160 kg N/ha recorded the highest yield of 2295 kg/ha while unfertilized control produced 1281 kg/ha. Topping height only recorded a significant difference ($P<0.05$) on leaf area index on the first harvesting stage and final harvesting stage in the Bungoma site, but N rate had significant effects on leaf area index across all the stages in both sites. Nitrogen fertilizer rates effect on topping at 14 leaves had higher nitrogen levels on the leaf compared to leaf topped at 22. Therefore, Topping height of 22 leaves is recommended for tobacco crops which could produce the highest leaf yield. Nitrogen rate at 160 & 120kg/ha recorded significantly higher performance in yield, crop growth rate, biomass & leaf area index hence making nitrogen rate a key factor.

Key words: leaves, Lateral growth, Nitrogen rate, suckers

TOPIC	Pastoralism and Acacia: The potential role of indigenous Acacia species in mitigating climate change and enhancing pastoralism in Eastern Africa's ASALs.
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ORGANISATION	Lukenya University. Corresponding author: jwafula@lukenyauniversity.ac.ke, https://orcid.org/0000-0001-5810-2171

This study investigates the potential role of indigenous Acacia species in mitigating climate change and enhancing pastoralism in Eastern Africa's arid and semi-arid lands (ASALs). The ASALs are home to pastoralist communities in Eastern Africa. Pastoralism in these regions faces significant challenges due to climate change, particularly through the devastating impact of droughts and extreme weather events on livestock. The resulting economic losses, often reaching billions of US dollars, highlight the urgency of developing resilient animal feed systems. Declining communal grazing lands, due to land subdivision and privatization, further exacerbate these challenges. The research draws on a survey of 26 young pastoralists from eight ethnic communities in Ethiopia, Kenya, and Tanzania, supplemented by panel discussions and literature reviews. During a three-day workshop, participants identified local Acacia species and shared their experiences. Two key findings emerged: first, the use of Acacia trees for fodder was widespread across the studied countries; second, three Acacia species—Acacia tortilis, Acacia nilotica, and Acacia senegal—were prevalent and well-adapted to these regions. Of these, Acacia tortilis was the most prominent. Given their resilience and minimal growth requirements, these Acacia species are recommended as fodder crops for ASAL in Eastern Africa. Specifically, the intentional propagation of Acacia tortilis, Acacia nilotica, and Acacia senegal is advised. Additionally, establishing climate-smart fodder forests using these species is crucial. The development of a dedicated center to promote climate-smart afforestation in Eastern Africa's arid and semi-arid regions is also recommended.

Key words: Acacia tortillis, Acacia nilotica, Acacia Senegal, pastoralism, ASAL, Indigenous species

ABSTRACTS

TOPIC	Feed resourcing innovations to build a resilient livestock system in drylands: lessons from a pilot project in Ethiopia
CONTRIBUTORS	Melkamu B Derseh
ORGANISATION	International Institute of Livestock Research

The livelihood of pastoral and agro-pastoral communities in sub-Saharan Africa mainly depends on livestock. However, livestock production in this region is heavily constrained by a shortage of quality feed, exacerbated by climate change, leading to recurrent livelihood losses during droughts. For generations, livestock fodder has primarily come from rainfed agriculture. However, fodder growing seasons have shortened and become unpredictable due to frequent extreme weather conditions in dryland areas. Consequently, it has become necessary to harness water resources for fodder production and build a resilient livestock system.

This paper describes a research project that tested and validated technological innovations for irrigated fodder development to improve feed availability and the livelihoods of smallholder livestock keepers in Ethiopia. The specific objectives were to: 1) pilot and validate the use of climate-smart forage genotypes and irrigation technologies for fodder production, 2) assess the productivity, economic, nutritional, and social gains from irrigated fodder interventions, and 3) develop suitability maps for expanding irrigated fodder nationwide.

The approach followed was research for development, piloting small-scale irrigation technologies for fodder development on farms with active farmer participation, and generating evidence on the productivity, economic, nutritional, and social impacts of the intervention. The research included controlled experiments to enhance water and nutrient use efficiency in fodder production by using suitable forage genotypes and irrigation practices.

Results indicated that using context-specific small-scale irrigation technologies to produce fodder during off-seasons is economically viable and supports a resilient livestock system by supplying much-needed green feed during critical shortages. After a few years of on-farm validation and demonstrations, farmer awareness and interest increased significantly, leading to more farmers adopting the intervention in the project sites. Livestock productivity gains of 50 to 70% were observed due to the inclusion of high-quality irrigated fodder in the diets of lactating animals, with even more attractive gains when fed to genetically enhanced animals. On-farm simulation models indicated significant nutritional gains, with increases in caloric, calcium, vitamin, and fat intakes in households. Moreover, on-farm cost-benefit analysis showed a potential income increase of about 67% for farmers integrating irrigated fodder into their practices.

Given that water is a scarce resource with competing uses, it is crucial to increase livestock water productivity by using drought-tolerant and water-efficient forage genotypes, livestock breeds, and irrigation practices. Research indicates considerable room for improvement, with the potential to more than double water productivity through improved forages and livestock breeds. Suitability maps showed that over 20% of Ethiopia's 1.1 million square kilometers are suitable for irrigated fodder production, suggesting the practice can be scaled to transform the feed resource base and livestock sector for greater resilience in the face of climate change. The evidence generated is likely applicable to other sub-Saharan countries due to similar climatic conditions and challenges faced by livestock farmers.

TOPIC	Enhancing Soil Structure and Moisture Retention in Drylands Through Soil Amendments Using Biochar, Compost, and Mulch.
CONTRIBUTORS	Birgen Jael*1 and Kivyatu Benard1, June 2024.
ORGANISATION	Lukenya University

Dryland agriculture encounters significant obstacles due to soil degradation, poor structure of soil, and inability to retain water. This needs implementation of more sustainable soil health and fertility preservation management practices. This study seeks to explore how the use of biochar, compost, and mulch can enhance the condition of the soil and its ability to hold moisture in drylands. Study on crop response to combination of compost, biochar and compost in drylands is limited. The pyrolysis of biomass residues from agricultural production yields biochar, a porous material rich in carbon that creates spaces within the soil matrix. The increased porosity enhances growth of roots and improve soil aeration as well as enhancing microbial activity. Organic mulching minimizes soil deterioration- soil cracking, enhances organic matter, and boosts the soil's water retention capacity and control soil erosion. Good composts improve soil fertility by enhancing soil structure and improve water retention. To achieve sustainable food and nutritional production, we may need to reduce the use of chemical fertilizers, enhance soil nutrient cycle and moisture retention to improve soil fertility. By conducting field experiments and laboratory analyses, the impact of these amendments on soil physical properties, water-holding capacity, and the yield of crops will be evaluated. Selected staple food crops in Makueni- Kenya will be used for the study. The results of this study will offer practical recommendations for sustainable soil management practices, contributing to increased agricultural productivity and resilience in dryland regions.

ABSTRACTS

TOPIC	Food Sovereignty in Postcolonial Literature: Building Resilient Communities in Chinua Achebe's Things Fall Apart.
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"Food sovereignty is an affirmation of who we are, and it's an affirmation of culture, of small-scale farmers being able to grow food in the same way that they have done for centuries." Raj Patel

This research paper explores the theme of food sovereignty in postcolonial literature, with a focus on Chinua Achebe's Things Fall Apart. The study has two primary objectives: to analyze Achebe's portrayal of pre-colonial Igbo society's traditional agricultural practices and community resilience, and to examine the impact of colonial disruption on these practices and the subsequent struggle for food sovereignty. By employing postcolonial theory and eco-criticism, this paper situates Achebe's narrative within the broader contexts of indigenous knowledge systems and sustainable agriculture.

Postcolonial theory provides a framework for understanding the socio-economic and cultural disruptions caused by colonialism, highlighting the loss of indigenous food practices and the imposition of foreign agricultural methods. Eco-criticism offers insights into the relationship between literature and the environment, emphasizing ecological balance and sustainability in pre-colonial societies. The methodology involves a close textual analysis of Things Fall Apart, supplemented by secondary sources discussing postcolonial impacts on indigenous agricultural systems. This analysis focuses on key scenes and characters that embody themes of resilience and adaptation. Interviews with scholars in postcolonial studies and agricultural history provide contemporary perspectives on Achebe's depiction of food sovereignty.

Findings suggest that Achebe's depiction of traditional Igbo agricultural practices illustrates a self-sufficient and resilient community that thrived on sustainable farming. The arrival of colonial powers disrupted these systems, leading to food insecurity and cultural identity loss. The novel critiques colonialism's detrimental effects on indigenous food systems and calls for reclaiming food sovereignty.

This paper contributes to postcolonial literature by emphasizing the importance of food sovereignty and sustainable agriculture in building resilient communities. It underscores the relevance of Achebe's work in contemporary discussions on food security and environmental sustainability.

Keywords: *food sovereignty, postcolonial literature, Chinua Achebe, Things Fall Apart, indigenous knowledge, sustainable agriculture, colonial disruption, community resilience*

TOPIC	Comparative Effects of Organic Manure and Inorganic Fertilizers on Growth and Yield of Sorghum (Sorghum bicolor L. Moench) in Kibwezi East, Makueni County, Kenya
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This study investigated the effects of organic manure, inorganic fertilizers, and their combination on the growth and yield of sorghum (Sorghum bicolor) in Makueni County, Eastern Kenya. A Randomized Complete Block Design (RCBD) with four treatments (organic manure, inorganic fertilizers, combined organic and inorganic fertilizers, and a control) replicated three times was employed. Data on growth parameters, yield components, and physiological traits such as chlorophyll content and canopy temperature were collected and analyzed using ANOVA. Results indicated significant differences among treatments in terms of days to emergence, growth parameters, and yield components. Specifically, the combined organic and inorganic fertilizer treatment exhibited the highest performance in most parameters studied, with yield increases up to 1200kg compared to the control. These findings suggest that integrated nutrient management could enhance sorghum production in semi-arid regions. Adoption of such practices could significantly contribute to food security and economic stability in similar agro-ecological zones by improving crop productivity and sustainability.

Key words: *Integrated Nutrient Management, Sorghum Yield, Semi-Arid Agriculture*

ABSTRACTS

TOPIC	Influence of Headteachers' Coordination of Donor Support Services on Inclusion of Learners with Special Needs Education in Public Primary Schools in Kenya.
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The concept of Inclusion in education refers to the stakeholders' efforts to have every child have access to a learning institution with a conducive environment to the learner to facilitate personalized learning. Inclusion in education is in line with international policy positions summarized by the Salamanca statement "No Child is Left behind". The Government of Kenya has made efforts to ensure that learners with special needs in education in public primary schools are included in education and more practically through the Competency Based Education (CBE)where practical lessons like Agriculture are taught. Nevertheless, inclusion has been a major challenge to stakeholders in the education sector in Kenya since independence. The purpose of this study was to establish the influence of headteachers' coordination of donor support services on inclusion of learners with special needs education in public primary schools in Kenya.

The study used descriptive research design and mixed research designs which put together components of qualitative and quantitative techniques to provide a more comprehensive understanding of the research challenge than each individual design. The targeted population was (N=1896) who included 204 public primary headteachers, 1632 public primary school teachers, 60 parents from units only, and 2 Education Officers. A total of 196 respondents participated in the study that included 163 teachers, 23 headteachers, 6 parents and 2 Education Officers. Data that was obtained from questionnaires for headteachers and teachers were analyzed quantitatively using SPSS version 23 while data obtained from interviews with parents and Education Officers were analyzed qualitatively. Hypothesis was tested using Independent t-test at 0.05 level of significance.

The results therefore conclude that teachers do not approve the headteachers' coordination of donor support services hence the poor implementation of inclusion, mitigation of climate change, poor farming practices and CBE in Kenya. The study recommends that the Ministry of Education, the Teachers' Service Commission, the Kenya Education Management Institute, the various Boards of Management and other education stakeholders, the national and county government levels consider issues on infusion of mitigation of climate change in SNE training, dryland farming models, INSETS on role of donor funding and coordination, parents with SNE learners representation in BoM, headteachers' training on CBE curriculum and creation of conducive learning environment for implementation of inclusion and CBE.

Key words: *Donor support services, Inclusion, Climate change, Stakeholders, Dryland farming*

TOPIC	Unraveling of Key-Adaptive and Stress-Responsive Proteins to Climate Variability in Cassava Varieties for Climate-Resilient Cultivation Strategies
CONTRIBUTORS	Maitha Purity Mutheu, Paul Mutwiwa Mwania and Victor M. Masai
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Cassava (Manihot esculenta) is a crucial staple crop in tropical and subtropical regions, known for its resilience to drought. However, the increasing frequency of climate change-induced stressors, such as extreme temperatures, salinity, and severe droughts, necessitates a deeper understanding of cassava's adaptive mechanisms with some of the environmental stressors remaining under-explored. Proteomics offers a comprehensive approach to unveil the molecular mechanisms underlying cassava's stress responses. This study aims to investigate protein expression changes in cassava varieties under diverse stress conditions, identify stress-responsive proteins, and elucidate their roles in enhancing stress tolerance. Proteins will be extracted from cassava tissues subjected to drought, salinity, waterlogging stress, and control conditions. Protein profiles will be analyzed using 2D gel electrophoresis and mass spectrometry (MS) techniques (MALDI-TOF and LC-MS/MS). Differentially expressed proteins will be quantified via label-free quantification and isotope labeling techniques (SILAC and iTRAQ), and characterized using functional genomics approaches. Key stress-responsive proteins to be identified include heat shock proteins (HSPs), antioxidant enzymes (superoxide dismutase, catalase), osmoprotectant-related proteins, ion transporters (HKT, NHX), and pathogenesis-related (PR) proteins. Functional studies encompassing gene knockout, over-expression, and protein-protein interaction assays will underscore the crucial roles of these proteins in stress adaptation. Post-translational modifications (PTMs) will further illuminate regulatory mechanisms controlling protein function(s) under stress conditions. Proteomic analysis provides significant insights into cassava's intricate stress response mechanisms. The identification and functional characterization of stress-responsive proteins lay the groundwork for breeding and biotechnological strategies aimed at enhancing cassava's resilience to diverse environmental stressors. Integrating proteomics with other omics disciplines and field data is imperative for devising comprehensive stress management strategies in cassava cultivation.

ABSTRACTS

TOPIC	Enhancing Dryland Agriculture Education: A Comparative Analysis of Graduate Exit Surveys
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Preparing a skilled workforce to address dryland agriculture challenges and contribute to sustainable food systems is crucial for higher education institutions. This study analyzes graduate exit surveys from agricultural programs, comparing results from two consecutive academic years, to evaluate students' perceptions of their educational experiences and career readiness. The research employed a standardized questionnaire using a 5-point Likert scale, covering curriculum content, teaching quality, facilities, mentoring, support services, and co-curricular activities. Quantitative data were analyzed using paired t-tests and ANOVA, while qualitative responses underwent thematic analysis. Findings indicate that students appreciate the academic rigor but highlight opportunities for enhancing practical learning experiences, updating resources, and strengthening support services. The survey reveals increased satisfaction with practical training and community engagement activities. Students' overall experiences, including career planning exposure and service engagement, significantly influence their perceived readiness for dryland agriculture careers. This study highlights the exit survey's role as an essential tool for identifying areas of satisfaction and improvement in agricultural education. Recommendations focus on curriculum enhancements, resource optimization, collaborative learning opportunities, and tailored student support mechanisms. These insights aim to guide universities in improving agricultural education programs, fostering a skilled workforce to address food security challenges in dryland regions and contribute to resilient food systems.

Keywords: *Dryland Agriculture Education, Graduate Exit Surveys, 5-point Likert scale*

TOPIC	Assessing Dietary Habits and Nutrient Intake Across Different Groups at Lukenya University, Kibwezi East, Makueni County Kenya
CONTRIBUTORS	Grace Mutheu[1]* Esther Muli[2]* and Christine Okiru[3]*
ORGANISATION	Corresponding author: nzukigrace285@gmail.com

This study investigated the dietary habits and nutrient intake of various groups within Lukenya University, encompassing 20 security personnel, 20 faculty members, 50 students, and 20 cleaning staff. Examining the consumption patterns of carbohydrates, proteins, and vitamins and minerals, this research highlighted significant disparities in nutritional awareness and diet quality among these distinct segments of the university population. The findings revealed that students predominantly prioritized affordability and satiety over nutritional value, often resulting in an imbalanced diet. Faculty members generally exhibited the highest adherence to balanced dietary practices, with a notable preference for protein-rich foods over vegetables. Security personnel and cleaners shared similar dietary patterns, characterized by a high intake of carbohydrates and proteins mainly from cereals, with limited access to a variety of quality vegetables, often relying on kale and cabbage. These insights underscored the critical need for targeted nutritional education and intervention programs to promote healthier eating habits across the university community. Addressing these nutritional gaps was essential for improving overall health and well-being, fostering a more informed and health-conscious campus environment.

Key words: Dietary Habits, Nutrient Intake, Nutritional Awareness

ABSTRACTS

TOPIC	Dynamics of Velocity and Pressure Profiles in Enhancing Climate Resilience in Dryland Agriculture in Kenya using turbulent forced convection modelling.
CONTRIBUTORS	Clementine K. Mutua

Dryland agriculture in Kenya's arid and semi-arid lands (ASALs) faces significant challenges due to climate variability and extreme weather conditions. This research investigates the impact of velocity and pressure profiles on microclimate regulation, focusing on airflow dynamics within agricultural systems in Kitui, Turkana, and Mandera counties. Through a combination of field measurements, computational fluid dynamics (CFD) simulations, and turbulent forced convection modeling, how strategic airflow management can enhance climate resilience is examined. The study highlights the role of optimized natural ventilation and forced convection in moderating temperature extremes, reducing heat stress, and improving soil moisture retention. Results demonstrate that the use of windbreaks and advanced greenhouse designs can decrease peak temperatures by up to 10% and increase soil moisture levels by approximately 25%, promoting more sustainable crop growth. The findings underscore the importance of integrating airflow dynamics into agricultural practices and policies to bolster food security and livelihoods in Kenya's dryland regions.

Key words: *Velocity profiles, pressure profiles, climate resilience, dry land agriculture, turbulent forced convection modelling*

TOPIC	Coping with Droughts in agriculture of Northwest Vietnam
CONTRIBUTORS	Yen Nguyen
ORGANISATION	

This study took place in mountainous areas that are highly susceptible to climate change due to their high altitude and slope. Temperature increases more rapidly at higher altitudes, exacerbating the effects of global warming. These regions are particularly vulnerable to the impacts of climate change. Local livelihoods in mountainous areas face severe challenges due to limited options and low capacity to adapt. Data was collected using semi-structured interviews from people aged 30-70 years old, in households, using semi-structured methods. They had educational level from secondary school and above, understood Vietnamese language, not non-Viet ethnic language, frequently followed national news on TV and news from local people. Criteria to select experts for semi-structured interview included local people or people who had spent 5 or above years of study in the research location, be a contact point between authority, households and climate change related-project implemented at the site, good understanding about climate change and local livelihoods.

Data was collected in relation to livelihood structure and conditions of local community, climate vulnerability, climate change impacts, climate change adaptation measures and recommendations. Similarities and differences were sought. The similarities included the following: Agriculture was the main livelihood in the study area, predominantly focused on rice cultivation. Other crops grown include cassava, maize, and vegetables suitable for mountainous terrain. Livestock such as pigs, chickens, and ducks were also raised by most households. Challenges to livelihood sustainability included poor economic returns from crops and livestock. Productivity was unstable due to fluctuating weather conditions. Interviews indicated a shift in crop cultivation methods towards more profitable and weather-resilient crops. Examples included arrowroot and chayote in Paco, Mai Chau, and fruits like mango and longan in Xuan Nha, Mai Son, and Sap Vat, Yen Chau. Despite efforts, many households in the study area remain in poverty or near-poverty due to low production, minimal savings, thus ongoing livelihood concerns.

Livelihood structure, vulnerability, climate change, adaptation, agriculture

ABSTRACTS

TOPIC	Digital Twins for Sustainable Agriculture
CONTRIBUTORS	Kennedy Mugo1, Vyacheslav Kungurstsev2, Eunice Omwoyo3, Brian Olimba1 and Judith Wafula3
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Digital Twin is an idea that came from medicine. It aims at making an exact copy of a person in as much detail as possible through simulations. It involves experimenting, operating, feeding data to the twin, to learn without risk. Examples of the applications of the digital twins is in tree planting programmes. A digital twin of the tree of interest (e.g. a medicinal Acacia) is made. It performs "kinematic reconstruction" – the geometry of the tree growth. It also studies the primary and secondary metabolism, and predicts weather, soil content, production of compounds and other effects on the health of the tree. Another application is in agroforestry. By using agroforestry plots, the digital twin can model crops, trees, geographic formations and full contours of a plot and region. It is applicable in predicting how different rotations, placements and combinations work. In the river and river network, the digital twin can model the water flow, forecast risks of floods and quantity of groundwater remaining in the dry season, based on the water flow. Methods to make the digital twin are drawn from the fact that any gaps in the knowledge and uncertainty of parameters, use statistical models. These include the grey-box models which apply as much of the first principles of scientific knowledge as possible. The digital twin also requires as much data as possible that is easy and cheap to get to ensure affordability. Further, it targets the choice of the most relevant data, using information theory, when data is scarce and expensive. Findings show that the digital twin is a solution in probabilistic forecasting to assist economic investment and risk mitigation in all spheres including agriculture and food systems. It is also important in exploratory hypotheses and conjectures profiling. It can test, through simulations, bold but risky innovations. Its grand vision is in "Real time control," by optimizing the complex processes using data in real time. For example, if a tree is growing in a slanted way, towards an unfortunate direction, it gives information on the modification to be done on the shade, to correct it. If it is expected to be unreasonably warm this year, the composition of the agroforestry plot, which should include more flora that preserve soil moisture, is suggested. When a dam is about to break or cause extra flooding in a region, it suggests placement of a cheap barrier to disperse the water flow adequately until repairs are done.

Key words: Digital twin, agroforestry, agriculture, trees, crops

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